National Asthma Council Australia

AUSTRALIAN ASTHMA HANDBOOK

VERSION 2.0

MANAGEMENT

Adults

This PDF is a print-friendly reproduction of the content included in the *Management – Adults* section of the *Australian Asthma Handbook* at **asthmahandbook.org.au/management/adults**

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ABBREVIATIONS

CFC	chlorofluorocarbon
COPD	chronic obstructive pulmonary disease
COX	cyclo-oxygenase
DXA	dual-energy X-ray absorptiometry
ED	emergency department
EIB	exercise-induced bronchoconstriction
FEV_1	forced expiratory volume over one second
FEV_6	forced expiratory volume over six seconds
FSANZ	Food Standards Australia and New Zealand
FVC	forced vital capacity
GORD	gastro-oesophageal reflux disease
HFA	formulated with hydrofluroalkane propellant
ICS	inhaled corticosteroid
ICU	intensive care unit
IgE	Immunoglobulin E
IL	interleukin
IU	international units
IV	intravenous
LABA	long-acting beta$_2$-adrenergic receptor agonist
LAMA	long-acting muscarinic antagonist
LTRA	leukotriene receptor antagonist
MBS	Medical Benefits Scheme
NHMRC	National Health and Medical Research Council
NIPPV	non-invasive positive pressure ventilation
NSAIDs	nonsteroidal anti-inflammatory drugs
OCS	oral corticosteroids
OSA	obstructive sleep apnoea
PaCO	carbon dioxide partial pressure on blood gas analysis
PaO	oxygen partial pressure on blood gas analysis
PBS	Pharmaceutical Benefits Scheme
PEF	peak expiratory flow
pMDI	pressurised metered-dose inhaler or 'puffer'
PPE	personal protective equipment
SABA	short-acting beta$_2$ -adrenergic receptor agonist
SAMA	short-acting muscarinic antagonist
SaO_2	oxygen saturation
SpO_2	peripheral capillary oxygen saturation measured by pulse oximetry
TGA	Therapeutic Goods Administration

RECOMMENDED CITATION

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DISCLAIMER

Managing asthma in adults

Overview

Asthma management in adults is based on:

- confirming the diagnosis
- assessing asthma control (recent asthma symptom control and risk factors)
- identifying management goals in collaboration with the patient
- choosing initial treatment appropriate to recent asthma symptom control, risk factors and patient preference
- reviewing and adjusting drug treatment periodically
- providing information, skills and tools for self-management, including:
  - training in correct inhaler technique
  - information and support to maximise adherence
  - a written asthma action plan
  - information about avoiding triggers, where appropriate
- managing flare-ups when they occur
- managing comorbid conditions that affect asthma or contribute to respiratory symptoms
- providing advice about smoking, healthy eating, physical activity, healthy weight and immunisation.

Figure. Stepped approach to adjusting asthma medication in adults and adolescents

Please view and print this figure separately: http://www.asthmahandbook.org.au/figure/show/31

Table. Guide to selecting and adjusting asthma medication for adults and older adolescents

Clinical situation	Action
Newly diagnosed asthma	Consider low-dose ICS (plus SABA as needed) If symptoms severe at initial presentation, consider one of: • ICS plus a short course of oral corticosteroids • a short initial period of high-dose ICS then step down • (private prescription) combination ICS/LABA† See: *Table. Initial treatment choices (adults and adolescents not already using a preventer)*
Good recent asthma symptom control	If maintained 2–3 months, no flare-up in previous 12 months and low risk for flare-ups, step down where possible (unless already on low-dose ICS)
Partial recent asthma symptom control	Review inhaler technique and adherence – correct if suboptimal If no improvement, consider increasing treatment by one step and reviewing (if still no improvement, return to previous step, review diagnosis and consider referral)
Poor recent asthma symptom control	Review inhaler technique and adherence – correct if suboptimal Confirm that symptoms are likely to be due to asthma

Clinical situation	Action
	Consider increasing treatment until good asthma control is achieved, then step down again when possible
Difficult-to-treat asthma ‡	Consider referral for assessment or add-on options
Patient with risk factors §	Tailor treatment to reduce individual risk factors

† PBS status as at March 2019: ICS/LABA combination therapy as first-line preventer treatment is not subsidised by the PBS, except for patients with frequent symptoms while taking oral corticosteroids.

‡ Poor recent asthma symptom control despite ICS/LABA combination at high–medium dose.

§ Risk factors for asthma events or adverse treatment effects, irrespective of level of recent asthma symptom control.

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Table. Definition of levels of recent asthma symptom control in adults and adolescents (regardless of current treatment regimen)

Good control	Partial control	Poor control
All of: • Daytime symptoms ≤2 days per week • Need for SABA reliever ≤2 days per week† • No limitation of activities • No symptoms during night or on waking	One or two of: • Daytime symptoms >2 days per week • Need for SABA reliever >2 days per week† • Any limitation of activities • Any symptoms during night or on waking	Three or more of: • Daytime symptoms >2 days per week • Need for SABA reliever >2 days per week† • Any limitation of activities • Any symptoms during night or on waking

SABA: short-acting beta$_2$-agonist

† SABA, not including doses taken prophylactically before exercise. (Record this separately and take into account when assessing management.)

Note: Recent asthma symptom control is based on symptoms over the previous 4 weeks.

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Table. Definitions of ICS dose levels in adults

Inhaled corticosteroid	Daily dose (microg)		
	Low	Medium	High
Beclometasone dipropionate	100–200	250–400	>400

Inhaled corticosteroid	Daily dose (microg)		
	Low	**Medium**	**High**
†			
Budesonide	200–400	500–800	>800
Ciclesonide	80–160	240–320	>320
*Fluticasone furoate**	—	100	200
Fluticasone propionate	100–200	250–500	>500

† Dose equivalents for *Qvar* (TGA-registered CFC-free formulation of beclometasone dipropionate).

*Fluticasone furoate is not available as a low dose. TGA-registered formulations of fluticasone furoate contain a medium or high dose of fluticasone furoate and should only be prescribed as one inhalation once daily.

Note: The potency of generic formulations may differ from that of original formulations. Check TGA-approved product information for details.

Sources

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GlaxoSmithKline Australia Pty Ltd. Product Information: *Breo (fluticasone furoate; vilanterol) Ellipta*. Therapeutic Goods Administration, Canberra, 2014. Available from: https://www.ebs.tga.gov.au/

GlaxoSmithKline Australia Pty Ltd. Product Information: *Arnuity (fluticasone furoate) Ellipta*. Therapeutic Goods Administration, Canberra, 2016. Available from: https://www.ebs.tga.gov.au/

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- **By mid-adolescence (around 14–16 years), the guidance for managing asthma in adults will apply in most situations.**

In this section

Confirming diagnosis

Confirming the diagnosis of asthma in adults and adolescents

http://www.asthmahandbook.org.au/management/adults/confirming-diagnosis

Initial assessments

Assessing control, risk and goals before starting treatment in adults and adolescents

http://www.asthmahandbook.org.au/management/adults/initial-assessments

Initial treatment

Selecting initial treatment in adults and adolescents, including relievers for all patients and preventers where indicated

http://www.asthmahandbook.org.au/management/adults/initial-treatment

Stepped adjustment

Adjusting treatment in adults and adolescents by stepping up or stepping down

http://www.asthmahandbook.org.au/management/adults/stepped-adjustment

Reviewing asthma

Planning and conducting asthma reviews in adults and adolescents, including opportunistic review, visits for respiratory symptoms and scheduled asthma visits, with guidance on the role of lung function tests in ongoing asthma care

http://www.asthmahandbook.org.au/management/adults/reviewing-asthma

Flare-ups

Managing flare-ups when they occur in adults and adolescents

http://www.asthmahandbook.org.au/management/adults/flare-ups

Self-management

Providing support for self-management by adults and adolescents, including education, training in inhaler technique and a written asthma action plan

http://www.asthmahandbook.org.au/management/adults/self-management

Severe asthma in adults and adolescents

Identifying and managing severe asthma in adults and adolescents, including the use of non-pharmacological strategies, add-on treatments and monoclonal antibody therapies

http://www.asthmahandbook.org.au/management/adults/severe-asthma

Figure. Stepped approach to adjusting asthma medication in adults

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Medication	At this step§
Add-on specialised treatments	Refer to respiratory physician or severe asthma clinic, if available
4 **Higher-dose combination regular preventer (+ reliever* as needed)** Preventer options: • Budesonide/formoterol maintenance (medium dose) and reliever† (low dose) therapy • ICS/LABA combination (moderate–high dose) as maintenance therapy ***Few patients***	Monitor and adjust to maintain good control at lowest effective dose Consider referral
3 **Low-dose combination regular preventer (+ reliever* as needed)** Preventer options: • Budesonide/formoterol (low dose) maintenance-and-reliever therapy • ICS/LABA combination (low dose) as maintenance therapy ***Some patients***	Monitor and adjust to maintain good control at lowest effective dose Consider referral *Table. Guide to selecting and adjusting asthma medication for adults and older adolescents*
2 **Low-dose regular preventer (+ SABA as needed)** ICS (low dose) ***Most patients***	Monitor and adjust to maintain good control at lowest effective dose *Table. Definitions of ICS dose levels in adults* *Table. Initial treatment choices (adults and adolescents not already using a preventer)*
1 **As-needed SABA only** ***Few Patients***	Monitor reliever use Reassess need for preventer *Table. Definition of levels of recent asthma symptom control in adults and adolescents (regardless of current treatment regimen)* *Table. Risk factors for adverse asthma outcomes in adults and adolescents*
• Assess each patient's individual risk factors and comorbidities • Advise/prescribe reliever to be carried at all times • Provide education and a written asthma action plan • Ask about the patient's goals and concerns and implement shared decision-making ***All patients***	

⚠	Before considering stepping up, check symptoms are due to asthma, inhaler technique is correct, and adherence is adequate
↗	Consider stepping up if good control is not achieved despite good adherence and correct inhaler technique.
↘	When asthma is stable and well controlled for 2–3 months, consider stepping down (e.g. reducing inhaled corticosteroid dose, or stopping long-acting $beta_2$ agonist if inhaled corticosteroid dose is already low).

ICS: inhaled corticosteroid; SABA: short-acting $beta_2$ agonist; LABA: long-acting $beta_2$ agonist

* Reliever means rapid-onset $beta_2$ agonist and includes:

- short-acting $beta_2$ agonists
- low-dose budesonide/formoterol combination – only applies to patients using this combination in a maintenance-and-reliever regimen (steps 3 and above).

  This combination is not classed as a reliever when used in a maintenance-only regimen.

§ At all steps: review recent symptom control and risk regularly. Manage comorbidities and individual risk factors. Manage flare-ups with extra treatment when they occur. Manage exercise-related asthma symptoms as indicated.

† Medium dose as maintenance, low dose as reliever.

Confirming the diagnosis of asthma in adults

Recommendations

Before starting preventer treatment, confirm the diagnosis of asthma if possible (unless symptoms are severe).

How this recommendation was developed

Consensus

Based on clinical experience and expert opinion (informed by evidence, where available), with particular reference to the following source(s):

- Aaron *et al.* 2008[1]
- Lucas *et al.* 2008[2]
- Luks *et al.* 2010[3]
- Marklund *et al.* 1999[4]

For patients who report the diagnosis of asthma made in the past or elsewhere, confirm the diagnosis if possible.

Table. Confirming the diagnosis of asthma in a person using preventer treatment

Please view and print this figure separately: http://www.asthmahandbook.org.au/table/show/9

How this recommendation was developed

Consensus

Based on clinical experience and expert opinion (informed by evidence, where available), with particular reference to the following source(s):

- Aaron *et al.* 2008[1]
- Lucas *et al.* 2008[2]
- Luks *et al.* 2010[3]
- Marklund *et al.* 1999[4]

For a patient with a diagnosis of asthma and new respiratory symptoms, confirm the symptoms are due to asthma.

How this recommendation was developed

Consensus

Based on clinical experience and expert opinion (informed by evidence, where available).

More information

Confirming the diagnosis of asthma in adults and adolescents

A prior diagnosis of asthma reported by a patient should be corroborated by documentation of how the diagnosis was confirmed at the time, or by current evidence.

Reports from around the world show that 25–35% of people with a diagnosis of asthma in primary care may not actually have asthma.[2, 3, 4, 5] Wheezing and other respiratory symptoms do not always mean a person has asthma. Airflow limitation demonstrated on

spirometry can be transient and does not necessarily mean that the person has asthma (e.g. when recorded during a severe acute viral infection of the respiratory tract). Ideally, airflow limitation should be confirmed when the patient does not have a respiratory tract infection.

Once a person is already taking regular treatment with a preventer, it may be more difficult to confirm the diagnosis because variability in lung function often decreases with treatment.

Table. Confirming the diagnosis of asthma in a person using preventer treatment

Please view and print this figure separately: http://www.asthmahandbook.org.au/table/show/9

Definition of variable expiratory airflow limitation

Most of the tests for variable expiratory airflow limitation are based on showing variability in FEV_1. While reduced FEV_1 may be seen with many other lung diseases (or due to poor spirometric technique), a reduced ratio of FEV_1 to FVC indicates airflow limitation.[6] Normal FEV_1/FVC values derived from population studies vary,[7, 8] but are usually greater than:[7]

- 0.85 in people aged up to 19 years
- 0.80 in people aged 20–39 years
- 0.75 in people aged 40–59 years
- 0.70 in people aged 60–80 years.

In children, it is less useful to define expiratory airflow limitation according to a specific cut-off for FEV_1/FVC ratio, because normal values in children change considerably with age.[8]

Some spirometers provide predicted normal values specific to age group. If these are available, a FEV_1/FVC ratio less than the lower limit of normal (i.e. less than the 5th percentile of normal population) indicates airflow limitation.

Variable expiratory airflow limitation (beyond the range seen in healthy populations) can be documented if any of the following are recorded:

- a clinically important increase in FEV_1 (change in FEV_1 of at least 200 mL and 12% from baseline for adults, or at least 12% from baseline for children) 10–15 minutes after administration of bronchodilator
- clinically important variation in lung function (at least 20% change in FEV_1) when measured repeatedly over time (e.g. spirometry on separate visits)
- a clinically important reduction in lung function (decrease in FEV_1 of at least 200 mL and 12% from baseline on spirometry, or decrease in peak expiratory flow rate by at least 20%) after exercise (formal laboratory-based exercise challenge testing uses different criteria for exercise-induced bronchoconstriction)
- a clinically important increase in lung function (at least 200 mL and 12% from baseline) after a trial of 4 or more weeks of treatment with an inhaled corticosteroid
- clinically important variation in peak expiratory flow (diurnal variability of more than 10%)
- a clinically important reduction in lung function (15–20%, depending on the test) during a test for airway hyperresponsiveness (exercise challenge test or bronchial provocation test) measured by a respiratory function laboratory.

Notes

Patients referred to a respiratory function laboratory may be asked not to take certain medicines within a few hours to days before a spirometry visit.

A clinically important increase or decrease in lung function is defined as a change in FEV_1 of at least 200 mL and 12% from baseline for adults, or at least 12% from baseline for children, or a change in peak expiratory flow rate of at least 20% on the same meter.[9, 6] A clinically important increase in FVC after administering bronchodilator may also indicate reversible airflow limitation, but FVC is a less reliable measure in primary care because FVC may vary due to factors such as variation in inspiratory volume or expiratory time.

The finding of 'normal' lung function during symptoms reduces the probability that a patient has asthma, but a clinically important improvement in response to bronchodilator or inhaled corticosteroid can occur in patients whose baseline value is within the predicted normal range.

The greater the variation in lung function, the more certain is the diagnosis of asthma. However, people with longstanding asthma may develop fixed airflow limitation.

Reversibility in airflow limitation may not be detected if the person is already taking a long-acting $beta_2$ agonist or inhaled corticosteroid.

Airflow limitation can be transient and does not necessarily mean that the person has asthma (e.g. when recorded during a severe acute infection of the respiratory tract). Ideally, airflow limitation should be confirmed when the patient does not have a respiratory tract infection. Reduction in lung function during a respiratory tract infection with improvement in lung function after its resolution, commonly occurs in people with asthma, but can also be seen in patients with COPD or in healthy people without either asthma or COPD.[10,11]

▶ Go to: National Asthma Council Australia's *Spirometry Resources*
Go to: National Asthma Council Australia and Woolcock Institute *Peak Flow Chart*

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Conducting initial assessments in adults before starting treatment

In this section

Assessing recent asthma symptom control and risk of adverse asthma outcomes in adults

Recommendations

Before starting treatment, document the patient's:

- **baseline lung function**
- **level of recent asthma symptom control**
- **risk factors for flare-ups, life-threatening asthma, accelerated decline in lung function, or adverse effects of treatment.**

Table. Definition of levels of recent asthma symptom control in adults and adolescents (regardless of current treatment regimen)

Good control	Partial control	Poor control
All of: • **Daytime symptoms ≤2 days per week** • **Need for SABA reliever ≤2 days per week†** • **No limitation of activities** • **No symptoms during night or on waking**	**One or two of:** • **Daytime symptoms >2 days per week** • **Need for SABA reliever >2 days per week†** • **Any limitation of activities** • **Any symptoms during night or on waking**	**Three or more of:** • **Daytime symptoms >2 days per week** • **Need for SABA reliever >2 days per week†** • **Any limitation of activities** • **Any symptoms during night or on waking**

SABA: short-acting beta$_2$-agonist

† SABA, not including doses taken prophylactically before exercise. (Record this separately and take into account when assessing management.)

Note: Recent asthma symptom control is based on symptoms over the previous 4 weeks.

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Table. Risk factors for adverse asthma outcomes in adults and adolescents

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Table. Management of risk factors for adverse asthma outcomes in adults

Risk factor	Clinical action †
Any risk factor for flare-ups	**Check patient has an appropriate action plan** **Carefully check inhaler technique and adherence, and identify any barriers**

Risk factor	Clinical action †
	to good adherence **Review frequently (e.g. every 3 months)**
Hospitalisation or ED visit for asthma or any asthma flare-up during the previous 12 months	**Ask about triggers for flare-ups, and lead time**
History of intubation or intensive care unit admission for asthma	**Ensure action plan recommends early medical review when asthma worsens**
Hospitalisation or ED visit for asthma in the past month	**Emphasise importance of maintaining regular ICS use after symptoms improve** **Confirm that patient has resumed using SABA only when needed for symptoms**
High SABA use (>3 canisters per year)	**Check lung function** **If SABA use appears to be habitual, investigate causes and consider alternative strategies, e.g. short-term substitution of ipratropium for SABA**
Long-term high-dose ICS	**Consider gradual reduction of ICS dose if symptoms stable** **Monitor regularly (e.g. assessment of bone density, regular eye examinations)** **For local side-effects, ensure inhaler technique is appropriate**
Poor lung function (even if few symptoms)	**Consider 3-month trial of higher ICS dose, then recheck lung function** **Consider referral for detailed specialist investigation**
Sensitivity to unavoidable allergens (e.g. **Alternaria** *species of common moulds)*	**Refer for further investigation and management**
Exposure to cigarette smoke (smoking or environmental exposure)	**Emphasise the importance of avoiding smoke** **Provide quitting strategies** **Consider increasing ICS dose (higher dose of ICS likely to be necessary to control asthma)** **Refer for assessment of asthma–COPD overlap**
Difficulty perceiving airflow limitation or the severity of exacerbations	**Regular PEF monitoring** **Action plan should recommend early review and measurement of lung function**
No current written asthma action plan	**Provide and explain written asthma action plan**

† In addition to actions applicable to all risk factors

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Asset ID: 41

How this recommendation was developed

Adapted from existing guidance

Based on reliable clinical practice guideline(s) or position statement(s):

- Global Initiative for Asthma, 2012[1]

Measure lung function by spirometry to establish the patient's baseline values.

Notes

If reliable equipment and appropriately trained staff are available, spirometry can be performed in primary care. If not, refer to an appropriate provider such as an accredited respiratory function laboratory.

Document if spirometry is pre- or post-bronchodilator.

How this recommendation was developed

Consensus

Based on clinical experience and expert opinion (informed by evidence, where available).

More information

Classification of asthma severity and recent asthma symptom control in adults

Recent asthma symptom control

Recent asthma symptom control in adults is defined by frequency of symptoms, the degree to which symptoms affect sleep and activity, and the need for reliever medication over the previous 4 weeks.

Recent asthma symptom control is a component of overall asthma control. The other component is the risk of future events (e.g. flare-ups, life-threatening asthma, accelerated decline in lung function, or adverse effects of treatment).

Any experience of flare-ups or night-time waking due to asthma symptoms, even if infrequent, usually indicates that the person needs regular preventer treatment.

Table. Definition of levels of recent asthma symptom control in adults and adolescents (regardless of current treatment regimen)

Good control	Partial control	Poor control
All of: • Daytime symptoms ≤2 days per week • Need for SABA reliever ≤2 days per week† • No limitation of activities • No symptoms during night or on waking	One or two of: • Daytime symptoms >2 days per week • Need for SABA reliever >2 days per week† • Any limitation of activities • Any symptoms during night or on waking	Three or more of: • Daytime symptoms >2 days per week • Need for SABA reliever >2 days per week† • Any limitation of activities • Any symptoms during night or on waking

SABA: short-acting beta$_2$-agonist

† SABA, not including doses taken prophylactically before exercise. (Record this separately and take into account when assessing management.)

Note: Recent asthma symptom control is based on symptoms over the previous 4 weeks.

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Severity

Severity of asthma in adults is defined by the type and amount of treatment needed to maintain good control, not by the severity of acute flare-ups.

For patients prescribed a preventer, asthma severity can only be determined after using a preventer for at least 8 weeks and after checking adherence and inhaler technique.

▶ See: *Severe asthma in adults and adolescents*

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Assessing risk factors for adverse asthma outcomes in adults

Predicting poor asthma outcomes

As well as assessing recent asthma symptom control, it is necessary to assess each patient's risk of future asthma events or adverse treatment effects. (Recent asthma symptom control and risk of adverse events are both components of overall asthma control.)

Table. Risk factors for adverse asthma outcomes in adults and adolescents Please view and print this figure separately: http://www.asthmahandbook.org.au/table/show/40

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Table. Risk factors for adverse asthma outcomes in adults and adolescents

Risk factors for adverse asthma outcomes in adults and adolescents

	Medical history	Investigation findings	Other factors
Factors associated with increased risk of flare-ups	Poor asthma control Any asthma flare-up during the previous 12 months Other concurrent chronic lung disease	Poor lung function (even if few symptoms) Difficulty perceiving airflow limitation or the severity of flare-ups Eosinophilic airway inflammation§	Exposure to cigarette smoke (smoking or environmental exposure) Socioeconomic disadvantage Use of illegal substances Major psychosocial problems Mental illness
Factors associated with increased risk of life-threatening asthma	Intubation or admission to intensive care unit due to asthma (ever) 2 or more hospitalisations for asthma in past year 3 or more ED visits for asthma in the past year Hospitalisation or ED visit for asthma in the past	Sensitivity to an unavoidable allergen (e.g. *Alternaria* species of common moulds)	Inadequate treatment Experience of side-effects of OCS use (may contribute to under-treatment or delayed presentation to hospital during flare-ups) Lack of written asthma action plan Socioeconomic

	Medical history	Investigation findings	Other factors
	month High short-acting beta$_2$ agonist use • Dispensing of 3 or more canisters in a year (average 1.6 puffs per day) is associated with increased risk of flare-ups in adults and children. • Dispensing 12 or more canisters in a year (average 6.6 puffs per day) is associated with increased risk of asthma death. History of delayed presentation to hospital during flare-ups History of sudden-onset acute asthma Cardiovascular disease		disadvantage Living alone Mental illness Use of alcohol or illegal substances Poor access to health care (e.g. rural/remote region)
Factors associated with accelerated decline in lung function	Chronic mucus hypersecretion Severe asthma flare-up in a patient not taking ICS	Poor lung function Eosinophilic airway inflammation[§]	Exposure to cigarette smoke (smoking or environmental exposure) Occupational asthma
Factors associated with treatment-related adverse events	Long-term high-dose ICS Frequent use of OCS		Anxiety disorder (due to increased sensitivity to asthma symptoms and reluctance to reduce ICS dose when asthma well controlled) Euphoria with OCS use

§ White cell differential count on a peripheral blood sample is not currently recommended routinely in the investigation and management of asthma, but might be undertaken in the investigation of severe asthma to help guide biologic therapy.

► See: *Monoclonal antibody therapy*

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Table. Management of risk factors for adverse asthma outcomes in adults

Risk factor	Clinical action †
Any risk factor for flare-ups	Check patient has an appropriate action plan Carefully check inhaler technique and adherence, and identify any barriers to good adherence Review frequently (e.g. every 3 months)
Hospitalisation or ED visit for asthma or any asthma flare-up during the previous 12 months	Ask about triggers for flare-ups, and lead time
History of intubation or intensive care unit admission for asthma	Ensure action plan recommends early medical review when asthma worsens
Hospitalisation or ED visit for asthma in the past month	Emphasise importance of maintaining regular ICS use after symptoms improve Confirm that patient has resumed using SABA only when needed for symptoms
High SABA use (>3 canisters per year)	Check lung function If SABA use appears to be habitual, investigate causes and consider alternative strategies, e.g. short-term substitution of ipratropium for SABA
Long-term high-dose ICS	Consider gradual reduction of ICS dose if symptoms stable Monitor regularly (e.g. assessment of bone density, regular eye examinations) For local side-effects, ensure inhaler technique is appropriate
Poor lung function (even if few symptoms)	Consider 3-month trial of higher ICS dose, then recheck lung function Consider referral for detailed specialist investigation

Risk factor	Clinical action †
Sensitivity to unavoidable allergens (e.g. **Alternaria** *species of common moulds)*	Refer for further investigation and management
Exposure to cigarette smoke (smoking or environmental exposure)	Emphasise the importance of avoiding smoke Provide quitting strategies Consider increasing ICS dose (higher dose of ICS likely to be necessary to control asthma) Refer for assessment of asthma–COPD overlap
Difficulty perceiving airflow limitation or the severity of exacerbations	Regular PEF monitoring Action plan should recommend early review and measurement of lung function
No current written asthma action plan	Provide and explain written asthma action plan

† In addition to actions applicable to all risk factors

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Poor clinical control, as indicated by frequent asthma symptoms and frequent reliever use, is a very strong predictor of the risk of flare-ups in the future. Any asthma flare-up during the previous 12 months indicates higher risk of flare-up over the next 12 months. A history of artificial ventilation due to acute asthma, and admission to an intensive care unit due to acute asthma have been associated with increased risk of near-fatal asthma,[2] but there is not enough evidence to indicate how long this risk may persist over a person's lifetime. Other risk factors indicate increased probability of future flare-ups or accelerated decline in lung function, independent of the person's level of recent asthma symptom control.[3, 4]

Other factors may increase a person's risk of treatment-associated adverse effects. The most important of these are prescription of high dose treatment and frequent courses of oral steroids.

People with risk factors need more frequent asthma review, a carefully tailored written asthma action plan, and close attention to adherence and correct inhaler technique.

Inflammatory markers

Inflammatory markers, such as sputum eosinophil percentage or exhaled nitric oxide, are used in research and for managing severe asthma in patients attending secondary or tertiary care. Elevated sputum eosinophil levels and, to a lesser extent, elevated exhaled nitric oxide, are associated with increased risk of flare-ups. At present, treatment based on inflammatory markers is not recommended for routine use in primary care.

The value of inflammatory markers is being evaluated:

- Adjusting asthma treatment by monitoring exhaled nitric oxide does not reduce the rate of flare-ups or improve asthma control in adults and children, compared with adjusting treatment according to clinical symptoms or spirometry, based on a meta-analysis of randomised controlled clinical trials.[5] However, many of the studies were not optimally designed to answer this question,[6] and some comparator regimens did not match current recommended treatment options.
- In some studies, asthma treatment algorithms based on monitoring sputum eosinophil counts reduced flare-ups, compared with control-based management.[7, 8] However, most studies assessing treatment guided by sputum eosinophilia have been conducted in selected populations in a few research centres, and therefore may not apply to the general community population. Assessment of sputum inflammatory cells is not generally available at present even in secondary care.
- Limited evidence[9] suggests that patients whose symptoms do not match their degree of eosinophilic inflammation may benefit more from treatment monitoring using sputum eosinophil count than other patients.
- Monitoring inflammatory markers might enable safer down-titration of maintenance inhaled corticosteroid doses.

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Assessing recent asthma control in adults: symptoms

Questionnaires

Questionnaire-based tools can be used to standardise review of asthma symptoms, e.g.:

- Primary care Asthma Control Screening tool (also known as Pharmacy Asthma Control Screening tool)[10] – a quick screening test to detect poor asthma control, developed and validated for use with Australian patients attending primary care
- UK Royal College of Physicians '3 Questions'[11, 12]
- Asthma Score (also known as Asthma Control Test).[3]
- *Asthma Control Questionnaire (ACQ)*

The questionnaires can be completed on paper in the waiting room and scored by the practice nurse. They have also been administered via an application on hand-held personal electronic devices, [13, 14] or by telephone.[15]

Note: Clinicians and researchers should only use the versions of the ACQ and Asthma Score that have been validated for use in the Australian population. The wording and layout of questionnaires must not be changed.

Table. Primary care Asthma Control Screening tool (PACS)

Have you experienced any of the following more than once a week in the last month?	**Yes**	**No**
Symptoms of asthma, cough, wheeze, shortness of breath	•	•
Waking at night because of asthma	•	•
Chest tightness on waking	•	•
Difficulty in performing vigorous activity like running, lifting heavy objects, exercise	•	•
Difficulty in performing moderate activities like vacuuming, climbing flights of stairs	•	•

Interpretation: 'Yes' to any question indicates that the person may have poorly controlled asthma, so more detailed assessment is needed.

Source: LeMay KS, Armour CL, Reddel HK. Performance of a brief asthma control screening tool in community pharmacy: a cross-sectional and prospective longitudinal analysis. *Prim Care Respir J*; 2014. Available from: http://dx.doi.org/10.4104/pcrj.2014.00011

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Table. UK Royal College of Physicians '3 Questions' screening tool

In the last month:	**Yes**	**No**
Have you had difficulty sleeping because of your asthma symptoms (including cough)?	•	•
Have you had your usual asthma symptoms during the day (cough, wheeze, chest tightness or breathlessness)?	•	•
Has your asthma interfered with your usual activities (e.g. housework, work/school etc)?	•	•

Inerpetation:

No to all three questions indicates good control.

Yes to 2 or 3 questions indicates poor control.

Yes to 1 question indicates that more detailed questioning is needed to assess level of asthma control (using another validated questionnaire or by asking about frequency of daytime symptoms, reliever requirement, limitation of activities and symptoms at night or on waking during the previous month).

Note: This test provides a quick and easy way of confirming someone's asthma control is good, or identifying those who need more assessments.

Sources

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Asset ID: 37

▶ See: *Asthma Score*

Symptom-guided management

Data from one UK study suggest that, for the majority of patients attending primary care, asthma symptoms are concordant with eosinophilic airway inflammation, and that symptoms can therefore be used as a guide to changing anti-inflammatory treatment.[9]

However, if symptoms do not improve as expected after a change in treatment, or if the person continues to experience flare-ups, it is necessary to measure lung function and consider other possible causes:

- Respiratory symptoms in a person with asthma may be due to non-asthma factors (e.g. cough due to post-nasal drip, shortness of breath due to obesity). Increasing the preventer treatment in such patients could result in unnecessarily high doses. A careful history (with lung function measurement in some patients) is necessary to confirm that symptoms are due to asthma, before deciding to change a person's treatment.
- Patients vary in their ability to perceive airflow limitation, so symptoms may be an unreliable measure of asthma control in some patients. Spirometry can help identify if the person is a poor perceiver of airflow limitation (e.g. person is unable to feel the difference when FEV_1 increases or decreases by 15%).

▶ See: *Diagnosing asthma in adults*

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Assessing asthma control in adults: spirometry

Spirometry is necessary when making the diagnosis of asthma and when establishing the patient's baseline and personal best status.

In ongoing asthma management, spirometry is useful in the following clinical situations:

- During a flare-up, spirometry provides objective evidence about the severity of bronchoconstriction.
- After a dose adjustment (either an increase or a decrease), change in lung function measured by spirometry provides additional information about the response to treatment.
- Spirometry can help identify if the person's symptoms may be due to non-asthma conditions (e.g. for a patient with frequent respiratory symptoms, FEV_1 above 80–90% predicted should prompt consideration of an alternative cause).
- Spirometry can help identify if the person is a poor perceiver of airflow limitation (e.g. person is unable to feel the difference when FEV_1 increases or decreases by 15%).
- Repeating spirometry over time may identify lung function decline that is more rapid than expected decline due to ageing alone, so the person can be referred for specialist review. (Spirometry should be repeated approximately every 1–2 years in most patients but more frequently as indicated by individual needs.)

There are limits to the amount of information that can be gained from spirometry alone:

- For an individual, spirometry readings are not closely reproducible between visits, so only a change in FEV_1 of greater than 0.2 L and 12% from baseline can be considered clinically meaningful in adults.[16]
- Older people with long-standing asthma may develop fixed (irreversible or incompletely reversible) airflow limitation. Reliance solely on lung function expressed as percentage predicted value as a guide to adjusting preventer treatment would risk dose-escalation and over-treatment in these patients.
- At the population level, spirometry correlates poorly with symptom-based measures of asthma control,[17] so in individual patients it

is not possible to predict lung function from symptoms or vice versa.

To obtain reliable, good-quality readings, the spirometer must be well maintained and correctly calibrated, and the operator must be adequately trained and experienced.

▶ Go to: National Asthma Council Australia's *Spirometry Resources*

Spirometry in diagnosis and monitoring

Spirometry is the best lung function test for diagnosing asthma and for measuring lung function when assessing asthma control. Spirometry can:

- detect airflow limitation
- measure the degree of airflow limitation compared with predicted normal airflow (or with personal best)
- demonstrate whether airflow limitation is reversible.

It should be performed by well-trained operators with well-maintained and calibrated equipment.[18, 19]

Before performing spirometry, check if the person has any contraindications (e.g. myocardial infarction, angina, aneurysm, recent surgery, suspected pulmonary embolism, suspected pneumothorax, fractured ribs). Advise them to stop if they become dizzy.

Clearly explain and physically demonstrate correct spirometry technique: [20]

- Sit upright with legs uncrossed and feet flat on the floor and do not lean forward.
- Breathe in rapidly until lungs feel absolutely full. (Coaching is essential to do this properly.)
- Do not pause for more than 1 second.
- Place mouthpiece in mouth and close lips to form a tight seal.
- Blast air out as hard and fast as possible and for as long as possible, until the lungs are completely empty or you are unable to blow out any longer.
- Remove mouthpiece.

▶ Go to: National Asthma Council Australia's spirometry technique video, *Performing spirometry in primary care*

Repeat the test until you obtain three acceptable tests and these meet repeatability criteria.

Acceptability of test

A test is acceptable if all the following apply:

- forced expiration started immediately after full inspiration
- expiration started rapidly
- maximal expiratory effort was maintained throughout the test, with no stops
- the patient did not cough during the test
- the patient did not stop early (before 6 seconds for adults and children over 10 years, or before 3 seconds for children under 10 years).

Record the highest FEV_1 and FVC result from the three acceptable tests, even if they come from separate blows.[20]

Repeatability criteria

Repeatability criteria for a set of acceptable tests are met if both of the following apply:[18]

- the difference between the highest and second-highest values for FEV_1 is less than 150 mL
- the difference between the highest and second-highest values for FVC is less than 150 mL.

For most people, it is not practical to make more than eight attempts to meet acceptability and repeatability criteria.[20]

Testing bronchodilator response (reversibility of airflow limitation)

Repeat spirometry 10-15 minutes after giving 4 separate puffs of salbutamol (100 microg/actuation) via a pressurised metered-dose inhaler and spacer.[20] (For patients who have reported unacceptable side-effects with 400 microg, 2 puffs can be used.)

For adults and adolescents, record a clinically important bronchodilator response if FEV_1 increases by ≥ 200 mL and ≥ 12%.[20]

For children, record a clinically important bronchodilator response if FEV_1 increases by ≥ 12%.[20]

▶ Go to: National Asthma Council Australia's *Spirometry Resources*

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Psychosocial factors affecting asthma self-management

Psychosocial factors can affect asthma symptoms and outcomes in children and adults. These can include biological, individual, family and community-level factors, which can have synergistic effects in an individual with asthma.[21] Mechanisms may include effects of stress on the immune system[21] and effects of life circumstances on patients' and families' ability to manage asthma.

Relationships between psychosocial and cultural factors

Important influences on asthma outcomes include the person's asthma knowledge and beliefs, confidence in ability to self-manage, perceived barriers to healthcare, socioeconomic status, and healthcare system navigation skills, and by the quality of interaction and communication between patient and healthcare provider.[22] There is a complex interrelationship between:[22]

- patient factors (e.g. health literacy, health beliefs, ethnicity, educational level, social support, cultural beliefs, comorbidities, mental health)
- healthcare provider factors (e.g. communication skills, teaching abilities, available time, educational resources and skills in working with people from different backgrounds)
- healthcare system factors (e.g. the complexity of the system, the healthcare delivery model, the degree to which the system is oriented towards chronic disease management or acute care, and the degree to which the system is sensitive to sociocultural needs).

Health literacy

'Health literacy' refers to the individual's capacity to obtain, process, and understand basic health information and services they need to make appropriate health decisions.[23] A person's level of health literacy is influenced by various factors including skills in reading, writing, numeracy, speaking, listening, cultural and conceptual knowledge.[22]

Inadequate health literacy is recognised as a risk factor for poorer health outcomes and less effective use of health care services.[22] Poor health literacy has been associated with poor asthma control,[24] poor knowledge of medications,[25] and incorrect inhaler technique.[25] Aspects of health literacy that have been associated with poorer asthma outcomes in adults include reading skills, listening skills, numeracy skills, and combinations of these.[22] Studies assessing the association between parents' health literacy and children's asthma have reported inconsistent findings.[22] Overall, there is not enough evidence to prove that low health literacy causes poor asthma control or inadequate self-management.[22]

Australian research suggests that there are probably many Australians with limited health literacy.[26] It may be possible to identify some groups of patients more likely to have inadequate health literacy, such as people living in regions with low socioeconomic status, and those with low English literacy (e.g. people with limited education, members of some ethnic minorities, immigrants, and the elderly).[22] However, even well-educated patients might have trouble with basic health literacy skills.[22]

Attempting to assess every patient's health literacy is impractical and may be embarrassing for the person and time-consuming for the health professional.[22] Instead, it may be more effective for health professionals simply to assume that all patients have limited health literacy.[22] Accordingly, all self-management skills need to be explained carefully, simply and repeatedly, and all written material should be clear and easy to read. Special consideration is needed for patients from culturally and linguistically diverse communities, including Aboriginal and Torres Strait Islander people.

Psychosocial support and improving health literacy

Psychosocial interventions that include asthma education may improve health-related quality of life for children and adolescents with asthma and their families.[27] However, simply providing education might not improve a person's health literacy, since it also depends on other factors like socioeconomic status, social support, and is influence by the provider and the healthcare system.[22]

Asthma Australia provides personal support and information for people with asthma and parents of children with asthma through the Asthma Australia Information line by telephone on 1800 Asthma (1800 278 462) or online.

▶ Go to: *Asthma Australia*

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Identifying management goals for adults

Recommendations

Before offering treatment options and advice:

- **find out what the person understands about their asthma (e.g. ask** *'Do you think you have asthma all the time or only when you have symptoms?'***)**
- **check smoking status and asthma triggers, if known**
- **discuss the person's goals for treatment**
- **gauge the person's ability to self-manage.**

How this recommendation was developed

Consensus

Based on clinical experience and expert opinion (informed by evidence, where available).

Aim to:

- **engage the person in managing their asthma**
- **minimise impact of asthma on quality of life**
- **optimise asthma symptom control with the minimal medication (number of medicines and doses) necessary**
- **minimise risk of flare-ups and loss of lung function**
- **minimise adverse effects of treatment.**

How this recommendation was developed

Consensus

Based on clinical experience and expert opinion (informed by evidence, where available).

More information

Health system initiatives that support asthma care

Chronic Disease Management Medicare items

Patients with asthma are eligible for Chronic Disease Management Medicare items.[1] These include:

- Preparation of a GP Management Plan (Item 721)
- Review of a GP Management Plan (Item 732)
- Coordination of Team Care Arrangements (Item 723) for patients who need ongoing care from a multidisciplinary team of at least three health or care providers
- Coordination of a Review of Team Care Arrangements (Item 732)
- Contribution to a multidisciplinary care plan being prepared by another health or care provider (Item 729)
- Contribution to a multidisciplinary care plan being prepared for a resident of an aged care facility (Item 731).

GPs can be assisted by practice nurses, Aboriginal and Torres Strait Islander health practitioners, Aboriginal health workers and other health professionals.[1]

▶ Go to: Australian Government Department of Health's *Chronic Disease Management (CDM) Medicare Items* webpage

Asthma cycle of care

The *Asthma cycle of care* is an Australian Government initiative to support primary care health professionals (GPs, other medical practitioners and trainees) to provide asthma care. It is implemented through the *Practice Incentives Program (PIP) Asthma Incentive* and applies to the clinical care of people with moderate-to-severe asthma, generally defined as people with (any of):[2]

- symptoms on most days
- use of preventative medication
- bronchodilator use at least three times per week
- hospital attendance or admission following an acute asthma flare-up.

The *Asthma cycle of care* involves at least two asthma-related consultations within 12 months for a patient with moderate-to-severe asthma, of which at least one visit is a planned asthma review. Each consultation includes:

- documenting the diagnosis, assessing asthma severity and assessing level of recent asthma symptom control
- reviewing the patient's use of and access to asthma medicines and inhaler devices
- providing a written asthma action plan (or documented alternative, if the patient is unable to use a written action plan)
- providing asthma self-management education
- reviewing the written or documented asthma action plan.

▶ Go to: Australian Government Department of Health's *Asthma cycle of care*
Go to: Medicare's *Practice Incentive Program (PIP)*

The Personally Controlled eHealth Record System

The eHealth record is an electronic record for a patient that contains a summary of their health information. Patients can choose to register for an eHealth record. Authorised healthcare professionals can access a patient's record and upload information to the record if their healthcare organisation has registered for the eHealth record system.

▶ Go to: Australian Government Department of Health's *eHealth Resources for Healthcare Providers*

Health system initiatives for Aboriginal and Torres Strait Islander people

Health system initiatives to support the care of Aboriginal and Torres Strait Islander people include:

- Health Assessment Medicare items
- The Indigenous Chronic Disease Package
- The Asthma Spacer Ordering System.

▶ See: *Asthma in Aboriginal and Torres Strait Islander peoples*

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Selecting initial treatment in adults

In this section

Relievers

Prescribing relievers for adults and adolescents with asthma and training patients to use them correctly

http://www.asthmahandbook.org.au/management/adults/initial-treatment/relievers

Preventers

Considering regular preventer treatment with ICS or other preventers for adults and adolescents

http://www.asthmahandbook.org.au/management/adults/initial-treatment/preventers

Prescribing relievers for adults

Recommendations

Advise all patients with asthma to carry a reliever containing a rapid-onset inhaled beta$_2$ agonist at all times and use it when they experience difficulty breathing.

Rapid-onset beta$_2$ agonist relievers include:

- **short-acting beta$_2$ agonists (salbutamol, terbutaline)**
- **low-dose budesonide/formoterol (for people using budesonide/formoterol as both maintenance and reliever).**

- **Formoterol alone should not be prescribed as a reliever inhaler.**
- **For all inhalers: Train the patient how to use their inhaler correctly (including spacer, if used). A physical demonstration is essential.**

How this recommendation was developed

Consensus

Based on clinical experience and expert opinion (informed by evidence, where available).

Short-acting beta$_2$ agonists should be used only on an as-needed basis for asthma symptoms (e.g. wheezing or breathlessness), and at the lowest dose and frequency required.

Warn patients:

- **that frequent use of short-acting beta$_2$ agonists is a sign of poorly controlled asthma, and may indicate or increase risk of asthma flare-ups**
- **not to take their reliever when they do not have asthma symptoms (except before exercise, if indicated).**

How this recommendation was developed

Consensus

Based on clinical experience and expert opinion (informed by evidence, where available), with particular reference to the following source(s):

- Frey et al. 2005[1]
- Global Initiative for Asthma, 2012[2]
- Hancox, 2006[3]
- Suissa *et al.* 1994[4]
- Taylor, 2009[5]
- Taylor *et al.* 1998[6]
- Walters *et al.* 2003[7]

Where more than one reliever option is appropriate, explain the options and take into consideration:

- **the person's preference**
- **the person's ability to use the device**
- **cost**
- **potential adverse effects.**

How this recommendation was developed

Consensus

Based on clinical experience and expert opinion (informed by evidence, where available).

More information

Correct use of inhaler devices

Checking and correcting inhaler technique is essential to effective asthma management.

Most patients with asthma or COPD do not use their inhalers properly,[8, 9,10, 10, 11] and most have not had their technique checked or corrected by a health professional.

Incorrect inhaler technique when using maintenance treatments increases the risk of severe flare-ups and hospitalisation for people with asthma or COPD.[8, 9, 12, 13, 14, 15]

Poor asthma symptom control is often due to incorrect inhaler technique.[16, 17]

Incorrect inhaler technique when using inhaled corticosteroids increases the risk of local side effects like dysphonia and oral thrush.

The steps for using an inhaler device correctly differ between brands. Checklists of correct steps for each inhaler type and how-to videos are available from the National Asthma Council website.

▶ Go to: National Asthma Council Australia's *Using your inhaler* webpage for information, patient resources and videos on inhaler technique
Go to: National Asthma Council Australia's information paper for health professionals on *Inhaler technique for people with asthma or COPD*
Go to: NPS MedicineWise information on *Inhaler devices for respiratory medicines*

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Short-acting beta-2 agonist relievers for adults and adolescents

Short-acting beta$_2$ agonists are used to:

- relieve asthma symptoms
- prevent exercise-induced bronchoconstriction
- relieve exercise-induced bronchoconstriction.

The duration of therapeutic effect is approximately 4 hours.

When using a pressurised metered-dose inhaler for salbutamol, the use of a large-volume spacer increases the proportion of drug delivered to the lung.[18] For adults, it is not essential to use a spacer with salbutamol for day-to-day symptoms if adequate relief is obtained with a pressurised metered dose inhaler alone.

Patients with well-controlled asthma do not need to use their reliever on more than 2 days per week, not counting doses taken before exercise to prevent exercise-induced bronchoconstriction.

Increased use of short-acting beta$_2$ agonists for relief of asthma symptoms, especially daily use, indicates worsening asthma control.

Dispensing of three or more canisters in a year (average 1.6 puffs per day) is associated with increased risk of flare-ups.[19] Dispensing 12 or more canisters in a year (average 6.6 puffs per day) is associated with increased risk of asthma death.[20]

Note: Routine preventive doses of short-acting beta$_2$ agonist taken before exercise are not counted when assessing recent asthma symptom control. However, persistent exercise-induced bronchoconstriction generally indicates inadequate asthma control.

Table. Definition of levels of recent asthma symptom control in adults and adolescents (regardless of current treatment regimen)

Good control	Partial control	Poor control
All of: • Daytime symptoms ≤2 days per week	One or two of: • Daytime symptoms >2 days per week	Three or more of: • Daytime symptoms >2 days per week

Good control	Partial control	Poor control
• Need for SABA reliever ≤2 days per week† • No limitation of activities • No symptoms during night or on waking	• Need for SABA reliever >2 days per week† • Any limitation of activities • Any symptoms during night or on waking	• Need for SABA reliever >2 days per week† • Any limitation of activities • Any symptoms during night or on waking

SABA: short-acting beta$_2$-agonist

† SABA, not including doses taken prophylactically before exercise. (Record this separately and take into account when assessing management.)

Note: Recent asthma symptom control is based on symptoms over the previous 4 weeks.

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Over-use of short-acting beta-2 agonists

High use of short-acting beta$_2$ agonists may, itself, increase the risk of asthma flare-ups:[4, 5]

Regular use of short-acting beta$_2$ agonists leads to receptor tolerance (down-regulation) to their bronchoprotective and bronchodilator effects. Tolerance becomes more apparent with worsening bronchoconstriction. In severe asthma, this could result in a poor response to emergency treatment.[3]

- Data from population and case-control studies has led to concerns that the frequent use of short-acting beta$_2$ agonists, including salbutamol, is associated with increased risk of asthma deaths.[7] The risk of asthma deaths was greatest for fenoterol, which has since been withdrawn from use.[4] For salbutamol, the risk is greatest for doses above 1000 microg/day (10 puffs).
- Dispensing of 3 or more canisters of short-acting beta$_2$ agonist in a year (average 1.6 puffs per day) is associated with increased risk of flare-ups[21] Dispensing 12 or more canisters in a year (average 6.6 puffs per day) is associated with increased risk of asthma death.[20]

When high doses of short-acting beta$_2$ agonist are needed (e.g. dose repeated at intervals of less than 4 hours in a person with acute severe asthma), the patient should be under medical supervision and should usually also be receiving systemic corticosteroids.

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Combination budesonide/formoterol maintenance-and-reliever regimen in adults and adolescents: overview of efficacy

Low-dose budesonide/formoterol combination can be used as reliever for asthma symptoms (instead of using a short-acting beta$_2$ agonist reliever), in addition to its use as regular long-term preventer treatment.[22, 23, 24, 25, 26, 27] The following formulations can be used in maintenance-and-reliever regimens:

- dry-powder inhaler (*Symbicort Turbuhaler*) 100/6 microg or 200/6 microg
- pressurised metered-dose inhaler (*Symbicort Rapihaler*) 50/3 microg or 100/3 microg.

Neither the 400/12 microg dry-powder inhaler nor the 200/6 microg pressurised metered-dose inhaler should be used in this way.

Overall, clinical trials show that budesonide/formoterol combination as maintenance and reliever reduces the risk of flare-ups that require oral corticosteroids, compared with other current preventer regimens and compared with a fixed higher dose of inhaled corticosteroids.[28]

Pooled data from five randomised controlled trials assessing budesonide/formoterol maintenance-and-reliever regimens showed that similar or better levels of asthma control were achieved with budesonide/formoterol maintenance-and-reliever compared with the conventional maintenance regimen comparators:[24]

- higher-dose budesonide
- same dose budesonide/formoterol
- higher-dose inhaled corticosteroid/long-acting beta$_2$ agonist (budesonide/formoterol or fluticasone propionate/salmeterol).

In randomised clinical trials in patients with a history of asthma flare-up within the previous 12 months (and therefore at greater risk of flare-up in the next 12 months), the use of formoterol/budesonide as maintenance-and-reliever regimen reduced the risk of asthma flare-ups that required treatment with oral corticosteroids, compared with the use of any of the following (plus a short-acting beta$_2$ agonist reliever as needed):[24, 29, 30]

- the same combination as maintenance treatment only
- higher-dose combination as maintenance treatment only
- higher-dose inhaled corticosteroids.

Meta-analysis of six randomised controlled trials found that maintenance-and-reliever treatment with budesonide/formoterol reduced the risk of severe asthma flare-ups (use of oral corticosteroids for 3 days or more, hospitalisation or emergency department visits), compared with higher-dose inhaled corticosteroid alone, or in combination with a long-acting beta$_2$ agonist.[31]

In open-label studies in which patients were not selected for a previous history of flare-ups, there was no overall difference in time to first flare-up between budesonide/formoterol as maintenance-and-reliever regimen and conventional maintenance regimens (including inhaled corticosteroid or inhaled corticosteroid/long-acting beta$_2$ agonist combinations, leukotriene receptor antagonists, xanthines or any other asthma medicines) with rapid-onset beta$_2$ agonist reliever (selected according to clinician's choice).[32] However, the inhaled corticosteroid dose was higher with conventional maintenance regimens.

Note: The fluticasone propionate/formoterol combination is approved by the Therapeutic Goods Administration only for regular maintenance therapy.

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Technical notes: pressurised metered-dose inhalers with spacers

Manufacturers of most pressurised metered-dose delivery devices recommend shaking the device before actuating. The physical characteristics of each formulation, including the effects of shaking, differ widely,[33] but for simplicity it is best always to recommend shaking of pressurised metered-dose inhalers.

Pressurised metered-dose inhalers (except for those that are breath-actuated) can be used with a spacer. When a spacer is used with a pressurised metered-dose inhaler, delivery of the medicine to the patient's airways is maximised when the patient takes a slow, deep breath from the spacer after each actuation.[34, 35] Multiple actuations of a pressurised metered-dose inhaler into a spacer can reduce the amount of respirable medicine available because aerosol particles can agglomerate into larger particles or become attached to the spacer walls.[34]

Therefore, the ideal way to deliver inhaled medicines via pressurised metered-dose inhaler and spacer is to shake the device, ask the person to breathe out all the way into the spacer, actuate a single puff into the spacer, and have the person immediately take a slow deep breath from the spacer, then hold their breath for 5 seconds. This process should be repeated until the total intended number of actuations is taken. Patients should be trained to follow these instructions when using their inhalers. Inhaling slowly with a single breath maximises delivery of the medicine to the lungs and minimises deposition in the upper airways when using a manually actuated pressurised metered-dose inhaler with or without a spacer, or when using a breath-actuated pressurised metered-dose inhaler.[36] However, slow breathing may not be possible for patients with acute asthma. Tidal breathing through the spacer (e.g. four breaths in and out without removing the spacer) is used in acute asthma and for very young children. First aid instructions should include how to use inhaler and spacer.

In practice, optimal delivery of inhaled medicines involves a balance between maximising the proportion of respirable medicine and maximising efficiency of inhalation by the patient within real-world constraints. The optimal delivery of salbutamol in real-world circumstances is not well defined. For day-to-day use of salbutamol, most adults gain sufficient relief from symptoms when using a pressurised metered-dose inhaler on its own. A spacer may only be needed during a flare-up. By contrast, the use of a spacer is always recommended for inhaled corticosteroids delivered by manually actuated pressurised metered-dose inhalers, to reduce the risk of local adverse effects and increase delivery to the airways.

Many available in vitro studies of aerosol particle deposition in the airways were performed using older CFC-propelled formulations, which are now obsolete. Similar studies have not been performed for current non-CFC pressurised metered-dose inhalers.

▶ Go to: National Asthma Council Australia's *first aid charts*

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Ipratropium for adults

Regular ipratropium bromide in addition to as-needed short-acting beta$_2$ agonist does not appear to provide clinically significant benefit over as-needed short-acting beta$_2$ agonists alone.[37]

Note: Ipratropium bromide may be used in the management of severe acute asthma.

▶ See: *Managing acute asthma in clinical settings*

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Prescribing regular preventer treatment for adults

In this section

General considerations

General considerations when prescribing regular preventer treatment for adults and adolescents

http://www.asthmahandbook.org.au/management/adults/initial-treatment/preventers/general-considerations

ICS-based preventers

Prescribing inhaled corticosteroid-based preventers for adults and adolescents

http://www.asthmahandbook.org.au/management/adults/initial-treatment/preventers/ics-based-preventers

Other preventers

The roles of non-corticosteroid preventers in the management of asthma in adults and adolescents

http://www.asthmahandbook.org.au/management/adults/initial-treatment/preventers/other-preventers

General considerations when prescribing regular preventer treatment for adults

Recommendations

Consider regular preventer treatment according to pattern of symptoms and the person's ability to use the device. Explain to the patient that preventers should be taken every day and continued long term to reduce the risk of flare-ups.

Table. Initial treatment choices (adults and adolescents not already using a preventer)

Clinical situation	*Suggested starting regimen †*	*Alternative options and notes*
Symptoms less than twice per month and no flare-up that required oral corticosteroids within previous 12 months	**SABA as needed**	
Symptoms twice per month or more	**Regular ICS starting at a low dose (plus SABA as needed)**	**Montelukast‡** **Cromones§**
Waking due to asthma symptoms at least once during the past month	**Regular ICS starting at a low dose (plus SABA as needed)**	**If patient also has frequent daytime symptoms consider either of:** • **medium- to high-dose ICS (plus SABA as needed)** • **(private prescription) combination low-dose ICS/LABA#**
Oral corticosteroids required for an asthma flare-up within the last 12 months (even if symptoms infrequent, e.g. less than twice per month on average)	**Regular ICS starting at a low dose (plus SABA as needed)**	
History of artificial ventilation or admission to an intensive care unit due to acute asthma (even if symptoms infrequent, e.g. less than twice per month on average)	**Regular ICS starting at a low dose (plus SABA as needed)** • **Monitor frequently**	

Clinical situation	*Suggested starting regimen †*	*Alternative options and notes*
Patient not currently taking a preventer whose symptoms are severely uncontrolled or very troublesome	**Regular ICS (plus SABA as needed)** **For very uncontrolled asthma at presentation (e.g. frequent night waking, low lung function), consider (either of):** • **high-dose ICS (then down-titrate when symptoms improve)** • **a short course of oral corticosteroids in addition to ICS**	**Consider (private prescription) combination ICS/LABA#**

† When prescribing inhaled asthma medicines, take into account the person's preferences, ability to use the device, and cost issues.

§ Requires multiple daily doses and daily maintenance of inhaler.

‡ PBS status as at March 2019: Montelukast treatment is not subsidised by the PBS for people aged 15 years or over. Special Authority is available for Department of Veteran's Affairs gold card holders or white card holders with approval for asthma treatments.

 # PBS status as at March 2019: ICS/LABA combination therapy as first-line preventer treatment is not subsidised by the PBS, except for patients with frequent symptoms while taking oral corticosteroids.

Asset ID: 32

Table. Definitions of ICS dose levels in adults

Inhaled corticosteroid	**Daily dose (microg)**		
	Low	**Medium**	**High**
Beclometasone dipropionate †	**100–200**	**250–400**	**>400**
Budesonide	**200–400**	**500–800**	**>800**
Ciclesonide	**80–160**	**240–320**	**>320**
*Fluticasone furoate**	**—**	**100**	**200**
Fluticasone propionate	**100–200**	**250–500**	**>500**

† Dose equivalents for *Qvar* **(TGA-registered CFC-free formulation of beclometasone dipropionate).**

***Fluticasone furoate is not available as a low dose. TGA-registered formulations of fluticasone furoate contain a medium or high dose of fluticasone furoate and should only be prescribed as one inhalation once daily.**

Note: The potency of generic formulations may differ from that of original formulations. Check TGA-approved product information for details.

Sources

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Asset ID: 22

How this recommendation was developed

Consensus

Based on clinical experience and expert opinion (informed by evidence, where available).

Where more than one preventer option is appropriate, explain the options and take into consideration:

- **the person's preference**
- **the person's ability to use the device**
- **cost**
- **potential adverse effects.**

How this recommendation was developed

Consensus

Based on clinical experience and expert opinion (informed by evidence, where available).

When prescribing any preventer medicine, consider each treatment adjustment as a treatment trial.

Table. Steps for conducting a treatment trial

1. **Document baseline lung function.**
2. **Document baseline asthma control using a validated standardised tool such as the Asthma Score.**
3. **Discuss treatment goals and potential adverse effects with the person.**
4. **Run treatment trial for agreed period (e.g. 4–8 weeks, depending on the treatment and clinical circumstances, including urgency).**
5. **At an agreed interval, measure asthma control and lung function again and document any adverse effects.**
6. **If asthma control has not improved despite correct inhaler technique and good adherence, resume previous treatment and consider referral for specialist consultation.**

▶ **See:** *Asthma Score (Asthma Control Test)*

Asset ID: 36

How this recommendation was developed

Consensus

Based on clinical experience and expert opinion (informed by evidence, where available).

After starting a new treatment regimen or making any adjustments to the treatment regimen, set a date to review response (e.g. 6–8 weeks) and follow up the patient, to ensure ineffective or unnecessary medication is not continued, or that the patient has not inappropriately stopped taking the treatment.

How this recommendation was developed

Consensus

Based on clinical experience and expert opinion (informed by evidence, where available).

Review asthma control periodically to step up or down as necessary to maintain good asthma control at the lowest effective dose.

Figure. Stepped approach to adjusting asthma medication in adults and adolescents

Please view and print this figure separately: http://www.asthmahandbook.org.au/figure/show/31

Table. Guide to selecting and adjusting asthma medication for adults and older adolescents

Clinical situation	Action
Newly diagnosed asthma	**Consider low-dose ICS (plus SABA as needed)** **If symptoms severe at initial presentation, consider one of:** • **ICS plus a short course of oral corticosteroids** • **a short initial period of high-dose ICS then step down** • **(private prescription) combination ICS/LABA†** **See:** *Table. Initial treatment choices (adults and adolescents not already using a preventer)*
Good recent asthma symptom control	**If maintained 2–3 months, no flare-up in previous 12 months and low risk for flare-ups, step down where possible (unless already on low-dose ICS)**
Partial recent asthma symptom control	**Review inhaler technique and adherence – correct if suboptimal** **If no improvement, consider increasing treatment by one step and reviewing (if still no improvement, return to previous step, review diagnosis and consider referral)**
Poor recent asthma symptom control	**Review inhaler technique and adherence – correct if suboptimal** **Confirm that symptoms are likely to be due to asthma** **Consider increasing treatment until good asthma control is achieved, then step down again when possible**
Difficult-to-treat asthma ‡	**Consider referral for assessment or add-on options**
Patient with risk factors §	**Tailor treatment to reduce individual risk factors**

† PBS status as at March 2019: ICS/LABA combination therapy as first-line preventer treatment is not subsidised by the PBS, except for patients with frequent symptoms while taking oral corticosteroids.

‡ Poor recent asthma symptom control despite ICS/LABA combination at high–medium dose.

§ Risk factors for asthma events or adverse treatment effects, irrespective of level of recent asthma symptom control.

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Asset ID: 5

Table. Definitions of ICS dose levels in adults

Inhaled corticosteroid	Daily dose (microg)		
	Low	Medium	High
Beclometasone dipropionate †	100–200	250–400	>400
Budesonide	200–400	500–800	>800
Ciclesonide	80–160	240–320	>320
*Fluticasone furoate**	—	100	200
Fluticasone propionate	100–200	250–500	>500

† Dose equivalents for *Qvar* **(TGA-registered CFC-free formulation of beclometasone dipropionate).**

***Fluticasone furoate is not available as a low dose. TGA-registered formulations of fluticasone furoate contain a medium or high dose of fluticasone furoate and should only be prescribed as one inhalation once daily.**

Note: The potency of generic formulations may differ from that of original formulations. Check TGA-approved product information for details.

Sources

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Asset ID: 22

How this recommendation was developed

Consensus

Based on clinical experience and expert opinion (informed by evidence, where available).

For adults prescribed low-dose ICS for an indefinite period, explain that:

- **the main purpose of long-term low-dose ICS-based preventer is to reduce the risk of flare-ups, even if day-to-day symptoms are infrequent**
- **even if the person has not experienced asthma symptoms for some time, they should not stop taking their preventer without discussing first.**

Table. Definitions of ICS dose levels in adults

Inhaled corticosteroid	Daily dose (microg)		
	Low	Medium	High
Beclometasone dipropionate	100–200	250–400	>400

Inhaled corticosteroid	Daily dose (microg)		
	Low	Medium	High
†			
Budesonide	200–400	500–800	>800
Ciclesonide	80–160	240–320	>320
*Fluticasone furoate**	—	100	200
Fluticasone propionate	100–200	250–500	>500

† Dose equivalents for *Qvar* **(TGA-registered CFC-free formulation of beclometasone dipropionate).**

***Fluticasone furoate is not available as a low dose. TGA-registered formulations of fluticasone furoate contain a medium or high dose of fluticasone furoate and should only be prescribed as one inhalation once daily.**

Note: The potency of generic formulations may differ from that of original formulations. Check TGA-approved product information for details.

Sources

Respiratory Expert Group, Therapeutic Guidelines Limited. *Therapeutic Guidelines: Respiratory, Version 4*. **Therapeutic Guidelines Limited, Melbourne, 2009.**

GlaxoSmithKline Australia Pty Ltd. Product Information: *Breo (fluticasone furoate; vilanterol) Ellipta*. **Therapeutic Goods Administration, Canberra, 2014. Available from: https://www.ebs.tga.gov.au/**

GlaxoSmithKline Australia Pty Ltd. Product Information: *Arnuity (fluticasone furoate) Ellipta*. **Therapeutic Goods Administration, Canberra, 2016. Available from: https://www.ebs.tga.gov.au/**

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How this recommendation was developed

Consensus

Based on clinical experience and expert opinion (informed by evidence, where available).

More information

Adherence to preventer treatment: adults and adolescents

Most patients do not take their preventer medication as often as prescribed, particularly when symptoms improve, or are mild or infrequent. Whenever asthma control is poor despite apparently adequate treatment, poor adherence, as well as poor inhaler technique, are probable reasons to consider.

Poor adherence may be intentional and/or unintentional. Intentional poor adherence may be due to the person's belief that the medicine is not necessary, or to perceived or actual adverse effects. Unintentional poor adherence may be due to forgetting or cost barriers.

Common barriers to the correct use of preventers include:

- being unable to afford the cost of medicines or consultations to adjust the regimen
- concerns about side effects
- interference of the regimen with the person's lifestyle
- forgetting to take medicines
- lack of understanding of the reason for taking the medicines
- inability to use the inhaler device correctly due to physical or cognitive factors
- health beliefs that are in conflict with the belief that the prescribed medicines are effective, necessary or safe (e.g. a belief that the

prescribed preventer dose is 'too strong' or only for flare-ups, a belief that asthma can be overcome by psychological effort, a belief that complementary and alternative therapies are more effective or appropriate than prescribed medicines, mistrust of the health professional).

Adherence to preventers is significantly improved when patients are given the opportunity to negotiate the treatment regimen based on their goals and preferences.[1]

Assessment of adherence requires an open, non-judgemental approach.

Accredited pharmacists who undertake Home Medicines Reviews can assess adherence while conducting a review.

Table. Suggested questions to ask adults and older adolescents when assessing adherence to treatment

1. *Many people don't take their medication as prescribed. In the last four weeks:*
   - how many days a week would you have taken your preventer medication? None at all? One? Two? (etc).
   - how many times a day would you take it? Morning only? Evening only? Morning and evening? (or other)
   - each time, how many puffs would you take? One? Two? (etc).
2. *Do you find it easier to remember your medication in the morning, or the evening?*

Source: Foster JM, Smith L, Bosnic-Anticevich SZ et al. Identifying patient-specific beliefs and behaviours for conversations about adherence in asthma. *Intern Med J* 2012; 42: e136-e44. Available from: http://www.ncbi.nlm.nih.gov/pubmed/21627747

Asset ID: 38

▶ Go to: Medicare's *Home Medicines Review (HMR)*

Inhaled corticosteroids for adults: overview

Inhaled corticosteroid preventer medicines available in Australia

The following inhaled corticosteroids are registered by the TGA:

- beclometasone dipropionate (low to high doses available)
- budesonide (low to high doses available, including in combination with a long-acting beta$_2$ agonist)
- ciclesonide (low to high doses available)
- fluticasone furoate (medium to high doses available, including in combination with a long-acting beta$_2$ agonist)
- fluticasone propionate (low to high doses available, including in combination with a long-acting beta$_2$ agonist)

Table. Definitions of ICS dose levels in adults

Inhaled corticosteroid	Daily dose (microg)		
	Low	Medium	High
Beclometasone dipropionate †	100–200	250–400	>400
Budesonide	200–400	500–800	>800
Ciclesonide	80–160	240–320	>320
*Fluticasone furoate**	—	100	200
Fluticasone propionate	100–200	250–500	>500

† Dose equivalents for *Qvar* (TGA-registered CFC-free formulation of beclometasone dipropionate).

*Fluticasone furoate is not available as a low dose. TGA-registered formulations of fluticasone furoate contain a medium or high dose of fluticasone furoate and should only be prescribed as one inhalation once daily.

Note: The potency of generic formulations may differ from that of original formulations. Check TGA-approved product information for details.

Sources

Respiratory Expert Group, Therapeutic Guidelines Limited. *Therapeutic Guidelines: Respiratory, Version 4*. Therapeutic Guidelines Limited, Melbourne, 2009.

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Clinical benefits

Inhaled corticosteroids are the most effective preventer medicines for adults.[2]

Inhaled corticosteroids are effective in reducing asthma symptoms, improving quality of life, improving lung function, decreasing airway hyperresponsiveness, controlling airway inflammation, reducing the frequency and severity of asthma flare-ups, and reducing the risk of death due to asthma.[3, 4, 5, 6, 7, 8, 9, 10, 11, 12]

Most adults with asthma benefit from regular inhaled corticosteroid treatment

The current recommendation to initiate inhaled corticosteroid treatment for adults with asthma symptoms twice or more during the past month, or who experience waking due to asthma symptoms once or more during the past month, is based on consideration of clinical trial evidence that even patients with infrequent symptoms benefit from regular use of inhaled corticosteroids:

- In patients with recent-onset (diagnosis within 2 years) mild asthma (45% with symptoms 2 days/week or less), low-dose inhaled corticosteroid (budesonide 400 microg/day) reduced the risk of severe flare-ups, increased symptom-free days and lung function, and protected against long-term decline in lung function associated with severe asthma flare-ups (evidence from a 5-year large randomised clinical trial).[6, 8, 9]
- In small clinical trials in adults with symptoms or reliever use twice per week or less, the use of regular inhaled corticosteroids (fluticasone propionate 250 microg/day) improved lung function,[13] reduced airway hyperresponsiveness and inflammation,[13, 14] and reduced the risk of mild flare-ups.[13, 14]

The current recommendation replaces the previous higher threshold for inhaled corticosteroid treatment (asthma symptoms three times a week or more, or waking at least one night per week with asthma symptoms), which was based on consensus.

Clinical benefits are achieved with low doses

Low doses of inhaled corticosteroids are sufficient to achieve benefits in most patients:

- Regular use of low-dose inhaled corticosteroids reduced the risk of hospitalisation for acute asthma and death due to asthma (evidence from a large population cohort study).[10] In that study, breaks in the use of inhaled corticosteroid of up to 3 months were associated with increased risk of death.[11]
- In adults and adolescents with mild asthma who were not taking inhaled corticosteroids, starting low-dose inhaled corticosteroid (budesonide 200 microg/day) reduced the risk of asthma flare-ups severe enough to require oral corticosteroids, and improved symptom control (evidence from a large clinical trial).[7]
- In patients with recent-onset (diagnosis within 2 years) mild asthma (45% with symptoms 2 days/week or less), low-dose inhaled corticosteroid (budesonide 400 microg/day) reduced the risk of severe flare-ups, increased symptom-free days and lung function, and protected against long-term decline in lung function associated with severe asthma flare-ups (evidence from a 5-year large randomised clinical trial).[6, 8, 9]

Note: PBS status as at March 2019: Fluticasone furoate is not subsidised by the PBS, except in combination with vilanterol.

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Inhaled corticosteroid/long-acting beta-2 agonist combinations for adults: overview

- To avoid the possibility of patients taking a long-acting beta$_2$ agonist without an inhaled corticosteroid, long-acting beta$_2$ agonists should (whenever possible) be prescribed as inhaled corticosteroid/long-acting beta$_2$ agonist combination in a single inhaler, rather than in separate inhalers. If no combination product is available for the desired medications, carefully explain to the patient that it is very important that they continue taking the inhaled corticosteroid.

Meta-analysis of evidence from randomised controlled clinical trials shows that, for adult patients already taking an inhaled corticosteroid, concomitant treatment with an inhaled corticosteroid and a long-acting beta$_2$ agonist:[3]

- reduces the risk of flare-ups, compared with increasing the dose of corticosteroids
- reduces the risk of flare-ups, compared with inhaled corticosteroids alone.

The studies included in this meta-analysis evaluated mainly budesonide/formoterol and fluticasone propionate/salmeterol.[3]

Each of the following inhaled corticosteroid/long-acting beta$_2$ agonist combinations is available as a single inhaler:

- budesonide/formoterol
- fluticasone furoate/vilanterol
- fluticasone propionate/salmeterol
- fluticasone propionate/formoterol.

There are two types of dosing regimens for inhaled corticosteroid/long-acting beta$_2$ agonist combination therapy:

- maintenance-only regimens (applicable to all available combinations)
- maintenance-and-reliever regimen (applicable only to the budesonide/formoterol combination).

Maintenance-only regimens

The fluticasone propionate/salmeterol combination and budesonide/formoterol combination appear to be equally effective when used for regular maintenance treatment, based on meta-analysis of evidence from clinical trials.[15] Most of the evidence for inhaled corticosteroid/long-acting beta$_2$ agonist combination therapy is from studies using these combinations.

Less evidence from double-blind randomised controlled clinical trials is available for the newer combinations: fluticasone furoate/vilanterol and fluticasone propionate/formoterol:

- The fluticasone furoate/vilanterol combination is equivalent to a medium-to-high dose of inhaled corticosteroids.[16] In adults and adolescents already taking inhaled corticosteroids, once-daily fluticasone furoate/vilanterol 100/25 microg reduced the risk of severe flare-ups (requiring oral corticosteroids or hospitalisation) and improved lung function, compared with fluticasone furoate alone.[17] Efficacy data for the comparison of fluticasone furoate/vilanterol with other inhaled corticosteroid/long-acting beta$_2$ agonist combinations is not available.
- In adults and adolescents with persistent asthma and FEV_1 50–80% at baseline, fluticasone propionate/formoterol achieved improvement in FEV_1 comparable to that achieved with budesonide/formoterol in a 12-week randomised double-blind clinical trial.[18] Other 12-week open-label studies have reported that fluticasone propionate/formoterol was as effective as budesonide/formoterol in improving lung function in adults and adolescents with poorly controlled asthma,[19] and was as effective as fluticasone propionate/salmeterol in adults.[20]

Long-acting beta$_2$ agonists should not be used without inhaled corticosteroids in the management of asthma.[21, 22, 23, 24] Long-acting beta$_2$ agonists are well tolerated when given in combination with inhaled corticosteroids.[15, 25]

Maintenance-and-reliever regimen

The low-dose budesonide/formoterol combination can be used as both maintenance and reliever. Under this regimen, the combination is used for relief of asthma symptoms (instead of using a short-acting beta$_2$ agonist reliever), in addition to its use as regular maintenance treatment.

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Combination budesonide/formoterol maintenance-and-reliever regimen in adults and adolescents: overview of efficacy

Low-dose budesonide/formoterol combination can be used as reliever for asthma symptoms (instead of using a short-acting beta$_2$ agonist reliever), in addition to its use as regular long-term preventer treatment.[26, 27, 28, 29, 30, 31] The following formulations can be used in maintenance-and-reliever regimens:

- dry-powder inhaler (*Symbicort Turbuhaler*) 100/6 microg or 200/6 microg
- pressurised metered-dose inhaler (*Symbicort Rapihaler*) 50/3 microg or 100/3 microg.

Neither the 400/12 microg dry-powder inhaler nor the 200/6 microg pressurised metered-dose inhaler should be used in this way.

Overall, clinical trials show that budesonide/formoterol combination as maintenance and reliever reduces the risk of flare-ups that require oral corticosteroids, compared with other current preventer regimens and compared with a fixed higher dose of inhaled corticosteroids.[32]

Pooled data from five randomised controlled trials assessing budesonide/formoterol maintenance-and-reliever regimens showed that similar or better levels of asthma control were achieved with budesonide/formoterol maintenance-and-reliever compared with the conventional maintenance regimen comparators:[28]

- higher-dose budesonide
- same dose budesonide/formoterol
- higher-dose inhaled corticosteroid/long-acting beta$_2$ agonist (budesonide/formoterol or fluticasone propionate/salmeterol).

In randomised clinical trials in patients with a history of asthma flare-up within the previous 12 months (and therefore at greater risk of flare-up in the next 12 months), the use of formoterol/budesonide as maintenance-and-reliever regimen reduced the risk of asthma flare-ups that required treatment with oral corticosteroids, compared with the use of any of the following (plus a short-acting beta$_2$ agonist reliever as needed):[28, 33, 34]

- the same combination as maintenance treatment only
- higher-dose combination as maintenance treatment only
- higher-dose inhaled corticosteroids.

Meta-analysis of six randomised controlled trials found that maintenance-and-reliever treatment with budesonide/formoterol reduced the risk of severe asthma flare-ups (use of oral corticosteroids for 3 days or more, hospitalisation or emergency department visits), compared with higher-dose inhaled corticosteroid alone, or in combination with a long-acting beta$_2$ agonist.[35]

In open-label studies in which patients were not selected for a previous history of flare-ups, there was no overall difference in time to first flare-up between budesonide/formoterol as maintenance-and-reliever regimen and conventional maintenance regimens (including inhaled corticosteroid or inhaled corticosteroid/long-acting beta$_2$ agonist combinations, leukotriene receptor antagonists, xanthines or any other asthma medicines) with rapid-onset beta$_2$ agonist reliever (selected according to clinician's choice).[36] However, the inhaled corticosteroid dose was higher with conventional maintenance regimens.

Note: The fluticasone propionate/formoterol combination is approved by the Therapeutic Goods Administration only for regular maintenance therapy.

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Correct use of inhaler devices

Checking and correcting inhaler technique is essential to effective asthma management.

Most patients with asthma or COPD do not use their inhalers properly,[37, 38,39, 39, 40] and most have not had their technique checked or corrected by a health professional.

Incorrect inhaler technique when using maintenance treatments increases the risk of severe flare-ups and hospitalisation for people with asthma or COPD.[37, 38, 41, 42, 43, 44]

Poor asthma symptom control is often due to incorrect inhaler technique.[45, 46]

Incorrect inhaler technique when using inhaled corticosteroids increases the risk of local side effects like dysphonia and oral thrush.

The steps for using an inhaler device correctly differ between brands. Checklists of correct steps for each inhaler type and how-to videos are available from the National Asthma Council website.

▶ Go to: National Asthma Council Australia's *Using your inhaler* webpage for information, patient resources and videos on inhaler technique
Go to: National Asthma Council Australia's information paper for health professionals on *Inhaler technique for people with asthma or COPD*
Go to: NPS MedicineWise information on *Inhaler devices for respiratory medicines*

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Prescribing inhaled corticosteroid-based preventers for adults

Recommendations

Prescribe a regular inhaled corticosteroid for all adults and adolescents who report any of the following:

- **asthma symptoms twice or more during the past month**
- **waking due to asthma symptoms once or more during the past month**
- **an asthma flare-up in the previous 12 months.**

- **For all inhalers: Train the patient how to use their inhaler correctly. A physical demonstration is essential.**

How this recommendation was developed

Consensus

Based on clinical experience and expert opinion (informed by evidence, where available), with particular reference to the following source(s):

- Sin *et al.* 2004[1]
- Global Initiative for Asthma, 2012[2]
- Adams *et al.* 1999[3]
- Adams *et al.* 2005[4]
- Busse *et al.* 2008[5]
- Adams *et al.* 2008[6]
- Reddel *et al.* 2008[7]
- Boulet *et al.* 2009[8]
- O'Byrne *et al.* 2001[9]
- O'Byrne *et al.* 2009[10]
- Pauwels *et al.* 2003[11]
- Suissa *et al.* 2002[12]
- Suissa *et al.* 2000[13]

When starting regular inhaled corticosteroids, begin at a low dose and review response 6–8 weeks later. (Also review during this interval, if appropriate.)

Follow the steps for conducting a treatment trial.

Table. Steps for conducting a treatment trial

1. **Document baseline lung function.**
2. **Document baseline asthma control using a validated standardised tool such as the Asthma Score.**
3. **Discuss treatment goals and potential adverse effects with the person.**
4. **Run treatment trial for agreed period (e.g. 4–8 weeks, depending on the treatment and clinical circumstances, including urgency).**
5. **At an agreed interval, measure asthma control and lung function again and document any adverse effects.**
6. **If asthma control has not improved despite correct inhaler technique and good adherence, resume previous treatment and consider referral for specialist consultation.**

▶ **See:** *Asthma Score (Asthma Control Test)*

Asset ID: 36

Table. Definitions of ICS dose levels in adults

Inhaled corticosteroid	Daily dose (microg)		
	Low	Medium	High
Beclometasone dipropionate †	100–200	250–400	>400
Budesonide	200–400	500–800	>800
Ciclesonide	80–160	240–320	>320
*Fluticasone furoate**	—	100	200
Fluticasone propionate	100–200	250–500	>500

† Dose equivalents for *Qvar* **(TGA-registered CFC-free formulation of beclometasone dipropionate).**

***Fluticasone furoate is not available as a low dose. TGA-registered formulations of fluticasone furoate contain a medium or high dose of fluticasone furoate and should only be prescribed as one inhalation once daily.**

Note: The potency of generic formulations may differ from that of original formulations. Check TGA-approved product information for details.

Sources

Respiratory Expert Group, Therapeutic Guidelines Limited. *Therapeutic Guidelines: Respiratory, Version 4***. Therapeutic Guidelines Limited, Melbourne, 2009.**

GlaxoSmithKline Australia Pty Ltd. Product Information: *Breo (fluticasone furoate; vilanterol) Ellipta***. Therapeutic Goods Administration, Canberra, 2014. Available from: https://www.ebs.tga.gov.au/**

GlaxoSmithKline Australia Pty Ltd. Product Information: *Arnuity (fluticasone furoate) Ellipta***. Therapeutic Goods Administration, Canberra, 2016. Available from: https://www.ebs.tga.gov.au/**

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Asset ID: 22

How this recommendation was developed

Consensus

Based on clinical experience and expert opinion (informed by evidence, where available).

Explain potential adverse effects of inhaled corticosteroids to patients.

Ask patients about any concerns they have about adverse effects and correct erroneous beliefs.

How this recommendation was developed

Consensus

Based on clinical experience and expert opinion (informed by evidence, where available).

For those taking inhaled corticosteroids via a manually-actuated pressurised metered-dose inhaler, advise them to use a valved spacer.

How this recommendation was developed

Adapted from existing guidance

Based on reliable clinical practice guideline(s) or position statement(s):

- National Asthma Council Australia, 2008[14]

Advise all patients using inhaled corticosteroids to rinse their mouth with water and spit after each dose, if possible.

How this recommendation was developed

Consensus

Based on clinical experience and expert opinion (informed by evidence, where available), with particular reference to the following source(s):

- National Asthma Council Australia, 2008[14]
- Rachelefsky *et al.* 2007[15]
- Yokoyama *et al.* 2007[16]

Advise patients not to increase the dose of any preventer treatment without discussing first (except as instructed in their written asthma action plan).

How this recommendation was developed

Consensus

Based on clinical experience and expert opinion (informed by evidence, where available).

Long-acting beta$_2$ agonists should only be used when an inhaled corticosteroid is taken concurrently – never as monotherapy for asthma.

How this recommendation was developed

Consensus

Based on clinical experience and expert opinion (informed by evidence, where available), with particular reference to the following source(s):

- Ducharme *et al.* 2011[17]
- Walters *et al.* 2007[18]
- Chowdhury and Dal Pan G, 2010[19]
- Chowdhury *et al.* 2011[20]

Where possible, avoid prescribing long-acting beta$_2$ agonists in single-agent inhalers separate from inhaled corticosteroids, to prevent patients using a long-acting beta$_2$ agonist alone.

Note: Occasionally patients may need to use separate devices, e.g. if the person needs an inhaled corticosteroid that is not available in combination with long-acting beta$_2$ agonist (ciclesonide or beclometasone dipropionate). In this case, clearly instruct patients not to take long-acting beta$_2$ agonist alone and explain the risks.

How this recommendation was developed

Consensus

Based on clinical experience and expert opinion (informed by evidence, where available).

For adults prescribed low-dose ICS for an indefinite period, explain that:

- **the main purpose of long-term low-dose ICS-based preventer is to reduce the risk of flare-ups, even if day-to-day symptoms are infrequent**

- **even if the person has not experienced asthma symptoms for some time, they should not stop taking their preventer without discussing first.**

Table. Definitions of ICS dose levels in adults

Inhaled corticosteroid	Daily dose (microg)		
	Low	Medium	High
Beclometasone dipropionate †	100–200	250–400	>400
Budesonide	200–400	500–800	>800
Ciclesonide	80–160	240–320	>320
*Fluticasone furoate**	—	100	200
Fluticasone propionate	100–200	250–500	>500

† Dose equivalents for *Qvar* **(TGA-registered CFC-free formulation of beclometasone dipropionate).**

***Fluticasone furoate is not available as a low dose. TGA-registered formulations of fluticasone furoate contain a medium or high dose of fluticasone furoate and should only be prescribed as one inhalation once daily.**

Note: The potency of generic formulations may differ from that of original formulations. Check TGA-approved product information for details.

Sources

Respiratory Expert Group, Therapeutic Guidelines Limited. *Therapeutic Guidelines: Respiratory, Version 4***. Therapeutic Guidelines Limited, Melbourne, 2009.**

GlaxoSmithKline Australia Pty Ltd. Product Information: *Breo (fluticasone furoate; vilanterol) Ellipta***. Therapeutic Goods Administration, Canberra, 2014. Available from: https://www.ebs.tga.gov.au/**

GlaxoSmithKline Australia Pty Ltd. Product Information: *Arnuity (fluticasone furoate) Ellipta***. Therapeutic Goods Administration, Canberra, 2016. Available from: https://www.ebs.tga.gov.au/**

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Asset ID: 22

How this recommendation was developed

Consensus

Based on clinical experience and expert opinion (informed by evidence, where available).

More information

Adherence to preventer treatment: adults and adolescents

Most patients do not take their preventer medication as often as prescribed, particularly when symptoms improve, or are mild or infrequent. Whenever asthma control is poor despite apparently adequate treatment, poor adherence, as well as poor inhaler technique, are probable reasons to consider.

Poor adherence may be intentional and/or unintentional. Intentional poor adherence may be due to the person's belief that the medicine is not necessary, or to perceived or actual adverse effects. Unintentional poor adherence may be due to forgetting or cost barriers.

Common barriers to the correct use of preventers include:

- being unable to afford the cost of medicines or consultations to adjust the regimen
- concerns about side effects
- interference of the regimen with the person's lifestyle
- forgetting to take medicines
- lack of understanding of the reason for taking the medicines
- inability to use the inhaler device correctly due to physical or cognitive factors
- health beliefs that are in conflict with the belief that the prescribed medicines are effective, necessary or safe (e.g. a belief that the prescribed preventer dose is 'too strong' or only for flare-ups, a belief that asthma can be overcome by psychological effort, a belief that complementary and alternative therapies are more effective or appropriate than prescribed medicines, mistrust of the health professional).

Adherence to preventers is significantly improved when patients are given the opportunity to negotiate the treatment regimen based on their goals and preferences.[21]

Assessment of adherence requires an open, non-judgemental approach.

Accredited pharmacists who undertake Home Medicines Reviews can assess adherence while conducting a review.

Table. Suggested questions to ask adults and older adolescents when assessing adherence to treatment

1. *Many people don't take their medication as prescribed. In the last four weeks:*
   - how many days a week would you have taken your preventer medication? None at all? One? Two? (etc).
   - how many times a day would you take it? Morning only? Evening only? Morning and evening? (or other)
   - each time, how many puffs would you take? One? Two? (etc).
2. *Do you find it easier to remember your medication in the morning, or the evening?*

Source: Foster JM, Smith L, Bosnic-Anticevich SZ et al. Identifying patient-specific beliefs and behaviours for conversations about adherence in asthma. *Intern Med J* 2012; 42: e136-e44. Available from: http://www.ncbi.nlm.nih.gov/pubmed/21627747

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▶ Go to: Medicare's *Home Medicines Review (HMR)*

Inhaled corticosteroids for adults: overview

Inhaled corticosteroid preventer medicines available in Australia

The following inhaled corticosteroids are registered by the TGA:

- beclometasone dipropionate (low to high doses available)
- budesonide (low to high doses available, including in combination with a long-acting beta$_2$ agonist)
- ciclesonide (low to high doses available)
- fluticasone furoate (medium to high doses available, including in combination with a long-acting beta$_2$ agonist)
- fluticasone propionate (low to high doses available, including in combination with a long-acting beta$_2$ agonist)

Table. Definitions of ICS dose levels in adults

Inhaled corticosteroid	Daily dose (microg)		
	Low	Medium	High
Beclometasone dipropionate †	100–200	250–400	>400
Budesonide	200–400	500–800	>800
Ciclesonide	80–160	240–320	>320

Inhaled corticosteroid	Daily dose (microg)		
	Low	Medium	High
*Fluticasone furoate**	—	100	200
Fluticasone propionate	100–200	250–500	>500

† Dose equivalents for *Qvar* (TGA-registered CFC-free formulation of beclometasone dipropionate).

*Fluticasone furoate is not available as a low dose. TGA-registered formulations of fluticasone furoate contain a medium or high dose of fluticasone furoate and should only be prescribed as one inhalation once daily.

Note: The potency of generic formulations may differ from that of original formulations. Check TGA-approved product information for details.

Sources

Respiratory Expert Group, Therapeutic Guidelines Limited. *Therapeutic Guidelines: Respiratory, Version 4*. Therapeutic Guidelines Limited, Melbourne, 2009.

GlaxoSmithKline Australia Pty Ltd. Product Information: *Breo (fluticasone furoate; vilanterol) Ellipta*. Therapeutic Goods Administration, Canberra, 2014. Available from: https://www.ebs.tga.gov.au/

GlaxoSmithKline Australia Pty Ltd. Product Information: *Arnuity (fluticasone furoate) Ellipta*. Therapeutic Goods Administration, Canberra, 2016. Available from: https://www.ebs.tga.gov.au/

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Clinical benefits

Inhaled corticosteroids are the most effective preventer medicines for adults.[22]

Inhaled corticosteroids are effective in reducing asthma symptoms, improving quality of life, improving lung function, decreasing airway hyperresponsiveness, controlling airway inflammation, reducing the frequency and severity of asthma flare-ups, and reducing the risk of death due to asthma.[1, 3, 4, 5, 9, 10, 11, 12, 13, 23]

Most adults with asthma benefit from regular inhaled corticosteroid treatment

The current recommendation to initiate inhaled corticosteroid treatment for adults with asthma symptoms twice or more during the past month, or who experience waking due to asthma symptoms once or more during the past month, is based on consideration of clinical trial evidence that even patients with infrequent symptoms benefit from regular use of inhaled corticosteroids:

- In patients with recent-onset (diagnosis within 2 years) mild asthma (45% with symptoms 2 days/week or less), low-dose inhaled corticosteroid (budesonide 400 microg/day) reduced the risk of severe flare-ups, increased symptom-free days and lung function, and protected against long-term decline in lung function associated with severe asthma flare-ups (evidence from a 5-year large randomised clinical trial).[5, 10, 11]
- In small clinical trials in adults with symptoms or reliever use twice per week or less, the use of regular inhaled corticosteroids (fluticasone propionate 250 microg/day) improved lung function,[7] reduced airway hyperresponsiveness and inflammation,[7, 8] and reduced the risk of mild flare-ups.[7, 8]

The current recommendation replaces the previous higher threshold for inhaled corticosteroid treatment (asthma symptoms three times a week or more, or waking at least one night per week with asthma symptoms), which was based on consensus.

Clinical benefits are achieved with low doses

Low doses of inhaled corticosteroids are sufficient to achieve benefits in most patients:

- Regular use of low-dose inhaled corticosteroids reduced the risk of hospitalisation for acute asthma and death due to asthma (evidence from a large population cohort study).[12] In that study, breaks in the use of inhaled corticosteroid of up to 3 months were associated with increased risk of death.[13]
- In adults and adolescents with mild asthma who were not taking inhaled corticosteroids, starting low-dose inhaled corticosteroid (budesonide 200 microg/day) reduced the risk of asthma flare-ups severe enough to require oral corticosteroids, and improved symptom control (evidence from a large clinical trial).[9]
- In patients with recent-onset (diagnosis within 2 years) mild asthma (45% with symptoms 2 days/week or less), low-dose inhaled corticosteroid (budesonide 400 microg/day) reduced the risk of severe flare-ups, increased symptom-free days and lung function, and protected against long-term decline in lung function associated with severe asthma flare-ups (evidence from a 5-year large

randomised clinical trial).[5, 10, 11]

Note: PBS status as at March 2019: Fluticasone furoate is not subsidised by the PBS, except in combination with vilanterol.

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Inhaled corticosteroids for adults: doses

Most of the benefit of inhaled corticosteroid is achieved with doses at the upper limit of the low-dose range (i.e. equivalent to 400 microg budesonide per day,[24, 25] 200 microg HFA beclometasone, 160 microg ciclesonide or 200 microg fluticasone propionate).

On average, higher doses provide relatively little extra benefit, but are associated with a higher risk of adverse effects.[2] However, a small proportion of individuals may need a higher dose to achieve asthma control.[2, 24, 25]

The recommendation to start inhaled corticosteroid at low dose is based on the following evidence.

A meta-analysis of results from randomised controlled trials comparing different doses of inhaled corticosteroids showed:

- An effective starting dose is 200–400 microg/day for fluticasone propionate, 400–800 microg/day for budesonide, or 200–400 microg/day beclometasone.[26]
- A starting dose higher than 800 microg/day budesonide, 400 microg/day fluticasone propionate, or 400 microg beclometasone does not provide enough clinical benefit over lower doses to warrant routinely starting with high doses.[26]
- Starting with a moderate dose of inhaled corticosteroid is as effective as commencing with a high dose and down-titrating.[26] Although it may be reasonable to use a high starting dose then reduce the dose, down-titration cannot be ensured in practice (e.g. if the person does not return for planned review).
- High doses of inhaled corticosteroids may be more effective than a moderate or low dose for controlling airway hyperresponsiveness,[26] but this may not equate to a clinical benefit.

Meta-analyses[6, 27] of inhaled corticosteroid safety have shown that the risk of local adverse effects (e.g. hoarseness, oral candidiasis) and the risk of systemic adverse effects (e.g. changes in hypothalamic-pituitary-adrenal function) increase significantly at higher doses. The risk of adrenal suppression should be considered whenever high doses are used (particularly of more potent inhaled corticosteroids), or when the patient uses concomitant medicines that inhibit cytochrome P450 (e.g. ritonavir, erythromycin or ketoconazole).

Notes

Dose equivalent for beclometasone applies to *Qvar* CFC-free formulation. Other brands may differ.

Do not use beclometasone dose recommendations from outdated or overseas guidelines based on older formulations containing CFC propellant – doses are different.

Table. Definitions of ICS dose levels in adults

Inhaled corticosteroid	Daily dose (microg)		
	Low	Medium	High
Beclometasone dipropionate †	100–200	250–400	>400
Budesonide	200–400	500–800	>800
Ciclesonide	80–160	240–320	>320
*Fluticasone furoate**	—	100	200
Fluticasone propionate	100–200	250–500	>500

† Dose equivalents for *Qvar* (TGA-registered CFC-free formulation of beclometasone dipropionate).

*Fluticasone furoate is not available as a low dose. TGA-registered formulations of fluticasone furoate contain a medium or high dose of fluticasone furoate and should only be prescribed as one inhalation once daily.

Note: The potency of generic formulations may differ from that of original formulations. Check TGA-approved product information

for details.

Sources

Respiratory Expert Group, Therapeutic Guidelines Limited. *Therapeutic Guidelines: Respiratory, Version 4*. Therapeutic Guidelines Limited, Melbourne, 2009.

GlaxoSmithKline Australia Pty Ltd. Product Information: *Breo (fluticasone furoate; vilanterol) Ellipta*. Therapeutic Goods Administration, Canberra, 2014. Available from: https://www.ebs.tga.gov.au/

GlaxoSmithKline Australia Pty Ltd. Product Information: *Arnuity (fluticasone furoate) Ellipta*. Therapeutic Goods Administration, Canberra, 2016. Available from: https://www.ebs.tga.gov.au/

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Inhaled corticosteroids for adults: adverse effects

Local adverse effects

Hoarseness (dysphonia) and candidiasis are the most common local adverse effects of inhaled corticosteroids with both pressurised metered-dose inhalers and dry-powder inhalers:[15]

- The rate of of dysphonia among patients taking inhaled corticosteroids has been estimated at 5–20%.[28] However, higher rates of up to 58% have been reported in some studies.[29] The risk varies with the device used.
- The rate of oropharyngeal candidiasis among adults using inhaled corticosteroids has been estimated at 5–7%, with positive mouth culture for *Candida albicans* in approximately 25% of patients. However, higher rates of up to 70% have been reported in some studies. The risk depends on the formulation, dose and dose frequency.[28]

When taking inhaled corticosteroids via pressurised metered-dose inhalers, the use of a spacer reduces the risk of dysphonia and candidiasis.[30] Spacers improve delivery of the medicine to the airways.

Quick mouth rinsing immediately after inhaling effectively removes a high proportion of remaining medicine.[16] This may reduce the risk of oropharyngeal candidiasis ('thrush').

The incidence of dysphonia and candidiasis is significantly lower with ciclesonide than with equivalent doses of fluticasone propionate.[31] This may an important consideration for patients who experience dysphonia, particularly for those for whom voice quality is important (e.g. singers, actors, teachers). With ciclesonide, the rate of adverse effects may not differ when taken with or without a spacer.[32]

▶ Go to: National Asthma Council Australia's *Inhaler technique in adults with asthma or COPD* information paper

Systemic adverse effects

Cross-sectional population studies have reported lower bone mineral density with long-term use of high doses of inhaled corticosteroid,[33] but the effect on fracture risk in patients with asthma is unclear.

A meta-analysis of randomised controlled trials in adults older than 40 years with COPD (in which osteoporosis is more common) or asthma found no association between the use of inhaled corticosteroid and fracture risk overall, but found a slight increase in fracture risk among those using high doses.[34]

Cross-sectional studies show a dose–response relationship between inhaled corticosteroid use for asthma or COPD, and risk of cataracts in adults.[35]

Long-term inhaled corticosteroid use for asthma or COPD is associated with a small increase in the risk of developing diabetes, and in the risk of diabetes progression. These risks are greatest at higher doses (equivalent to fluticasone propionate 1000 microg/day or higher).[36]

The incidence of osteoporosis, cataracts and diabetes increases with age, and these conditions are also more common in smokers and in patients with COPD. Few studies have assessed risk specifically in patients with asthma.

Patients at risk of osteoporosis should be referred for bone density screening, screened for vitamin D and/or calcium deficiency, and provided with advice about maintaining bone health.

▶ Go to: Australian and New Zealand Bone and Mineral Society's *Vitamin D and health in adults in Australia and New Zealand: a position statement*
Go to: Osteoporosis Australia's *Building healthy bones throughout life: an evidence-informed strategy to prevent osteoporosis in Australia*

Patient concerns about adverse effects

The prevalence of side effects that patients consider troubling increases with increasing dose of inhaled corticosteroids.[37] Mid and high doses are consistently associated with a higher intensity and a higher prevalence of reported adverse effects, after controlling for other factors.[37]

A high proportion of people with asthma may have misunderstandings and fears about using inhaled corticosteroids,[38, 39] such as fears about weight gain, unwanted muscle development, bone fractures, susceptibility to infections and reduction of efficacy of the medicine over time.[38] Most people do not discuss their concerns about inhaled corticosteroid treatment with health professionals.[38] Safety concerns are a major reason for poor adherence, particularly general concerns about corticosteroids rather than concerns about specific adverse effects.[40]

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Inhaled corticosteroids for adults and adolescents: particle size

Medicines with small particle size CFC-free beclometasone [*Qvar*] and ciclesonide) achieve a greater proportion of medicine deposited in the lungs·[41] and are potentially distributed more widely in the large, intermediate, and small airways.[41] Although there are theoretical advantages with fine-particle formulations, including in severe asthma, the clinical implications have not been established.[42]

Randomised controlled trials comparing ciclesonide with fluticasone propionate in adults and adolescents have observed lower rates of patient-reported side-effects,[43] and confirmed dysphonia and oral candidiasis,[31] among patients using ciclesonide than among those using fluticasone propionate.

A small randomised controlled trial reported that ciclesonide treatment reduced sputum eosinophil counts in patients with refractory asthma who has previously shown persistent airway eosinophilia despite high-dose inhaled corticosteroids.[44] However, this study did not provide any comparison with a higher dose of the patient's existing inhaled corticosteroid.

Evidence from clinical trials of ciclesonide is limited. There have been no high quality double-blind studies to date, and observational studies have not been properly designed to avoid confounding factors such as prescriber bias.[42]

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Inhaled corticosteroid/long-acting beta-2 agonist combinations for adults: overview

- To avoid the possibility of patients taking a long-acting beta$_2$ agonist without an inhaled corticosteroid, long-acting beta$_2$ agonists should (whenever possible) be prescribed as inhaled corticosteroid/long-acting beta$_2$ agonist combination in a single inhaler, rather than in separate inhalers. If no combination product is available for the desired medications, carefully explain to the patient that it is very important that they continue taking the inhaled corticosteroid.

Meta-analysis of evidence from randomised controlled clinical trials shows that, for adult patients already taking an inhaled corticosteroid, concomitant treatment with an inhaled corticosteroid and a long-acting beta$_2$ agonist:[1]

- reduces the risk of flare-ups, compared with increasing the dose of corticosteroids
- reduces the risk of flare-ups, compared with inhaled corticosteroids alone.

The studies included in this meta-analysis evaluated mainly budesonide/formoterol and fluticasone propionate/salmeterol.[1]

Each of the following inhaled corticosteroid/long-acting beta$_2$ agonist combinations is available as a single inhaler:

- budesonide/formoterol
- fluticasone furoate/vilanterol
- fluticasone propionate/salmeterol
- fluticasone propionate/formoterol.

There are two types of dosing regimens for inhaled corticosteroid/long-acting beta$_2$ agonist combination therapy:

- maintenance-only regimens (applicable to all available combinations)
- maintenance-and-reliever regimen (applicable only to the budesonide/formoterol combination).

Maintenance-only regimens

The fluticasone propionate/salmeterol combination and budesonide/formoterol combination appear to be equally effective when used for regular maintenance treatment, based on meta-analysis of evidence from clinical trials.[45] Most of the evidence for inhaled corticosteroid/long-acting beta$_2$ agonist combination therapy is from studies using these combinations.

Less evidence from double-blind randomised controlled clinical trials is available for the newer combinations: fluticasone furoate/vilanterol and fluticasone propionate/formoterol:

- The fluticasone furoate/vilanterol combination is equivalent to a medium-to-high dose of inhaled corticosteroids.[46] In adults and adolescents already taking inhaled corticosteroids, once-daily fluticasone furoate/vilanterol 100/25 microg reduced the risk of

severe flare-ups (requiring oral corticosteroids or hospitalisation) and improved lung function, compared with fluticasone furoate alone.[47] Efficacy data for the comparison of fluticasone furoate/vilanterol with other inhaled corticosteroid/long-acting beta$_2$ agonist combinations is not available.
- In adults and adolescents with persistent asthma and FEV$_1$ 50–80% at baseline, fluticasone propionate/formoterol achieved improvement in FEV$_1$ comparable to that achieved with budesonide/formoterol in a 12-week randomised double-blind clinical trial.[48] Other 12-week open-label studies have reported that fluticasone propionate/formoterol was as effective as budesonide/formoterol in improving lung function in adults and adolescents with poorly controlled asthma,[49] and was as effective as fluticasone propionate/salmeterol in adults.[50]

Long-acting beta$_2$ agonists should not be used without inhaled corticosteroids in the management of asthma.[17, 18, 19, 20] Long-acting beta$_2$ agonists are well tolerated when given in combination with inhaled corticosteroids.[45, 51]

Maintenance-and-reliever regimen

The low-dose budesonide/formoterol combination can be used as both maintenance and reliever. Under this regimen, the combination is used for relief of asthma symptoms (instead of using a short-acting beta$_2$ agonist reliever), in addition to its use as regular maintenance treatment.

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Combination budesonide/formoterol maintenance-and-reliever regimen in adults and adolescents: overview of efficacy

Low-dose budesonide/formoterol combination can be used as reliever for asthma symptoms (instead of using a short-acting beta$_2$ agonist reliever), in addition to its use as regular long-term preventer treatment.[52, 53, 54, 55, 56, 57] The following formulations can be used in maintenance-and-reliever regimens:

- dry-powder inhaler (*Symbicort Turbuhaler*) 100/6 microg or 200/6 microg
- pressurised metered-dose inhaler (*Symbicort Rapihaler*) 50/3 microg or 100/3 microg.

Neither the 400/12 microg dry-powder inhaler nor the 200/6 microg pressurised metered-dose inhaler should be used in this way.

Overall, clinical trials show that budesonide/formoterol combination as maintenance and reliever reduces the risk of flare-ups that require oral corticosteroids, compared with other current preventer regimens and compared with a fixed higher dose of inhaled corticosteroids.[58]

Pooled data from five randomised controlled trials assessing budesonide/formoterol maintenance-and-reliever regimens showed that similar or better levels of asthma control were achieved with budesonide/formoterol maintenance-and-reliever compared with the conventional maintenance regimen comparators:[54]

- higher-dose budesonide
- same dose budesonide/formoterol
- higher-dose inhaled corticosteroid/long-acting beta$_2$ agonist (budesonide/formoterol or fluticasone propionate/salmeterol).

In randomised clinical trials in patients with a history of asthma flare-up within the previous 12 months (and therefore at greater risk of flare-up in the next 12 months), the use of formoterol/budesonide as maintenance-and-reliever regimen reduced the risk of asthma flare-ups that required treatment with oral corticosteroids, compared with the use of any of the following (plus a short-acting beta$_2$ agonist reliever as needed):[54, 59, 60]

- the same combination as maintenance treatment only
- higher-dose combination as maintenance treatment only
- higher-dose inhaled corticosteroids.

Meta-analysis of six randomised controlled trials found that maintenance-and-reliever treatment with budesonide/formoterol reduced the risk of severe asthma flare-ups (use of oral corticosteroids for 3 days or more, hospitalisation or emergency department visits), compared with higher-dose inhaled corticosteroid alone, or in combination with a long-acting beta$_2$ agonist.[61]

In open-label studies in which patients were not selected for a previous history of flare-ups, there was no overall difference in time to first flare-up between budesonide/formoterol as maintenance-and-reliever regimen and conventional maintenance regimens (including inhaled corticosteroid or inhaled corticosteroid/long-acting beta$_2$ agonist combinations, leukotriene receptor antagonists, xanthines or any other asthma medicines) with rapid-onset beta$_2$ agonist reliever (selected according to clinician's choice).[62] However, the inhaled corticosteroid dose was higher with conventional maintenance regimens.

Note: The fluticasone propionate/formoterol combination is approved by the Therapeutic Goods Administration only for regular maintenance therapy.

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Correct use of inhaler devices

Checking and correcting inhaler technique is essential to effective asthma management.

Most patients with asthma or COPD do not use their inhalers properly,[63, 64,65, 65, 66] and most have not had their technique checked or corrected by a health professional.

Incorrect inhaler technique when using maintenance treatments increases the risk of severe flare-ups and hospitalisation for people with asthma or COPD.[63, 64, 67, 68, 69, 70]

Poor asthma symptom control is often due to incorrect inhaler technique.[71, 72]

Incorrect inhaler technique when using inhaled corticosteroids increases the risk of local side effects like dysphonia and oral thrush.

The steps for using an inhaler device correctly differ between brands. Checklists of correct steps for each inhaler type and how-to videos are available from the National Asthma Council website.

▶ Go to: National Asthma Council Australia's *Using your inhaler* webpage for information, patient resources and videos on inhaler technique
Go to: National Asthma Council Australia's information paper for health professionals on *Inhaler technique for people with asthma or COPD*
Go to: NPS MedicineWise information on *Inhaler devices for respiratory medicines*

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Prescribing other preventers for adults

Recommendations

Montelukast is less effective than inhaled corticosteroids for controlling asthma symptoms and reducing flare-ups in adults, but it may be considered as an alternative for (either of):

- **the extremely small proportion of people who experience intolerable dysphonia with inhaled corticosteroids despite correct inhaler technique and use of a spacer**
- **people who refuse other preventer options, despite explanation of relative benefits and risks.**

Note: PBS status as at March 2019: Montelukast treatment is not subsidised by the PBS for people aged 15 years or over. Special Authority is available for DVA gold card holders, or white card holders with approval for asthma treatments.

- **Montelukast use has been associated with neuropsychiatric adverse effects, including suicidality.**

▶ **Go to:** *TGA alert*

How this recommendation was developed

Consensus

Based on clinical experience and expert opinion (informed by evidence, where available), with particular reference to the following source(s):

- Ducharme 2004[1]
- Lazarus *et al.* 2007[2]
- Peters-Golden *et al.* 2006[3]
- Weiler *et al.* 2010[4]

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When starting regular montelukast, prescribe standard adult dose and review response 6–8 weeks later. (Also review during this interval, if appropriate.)

Follow the steps for conducting a treatment trial.

Table. Steps for conducting a treatment trial

1. **Document baseline lung function.**
2. **Document baseline asthma control using a validated standardised tool such as the Asthma Score.**
3. **Discuss treatment goals and potential adverse effects with the person.**
4. **Run treatment trial for agreed period (e.g. 4–8 weeks, depending on the treatment and clinical circumstances, including urgency).**
5. **At an agreed interval, measure asthma control and lung function again and document any adverse effects.**
6. **If asthma control has not improved despite correct inhaler technique and good adherence, resume previous treatment and consider referral for specialist consultation.**

▶ **See:** *Asthma Score (Asthma Control Test)*

Asset ID: 36

How this recommendation was developed

Consensus

Based on clinical experience and expert opinion (informed by evidence, where available).

Although cromones are less effective than inhaled corticosteroid in controlling asthma and improving lung function, they may be considered for (any of):

- **people who choose not to take inhaled corticosteroids**
- **people who cannot tolerate inhaled corticosteroids**
- **people with symptoms limited to exercise-induced bronchoconstriction.**

How this recommendation was developed

Consensus

Based on clinical experience and expert opinion (informed by evidence, where available), with particular reference to the following source(s):

- Guevara *et al.* 2006[5]
- Spooner *et al.* 2003[6]
- Weiler *et al.* 2010[4]

If considering sodium cromoglycate or nedocromil, explain to patients that the medicine must be taken multiple times per day, and that the device requires daily maintenance, and explain how to do this before prescribing. (Cromones are rarely prescribed to manage asthma in adults.)

How this recommendation was developed

Consensus

Based on clinical experience and expert opinion (informed by evidence, where available).

More information

Montelukast for adults: efficacy

In adults and adolescents with asthma that is not controlled by low-dose inhaled corticosteroid, the addition of a leukotriene receptor antagonist is less effective than the addition of a long-acting beta$_2$ agonist in reducing the rate of asthma flare-ups that require

treatment with oral corticosteroids.[1] The addition of a leukotriene receptor antagonist is also associated with lesser improvement in lung function and quality of life than the addition of a long-acting beta$_2$ agonist.[1]

Montelukast taken 1 hour before exercise can be used to manage exercise-induced bronchoconstriction, but it is less effective than short-acting beta$_2$ agonists.[4]

Montelukast may improve lung function, reduce short-acting beta2 bronchodilator use, reduce symptoms, and improve quality of life in patients with aspirin-exacerbated respiratory disease.[7]

Montelukast is sometimes prescribed as add-on treatment for adults with severe asthma. Current evidence does not support its long-term use unless the patient shows a clear improvement in symptoms during a treatment trial.[8]

▶ Go to: *Investigation and management of exercise-induced bronchoconstriction*

Note: PBS status as at March 2019: Montelukast treatment is not subsidised by the PBS for people aged 15 years or over. Special Authority is available for DVA gold card holders or white card holders with approval for asthma treatments.

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Montelukast for adults and adolescents: psychiatric effects

Post-marketing surveillance reports led to concerns about a possible association between leukotriene receptor antagonist use and suicide risk.[9] A recent case-control study reported a statistically significant association between the use of leukotriene receptor antagonists and suicide attempts in people aged 19–24 years. However, this association was no longer statistically significant after adjusting for potential confounding factors, including previous exposure to other asthma medicines and previous exposure to other medicines associated with suicide.[9]

▶ Go to: *TGA alert*

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Cromones for adults and adolescents

Sodium cromoglycate is less effective than inhaled corticosteroids in controlling asthma and improving lung function.[5]

Cromolyn sodium and nedocromil sodium taken before exercise can be used to manage exercise-induced bronchoconstriction, but they are only effective in approximately 50% of patients[4] and are less effective than short-acting beta$_2$ agonists.[6]

Cromones have a good safety profile and tolerance does not occur when either of these medicines is taken regularly.[4] Maintenance of the CFC-free device is difficult for patients because the formulation is sticky and blocks the device unless it is washed and thoroughly dried every day. Therefore, patients need two mouthpieces to use alternately.

▶ See: *Investigation and management of exercise-induced bronchoconstriction*

Adherence to preventer treatment: adults and adolescents

Most patients do not take their preventer medication as often as prescribed, particularly when symptoms improve, or are mild or infrequent. Whenever asthma control is poor despite apparently adequate treatment, poor adherence, as well as poor inhaler technique, are probable reasons to consider.

Poor adherence may be intentional and/or unintentional. Intentional poor adherence may be due to the person's belief that the medicine is not necessary, or to perceived or actual adverse effects. Unintentional poor adherence may be due to forgetting or cost barriers.

Common barriers to the correct use of preventers include:

- being unable to afford the cost of medicines or consultations to adjust the regimen
- concerns about side effects
- interference of the regimen with the person's lifestyle
- forgetting to take medicines
- lack of understanding of the reason for taking the medicines
- inability to use the inhaler device correctly due to physical or cognitive factors
- health beliefs that are in conflict with the belief that the prescribed medicines are effective, necessary or safe (e.g. a belief that the prescribed preventer dose is 'too strong' or only for flare-ups, a belief that asthma can be overcome by psychological effort, a belief that complementary and alternative therapies are more effective or appropriate than prescribed medicines, mistrust of the health professional).

Adherence to preventers is significantly improved when patients are given the opportunity to negotiate the treatment regimen based on their goals and preferences.[10]

Assessment of adherence requires an open, non-judgemental approach.

Accredited pharmacists who undertake Home Medicines Reviews can assess adherence while conducting a review.

Table. Suggested questions to ask adults and older adolescents when assessing adherence to treatment

1. *Many people don't take their medication as prescribed. In the last four weeks:*
   - how many days a week would you have taken your preventer medication? None at all? One? Two? (etc).
   - how many times a day would you take it? Morning only? Evening only? Morning and evening? (or other)
   - each time, how many puffs would you take? One? Two? (etc).
2. *Do you find it easier to remember your medication in the morning, or the evening?*

Source: Foster JM, Smith L, Bosnic-Anticevich SZ et al. Identifying patient-specific beliefs and behaviours for conversations about adherence in asthma. *Intern Med J* 2012; 42: e136-e44. Available from: http://www.ncbi.nlm.nih.gov/pubmed/21627747

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▶ Go to: Medicare's *Home Medicines Review (HMR)*

Correct use of inhaler devices

Checking and correcting inhaler technique is essential to effective asthma management.

Most patients with asthma or COPD do not use their inhalers properly,[11, 12,13, 13, 14] and most have not had their technique checked or corrected by a health professional.

Incorrect inhaler technique when using maintenance treatments increases the risk of severe flare-ups and hospitalisation for people with asthma or COPD.[11, 12, 15, 16, 17, 18]

Poor asthma symptom control is often due to incorrect inhaler technique.[19, 20]

Incorrect inhaler technique when using inhaled corticosteroids increases the risk of local side effects like dysphonia and oral thrush.

The steps for using an inhaler device correctly differ between brands. Checklists of correct steps for each inhaler type and how-to videos are available from the National Asthma Council website.

▶ Go to: National Asthma Council Australia's *Using your inhaler* webpage for information, patient resources and videos on inhaler technique
Go to: National Asthma Council Australia's information paper for health professionals on *Inhaler technique for people with asthma or COPD*
Go to: NPS MedicineWise information on *Inhaler devices for respiratory medicines*

Last reviewed version 2.0

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Adjusting treatment in adults by stepping up or stepping down

In this section

Stepping up

Stepping up asthma treatment in adults and adolescents

http://www.asthmahandbook.org.au/management/adults/stepped-adjustment/stepping-up

Stepping down

Stepping down asthma treatment in adults and adolescents

http://www.asthmahandbook.org.au/management/adults/stepped-adjustment/stepping-down

Stepping up treatment in adults

Recommendations

Before considering any increase in dose or addition to treatment regimen (step up), document the person's current level of asthma control and risk factors. Carefully check (all of):

- **adherence**
- **inhaler technique**
- **exposure to triggers**
- **the possibility that symptoms are due to comorbid or alternative diagnoses (e.g. allergic rhinitis or rhinosinusitis, de-conditioning, obesity, cardiac disease or upper airway dysfunction).**

Table. Definition of levels of recent asthma symptom control in adults and adolescents (regardless of current treatment regimen)

Good control	Partial control	Poor control
All of: • **Daytime symptoms ≤2 days per week** • **Need for SABA reliever ≤2 days per week†** • **No limitation of activities** • **No symptoms during night or on waking**	**One or two of:** • **Daytime symptoms >2 days per week** • **Need for SABA reliever >2 days per week†** • **Any limitation of activities** • **Any symptoms during night or on waking**	**Three or more of:** • **Daytime symptoms >2 days per week** • **Need for SABA reliever >2 days per week†** • **Any limitation of activities** • **Any symptoms during night or on waking**

SABA: short-acting beta$_2$-agonist

† SABA, not including doses taken prophylactically before exercise. (Record this separately and take into account when assessing management.)

Note: Recent asthma symptom control is based on symptoms over the previous 4 weeks.

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Table. Risk factors for adverse asthma outcomes in adults and adolescents

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Table. Management of risk factors for adverse asthma outcomes in adults

Risk factor	Clinical action †
Any risk factor for flare-ups	**Check patient has an appropriate action plan** **Carefully check inhaler technique and adherence, and identify any barriers**

Risk factor	Clinical action †
	to good adherence **Review frequently (e.g. every 3 months)**
Hospitalisation or ED visit for asthma or any asthma flare-up during the previous 12 months	**Ask about triggers for flare-ups, and lead time**
History of intubation or intensive care unit admission for asthma	**Ensure action plan recommends early medical review when asthma worsens**
Hospitalisation or ED visit for asthma in the past month	**Emphasise importance of maintaining regular ICS use after symptoms improve** **Confirm that patient has resumed using SABA only when needed for symptoms**
High SABA use (>3 canisters per year)	**Check lung function** **If SABA use appears to be habitual, investigate causes and consider alternative strategies, e.g. short-term substitution of ipratropium for SABA**
Long-term high-dose ICS	**Consider gradual reduction of ICS dose if symptoms stable** **Monitor regularly (e.g. assessment of bone density, regular eye examinations)** **For local side-effects, ensure inhaler technique is appropriate**
Poor lung function (even if few symptoms)	**Consider 3-month trial of higher ICS dose, then recheck lung function** **Consider referral for detailed specialist investigation**
Sensitivity to unavoidable allergens (e.g. **Alternaria** *species of common moulds)*	**Refer for further investigation and management**
Exposure to cigarette smoke (smoking or environmental exposure)	**Emphasise the importance of avoiding smoke** **Provide quitting strategies** **Consider increasing ICS dose (higher dose of ICS likely to be necessary to control asthma)** **Refer for assessment of asthma–COPD overlap**
Difficulty perceiving airflow limitation or the severity of exacerbations	**Regular PEF monitoring** **Action plan should recommend early review and measurement of lung function**
No current written asthma action plan	**Provide and explain written asthma action plan**

† In addition to actions applicable to all risk factors

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How this recommendation was developed

Consensus

Based on clinical experience and expert opinion (informed by evidence, where available).

If asthma is only partly controlled despite low-dose inhaled corticosteroids, good adherence and correct inhaler technique, consider stepping up to a low dose of an inhaled corticosteroid/long-acting beta$_2$ agonist combination.

Note: TGA-registered fluticasone furoate/vilanterol combinations contain moderate-to-high doses of inhaled corticosteroid (100/25 microg and 200/25 microg respectively).

Figure. Stepped approach to adjusting asthma medication in adults and adolescents

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Table. Guide to selecting and adjusting asthma medication for adults and older adolescents

Clinical situation	Action
Newly diagnosed asthma	**Consider low-dose ICS (plus SABA as needed)** **If symptoms severe at initial presentation, consider one of:** • **ICS plus a short course of oral corticosteroids** • **a short initial period of high-dose ICS then step down** • **(private prescription) combination ICS/LABA†** **See:** *Table. Initial treatment choices (adults and adolescents not already using a preventer)*
Good recent asthma symptom control	**If maintained 2–3 months, no flare-up in previous 12 months and low risk for flare-ups, step down where possible (unless already on low-dose ICS)**
Partial recent asthma symptom control	**Review inhaler technique and adherence – correct if suboptimal** **If no improvement, consider increasing treatment by one step and reviewing (if still no improvement, return to previous step, review diagnosis and consider referral)**
Poor recent asthma symptom control	**Review inhaler technique and adherence – correct if suboptimal** **Confirm that symptoms are likely to be due to asthma** **Consider increasing treatment until good asthma control is achieved, then step down again when possible**
Difficult-to-treat asthma ‡	**Consider referral for assessment or add-on options**
Patient with risk factors §	**Tailor treatment to reduce individual risk factors**

† PBS status as at March 2019: ICS/LABA combination therapy as first-line preventer treatment is not subsidised by the PBS, except for patients with frequent symptoms while taking oral corticosteroids.

‡ Poor recent asthma symptom control despite ICS/LABA combination at high–medium dose.

§ Risk factors for asthma events or adverse treatment effects, irrespective of level of recent asthma symptom control.

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How this recommendation was developed

Consensus

Based on clinical experience and expert opinion (informed by evidence, where available), with particular reference to the following source(s):

- Sin *et al.* 2004[1]
- Ducharme *et al.* 2010[2]
- Ducharme *et al.* 2010[3]
- Ducharme *et al.* 2011[4]
- Gibson *et al.* 2005[5]

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The combination of budesonide/formoterol can be used as maintenance-and-reliever treatment.

For patients using the maintenance-and-reliever regimen, prescribe a standard initial maintenance dose of (any of):

- **100/6 microg dry-powder inhaler – two actuations twice daily**
- **200/6 microg dry-powder inhaler – one or two actuations twice daily**
- **50/3 microg pressurised metered-dose inhaler – two or four actuations twice daily**
- **100/3 microg pressurised metered-dose inhaler – two or four actuations twice daily.**

Instruct the patient to take extra as-needed doses for relief of symptoms (1 extra actuation for dry-powder inhalers or 2 actuations for pressurised metered-dose inhalers, repeated after several minutes if symptoms persist, up to a maximum of 72 microg formoterol per day in total).

Note: The following formulations should not be used in maintenance-and-reliever regimens:

- **400/12 microg dry-powder inhaler**
- **200/6 microg pressurised metered-dose inhaler.**

How this recommendation was developed

Consensus

Based on clinical experience and expert opinion (informed by evidence, where available), with particular reference to the following source(s):

- Aubier *et al.* 2011[6]
- Aubier *et al.* 2010[7]
- AstraZeneca Pty Ltd 2010[8]
- AstraZeneca Pty Ltd 2012[9]
- Bateman *et al.* 2010[10]
- Bousquet *et al.* 2007[11]
- Demoly *et al.* 2009[12]
- Lundborg *et al.* 2006[13]
- Kuna *et al.* 2007[14]
- Patel *et al.* 2013[15]
- Reddel *et al.* 2011[16]
- Taylor *et al.* 2008[17]
- Vogelmeier *et al.* 2005[18]

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For most patients, high doses of inhaled corticosteroids should be used for short periods only. If a patient seems to need prolonged high-dose inhaled corticosteroids to control asthma, refer to a specialist for assessment.

Table. Definitions of ICS dose levels in adults

Inhaled corticosteroid	Daily dose (microg)		
	Low	Medium	High
Beclometasone dipropionate †	100–200	250–400	>400
Budesonide	200–400	500–800	>800
Ciclesonide	80–160	240–320	>320
*Fluticasone furoate**	—	100	200
Fluticasone propionate	100–200	250–500	>500

† Dose equivalents for *Qvar* **(TGA-registered CFC-free formulation of beclometasone dipropionate).**

***Fluticasone furoate is not available as a low dose. TGA-registered formulations of fluticasone furoate contain a medium or high dose of fluticasone furoate and should only be prescribed as one inhalation once daily.**

Note: The potency of generic formulations may differ from that of original formulations. Check TGA-approved product information for details.

Sources

Respiratory Expert Group, Therapeutic Guidelines Limited. *Therapeutic Guidelines: Respiratory, Version 4*. **Therapeutic Guidelines Limited, Melbourne, 2009.**

GlaxoSmithKline Australia Pty Ltd. Product Information: *Breo (fluticasone furoate; vilanterol) Ellipta*. **Therapeutic Goods Administration, Canberra, 2014. Available from: https://www.ebs.tga.gov.au/**

GlaxoSmithKline Australia Pty Ltd. Product Information: *Arnuity (fluticasone furoate) Ellipta*. **Therapeutic Goods Administration, Canberra, 2016. Available from: https://www.ebs.tga.gov.au/**

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How this recommendation was developed

Consensus

Based on clinical experience and expert opinion (informed by evidence, where available).

If a patient taking maintenance preventer treatment has been using frequent short-acting beta$_2$ agonist reliever for a prolonged period (e.g. 6–8 puffs per day for several weeks), and common causes of poor asthma control have been investigated and ruled out, consider referral to a respiratory physician.

How this recommendation was developed

Consensus

Based on clinical experience and expert opinion (informed by evidence, where available).

Occasionally, for a person who experiences a predictable seasonal pattern of asthma symptoms and has no asthma symptoms at all during the rest of the year, it may be appropriate to start treatment with inhaled corticosteroids beginning well before the predicted risk period and continuing throughout it.

For example, for patients with asthma who have allergic rhinitis in springtime and are sensitised to ryegrass pollen, but have no asthma symptoms at any other time of the year, consider prescribing an inhaled corticosteroid commencing at least 2 weeks (ideally 6 weeks) before the spring and summer thunderstorm season and discontinuing only after pollen levels decrease (e.g. in Victoria this would involve preventive treatment from 1 September to 31 December).

Note:

This applies to a very small proportion of patients only. Purely seasonal asthma is very rare in Australia. There is no available evidence on the safety of treating adults or adolescents with inhaled corticosteroids for only part of the year.

Refer to ASCIA's *Pollen calendar* for information on local high-risk periods.

How this recommendation was developed

Consensus

Based on clinical experience and expert opinion (informed by evidence, where available).

More information

Assessing risk factors for adverse asthma outcomes in adults

Predicting poor asthma outcomes

As well as assessing recent asthma symptom control, it is necessary to assess each patient's risk of future asthma events or adverse treatment effects. (Recent asthma symptom control and risk of adverse events are both components of overall asthma control.)

Table. Risk factors for adverse asthma outcomes in adults and adolescents Please view and print this figure separately: http://www.asthmahandbook.org.au/table/show/40

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Table. Risk factors for adverse asthma outcomes in adults and adolescents

Risk factors for adverse asthma outcomes in adults and adolescents

	Medical history	Investigation findings	Other factors
Factors associated with increased risk of flare-ups	Poor asthma control Any asthma flare-up during the previous 12 months Other concurrent chronic lung disease	Poor lung function (even if few symptoms) Difficulty perceiving airflow limitation or the severity of flare-ups Eosinophilic airway inflammation§	Exposure to cigarette smoke (smoking or environmental exposure) Socioeconomic disadvantage Use of illegal substances Major psychosocial problems Mental illness
Factors associated with increased risk of life-threatening asthma	Intubation or admission to intensive care unit due to asthma (ever) 2 or more hospitalisations for asthma in past year 3 or more ED visits for asthma in the past year	Sensitivity to an unavoidable allergen (e.g. *Alternaria* species of common moulds)	Inadequate treatment Experience of side-effects of OCS use (may contribute to under-treatment or delayed presentation to hospital during flare-ups) Lack of written asthma

	Medical history	Investigation findings	Other factors
	Hospitalisation or ED visit for asthma in the past month High short-acting beta$_2$ agonist use • Dispensing of 3 or more canisters in a year (average 1.6 puffs per day) is associated with increased risk of flare-ups in adults and children. • Dispensing 12 or more canisters in a year (average 6.6 puffs per day) is associated with increased risk of asthma death. History of delayed presentation to hospital during flare-ups History of sudden-onset acute asthma Cardiovascular disease		action plan Socioeconomic disadvantage Living alone Mental illness Use of alcohol or illegal substances Poor access to health care (e.g. rural/remote region)
Factors associated with accelerated decline in lung function	Chronic mucus hypersecretion Severe asthma flare-up in a patient not taking ICS	Poor lung function Eosinophilic airway inflammation[§]	Exposure to cigarette smoke (smoking or environmental exposure) Occupational asthma
Factors associated with treatment-related adverse events	Long-term high-dose ICS Frequent use of OCS		Anxiety disorder (due to increased sensitivity to asthma symptoms and reluctance to reduce ICS dose when asthma well controlled) Euphoria with OCS use

§ White cell differential count on a peripheral blood sample is not currently recommended routinely in the investigation and management of asthma, but might be undertaken in the investigation of severe asthma to help guide biologic therapy.

► See: *Monoclonal antibody therapy*

Sources

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Thomas M, Kay S, Pike J *et al.* The Asthma Control Test (ACT) as a predictor of GINA guideline-defined asthma control: analysis of a multinational cross-sectional survey. *Prim Care Respir J* 2009; 18: 41-9. Available from: http://www.nature.com/articles/pcrj200910

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Table. Management of risk factors for adverse asthma outcomes in adults

Risk factor	Clinical action †
Any risk factor for flare-ups	Check patient has an appropriate action plan Carefully check inhaler technique and adherence, and identify any barriers to good adherence Review frequently (e.g. every 3 months)
Hospitalisation or ED visit for asthma or any asthma flare-up during the previous 12 months	Ask about triggers for flare-ups, and lead time
History of intubation or intensive care unit admission for asthma	Ensure action plan recommends early medical review when asthma worsens
Hospitalisation or ED visit for asthma in the past month	Emphasise importance of maintaining regular ICS use after symptoms improve Confirm that patient has resumed using SABA only when needed for symptoms
High SABA use (>3 canisters per year)	Check lung function If SABA use appears to be habitual, investigate causes and consider alternative strategies, e.g. short-term substitution of ipratropium for SABA
Long-term high-dose ICS	Consider gradual reduction of ICS dose if symptoms stable Monitor regularly (e.g. assessment of bone density, regular eye examinations) For local side-effects, ensure inhaler technique is appropriate
Poor lung function (even if few	Consider 3-month trial of higher ICS dose, then recheck lung function

Risk factor	Clinical action †
symptoms)	Consider referral for detailed specialist investigation
Sensitivity to unavoidable allergens (e.g. **Alternaria** *species of common moulds)*	Refer for further investigation and management
Exposure to cigarette smoke (smoking or environmental exposure)	Emphasise the importance of avoiding smoke Provide quitting strategies Consider increasing ICS dose (higher dose of ICS likely to be necessary to control asthma) Refer for assessment of asthma–COPD overlap
Difficulty perceiving airflow limitation or the severity of exacerbations	Regular PEF monitoring Action plan should recommend early review and measurement of lung function
No current written asthma action plan	Provide and explain written asthma action plan

† In addition to actions applicable to all risk factors

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Poor clinical control, as indicated by frequent asthma symptoms and frequent reliever use, is a very strong predictor of the risk of flare-ups in the future. Any asthma flare-up during the previous 12 months indicates higher risk of flare-up over the next 12 months. A history of artificial ventilation due to acute asthma, and admission to an intensive care unit due to acute asthma have been associated with increased risk of near-fatal asthma,[19] but there is not enough evidence to indicate how long this risk may persist over a person's lifetime. Other risk factors indicate increased probability of future flare-ups or accelerated decline in lung function, independent of the person's level of recent asthma symptom control.[20, 21]

Other factors may increase a person's risk of treatment-associated adverse effects. The most important of these are prescription of high dose treatment and frequent courses of oral steroids.

People with risk factors need more frequent asthma review, a carefully tailored written asthma action plan, and close attention to adherence and correct inhaler technique.

Inflammatory markers

Inflammatory markers, such as sputum eosinophil percentage or exhaled nitric oxide, are used in research and for managing severe asthma in patients attending secondary or tertiary care. Elevated sputum eosinophil levels and, to a lesser extent, elevated exhaled nitric oxide, are associated with increased risk of flare-ups. At present, treatment based on inflammatory markers is not recommended for routine use in primary care.

The value of inflammatory markers is being evaluated:

- Adjusting asthma treatment by monitoring exhaled nitric oxide does not reduce the rate of flare-ups or improve asthma control in adults and children, compared with adjusting treatment according to clinical symptoms or spirometry, based on a meta-analysis of randomised controlled clinical trials.[22] However, many of the studies were not optimally designed to answer this question,[23] and some comparator regimens did not match current recommended treatment options.
- In some studies, asthma treatment algorithms based on monitoring sputum eosinophil counts reduced flare-ups, compared with control-based management.[17, 24] However, most studies assessing treatment guided by sputum eosinophilia have been conducted in selected populations in a few research centres, and therefore may not apply to the general community population. Assessment of sputum inflammatory cells is not generally available at present even in secondary care.
- Limited evidence[25] suggests that patients whose symptoms do not match their degree of eosinophilic inflammation may benefit more from treatment monitoring using sputum eosinophil count than other patients.
- Monitoring inflammatory markers might enable safer down-titration of maintenance inhaled corticosteroid doses.

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Inhaled corticosteroids for adults: overview

Inhaled corticosteroid preventer medicines available in Australia

The following inhaled corticosteroids are registered by the TGA:

- beclometasone dipropionate (low to high doses available)
- budesonide (low to high doses available, including in combination with a long-acting beta$_2$ agonist)
- ciclesonide (low to high doses available)
- fluticasone furoate (medium to high doses available, including in combination with a long-acting beta$_2$ agonist)
- fluticasone propionate (low to high doses available, including in combination with a long-acting beta$_2$ agonist)

Table. Definitions of ICS dose levels in adults

Inhaled corticosteroid	Daily dose (microg)		
	Low	Medium	High
Beclometasone dipropionate †	100–200	250–400	>400
Budesonide	200–400	500–800	>800
Ciclesonide	80–160	240–320	>320
*Fluticasone furoate**	—	100	200
Fluticasone propionate	100–200	250–500	>500

† Dose equivalents for *Qvar* (TGA-registered CFC-free formulation of beclometasone dipropionate).

*Fluticasone furoate is not available as a low dose. TGA-registered formulations of fluticasone furoate contain a medium or high dose of fluticasone furoate and should only be prescribed as one inhalation once daily.

Note: The potency of generic formulations may differ from that of original formulations. Check TGA-approved product information for details.

Sources

Respiratory Expert Group, Therapeutic Guidelines Limited. *Therapeutic Guidelines: Respiratory, Version 4*. Therapeutic Guidelines Limited, Melbourne, 2009.

GlaxoSmithKline Australia Pty Ltd. Product Information: *Breo (fluticasone furoate; vilanterol) Ellipta*. Therapeutic Goods Administration, Canberra, 2014. Available from: https://www.ebs.tga.gov.au/

GlaxoSmithKline Australia Pty Ltd. Product Information: *Arnuity (fluticasone furoate) Ellipta*. Therapeutic Goods Administration, Canberra, 2016. Available from: https://www.ebs.tga.gov.au/

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Clinical benefits

Inhaled corticosteroids are the most effective preventer medicines for adults.[26]

Inhaled corticosteroids are effective in reducing asthma symptoms, improving quality of life, improving lung function, decreasing airway hyperresponsiveness, controlling airway inflammation, reducing the frequency and severity of asthma flare-ups, and reducing the risk of death due to asthma.[1, 27, 28, 29, 30, 31, 32, 33, 34, 35]

Most adults with asthma benefit from regular inhaled corticosteroid treatment

The current recommendation to initiate inhaled corticosteroid treatment for adults with asthma symptoms twice or more during the past month, or who experience waking due to asthma symptoms once or more during the past month, is based on consideration of

clinical trial evidence that even patients with infrequent symptoms benefit from regular use of inhaled corticosteroids:

- In patients with recent-onset (diagnosis within 2 years) mild asthma (45% with symptoms 2 days/week or less), low-dose inhaled corticosteroid (budesonide 400 microg/day) reduced the risk of severe flare-ups, increased symptom-free days and lung function, and protected against long-term decline in lung function associated with severe asthma flare-ups (evidence from a 5-year large randomised clinical trial). [29, 31, 32]
- In small clinical trials in adults with symptoms or reliever use twice per week or less, the use of regular inhaled corticosteroids (fluticasone propionate 250 microg/day) improved lung function,[36] reduced airway hyperresponsiveness and inflammation,[36, 37] and reduced the risk of mild flare-ups.[36, 37]

The current recommendation replaces the previous higher threshold for inhaled corticosteroid treatment (asthma symptoms three times a week or more, or waking at least one night per week with asthma symptoms), which was based on consensus.

Clinical benefits are achieved with low doses

Low doses of inhaled corticosteroids are sufficient to achieve benefits in most patients:

- Regular use of low-dose inhaled corticosteroids reduced the risk of hospitalisation for acute asthma and death due to asthma (evidence from a large population cohort study).[33] In that study, breaks in the use of inhaled corticosteroid of up to 3 months were associated with increased risk of death.[34]
- In adults and adolescents with mild asthma who were not taking inhaled corticosteroids, starting low-dose inhaled corticosteroid (budesonide 200 microg/day) reduced the risk of asthma flare-ups severe enough to require oral corticosteroids, and improved symptom control (evidence from a large clinical trial).[30]
- In patients with recent-onset (diagnosis within 2 years) mild asthma (45% with symptoms 2 days/week or less), low-dose inhaled corticosteroid (budesonide 400 microg/day) reduced the risk of severe flare-ups, increased symptom-free days and lung function, and protected against long-term decline in lung function associated with severe asthma flare-ups (evidence from a 5-year large randomised clinical trial). [29, 31, 32]

Note: PBS status as at March 2019: Fluticasone furoate is not subsidised by the PBS, except in combination with vilanterol.

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Inhaled corticosteroids for adults: doses

Most of the benefit of inhaled corticosteroid is achieved with doses at the upper limit of the low-dose range (i.e. equivalent to 400 microg budesonide per day,[38, 39] 200 microg HFA beclometasone, 160 microg ciclesonide or 200 microg fluticasone propionate).

On average, higher doses provide relatively little extra benefit, but are associated with a higher risk of adverse effects.[40] However, a small proportion of individuals may need a higher dose to achieve asthma control.[40, 38, 39]

The recommendation to start inhaled corticosteroid at low dose is based on the following evidence.

A meta-analysis of results from randomised controlled trials comparing different doses of inhaled corticosteroids showed:

- An effective starting dose is 200–400 microg/day for fluticasone propionate, 400–800 microg/day for budesonide, or 200–400 microg/day beclometasone.[41]
- A starting dose higher than 800 microg/day budesonide, 400 microg/day fluticasone propionate, or 400 microg beclometasone does not provide enough clinical benefit over lower doses to warrant routinely starting with high doses.[41]
- Starting with a moderate dose of inhaled corticosteroid is as effective as commencing with a high dose and down-titrating.[41] Although it may be reasonable to use a high starting dose then reduce the dose, down-titration cannot be ensured in practice (e.g. if the person does not return for planned review).
- High doses of inhaled corticosteroids may be more effective than a moderate or low dose for controlling airway hyperresponsiveness,[41] but this may not equate to a clinical benefit.

Meta-analyses[42, 43] of inhaled corticosteroid safety have shown that the risk of local adverse effects (e.g. hoarseness, oral candidiasis) and the risk of systemic adverse effects (e.g. changes in hypothalamic-pituitary-adrenal function) increase significantly at higher doses. The risk of adrenal suppression should be considered whenever high doses are used (particularly of more potent inhaled corticosteroids), or when the patient uses concomitant medicines that inhibit cytochrome P450 (e.g. ritonavir, erythromycin or ketoconazole).

Notes

Dose equivalent for beclometasone applies to *Qvar* CFC-free formulation. Other brands may differ.

Do not use beclometasone dose recommendations from outdated or overseas guidelines based on older formulations containing CFC propellant – doses are different.

Table. Definitions of ICS dose levels in adults

Inhaled corticosteroid	Daily dose (microg)		
	Low	Medium	High

† Dose equivalents for *Qvar* (TGA-registered CFC-free formulation of beclometasone dipropionate).

*Fluticasone furoate is not available as a low dose. TGA-registered formulations of fluticasone furoate contain a medium or high dose of fluticasone furoate and should only be prescribed as one inhalation once daily.

Note: The potency of generic formulations may differ from that of original formulations. Check TGA-approved product information for details.

Sources

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Inhaled corticosteroids for adults: adverse effects

Local adverse effects

Hoarseness (dysphonia) and candidiasis are the most common local adverse effects of inhaled corticosteroids with both pressurised metered-dose inhalers and dry-powder inhalers:[44]

- The rate of of dysphonia among patients taking inhaled corticosteroids has been estimated at 5–20%.[45] However, higher rates of up to 58% have been reported in some studies.[46] The risk varies with the device used.
- The rate of oropharyngeal candidiasis among adults using inhaled corticosteroids has been estimated at 5–7%, with positive mouth culture for *Candida albicans* in approximately 25% of patients. However, higher rates of up to 70% have been reported in some studies. The risk depends on the formulation, dose and dose frequency.[45]

When taking inhaled corticosteroids via pressurised metered-dose inhalers, the use of a spacer reduces the risk of dysphonia and candidiasis.[47] Spacers improve delivery of the medicine to the airways.

Quick mouth rinsing immediately after inhaling effectively removes a high proportion of remaining medicine.[48] This may reduce the risk of oropharyngeal candidiasis ('thrush').

The incidence of dysphonia and candidiasis is significantly lower with ciclesonide than with equivalent doses of fluticasone propionate.[49] This may an important consideration for patients who experience dysphonia, particularly for those for whom voice quality is important (e.g. singers, actors, teachers). With ciclesonide, the rate of adverse effects may not differ when taken with or without a spacer.[50]

▶ Go to: National Asthma Council Australia's *Inhaler technique in adults with asthma or COPD* information paper

Systemic adverse effects

Cross-sectional population studies have reported lower bone mineral density with long-term use of high doses of inhaled corticosteroid,[51] but the effect on fracture risk in patients with asthma is unclear.

A meta-analysis of randomised controlled trials in adults older than 40 years with COPD (in which osteoporosis is more common) or asthma found no association between the use of inhaled corticosteroid and fracture risk overall, but found a slight increase in fracture risk among those using high doses.[52]

Cross-sectional studies show a dose–response relationship between inhaled corticosteroid use for asthma or COPD, and risk of cataracts in adults.[53]

Long-term inhaled corticosteroid use for asthma or COPD is associated with a small increase in the risk of developing diabetes, and in the risk of diabetes progression. These risks are greatest at higher doses (equivalent to fluticasone propionate 1000 microg/day or higher).[54]

The incidence of osteoporosis, cataracts and diabetes increases with age, and these conditions are also more common in smokers and in patients with COPD. Few studies have assessed risk specifically in patients with asthma.

Patients at risk of osteoporosis should be referred for bone density screening, screened for vitamin D and/or calcium deficiency, and provided with advice about maintaining bone health.

▶ Go to: Australian and New Zealand Bone and Mineral Society's *Vitamin D and health in adults in Australia and New Zealand: a position statement*
Go to: Osteoporosis Australia's *Building healthy bones throughout life: an evidence-informed strategy to prevent osteoporosis in Australia*

Patient concerns about adverse effects

The prevalence of side effects that patients consider troubling increases with increasing dose of inhaled corticosteroids.[55] Mid and high doses are consistently associated with a higher intensity and a higher prevalence of reported adverse effects, after controlling for other factors.[55]

A high proportion of people with asthma may have misunderstandings and fears about using inhaled corticosteroids,[56, 57] such as fears about weight gain, unwanted muscle development, bone fractures, susceptibility to infections and reduction of efficacy of the medicine over time.[56] Most people do not discuss their concerns about inhaled corticosteroid treatment with health professionals.[56] Safety concerns are a major reason for poor adherence, particularly general concerns about corticosteroids rather than concerns about specific adverse effects.[58]

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Inhaled corticosteroids for adults and adolescents: particle size

Medicines with small particle size CFC-free beclometasone [*Qvar*] and ciclesonide) achieve a greater proportion of medicine deposited in the lungs,[59] and are potentially distributed more widely in the large, intermediate, and small airways.[59] Although there are theoretical advantages with fine-particle formulations, including in severe asthma, the clinical implications have not been established.[60]

Randomised controlled trials comparing ciclesonide with fluticasone propionate in adults and adolescents have observed lower rates of patient-reported side-effects,[61] and confirmed dysphonia and oral candidiasis,[49] among patients using ciclesonide than among those using fluticasone propionate.

A small randomised controlled trial reported that ciclesonide treatment reduced sputum eosinophil counts in patients with refractory asthma who has previously shown persistent airway eosinophilia despite high-dose inhaled corticosteroids.[62] However, this study did not provide any comparison with a higher dose of the patient's existing inhaled corticosteroid.

Evidence from clinical trials of ciclesonide is limited. There have been no high quality double-blind studies to date, and observational studies have not been properly designed to avoid confounding factors such as prescriber bias.[60]

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Inhaled corticosteroid/long-acting beta-2 agonist combinations for adults: overview

- To avoid the possibility of patients taking a long-acting beta$_2$ agonist without an inhaled corticosteroid, long-acting beta$_2$ agonists should (whenever possible) be prescribed as inhaled corticosteroid/long-acting beta$_2$ agonist combination in a single inhaler, rather than in separate inhalers. If no combination product is available for the desired medications, carefully explain to the patient that it is very important that they continue taking the inhaled corticosteroid.

Meta-analysis of evidence from randomised controlled clinical trials shows that, for adult patients already taking an inhaled corticosteroid, concomitant treatment with an inhaled corticosteroid and a long-acting beta$_2$ agonist:[1]

- reduces the risk of flare-ups, compared with increasing the dose of corticosteroids
- reduces the risk of flare-ups, compared with inhaled corticosteroids alone.

The studies included in this meta-analysis evaluated mainly budesonide/formoterol and fluticasone propionate/salmeterol.[1]

Each of the following inhaled corticosteroid/long-acting beta$_2$ agonist combinations is available as a single inhaler:

- budesonide/formoterol
- fluticasone furoate/vilanterol
- fluticasone propionate/salmeterol
- fluticasone propionate/formoterol.

There are two types of dosing regimens for inhaled corticosteroid/long-acting beta$_2$ agonist combination therapy:

- maintenance-only regimens (applicable to all available combinations)
- maintenance-and-reliever regimen (applicable only to the budesonide/formoterol combination).

Maintenance-only regimens

The fluticasone propionate/salmeterol combination and budesonide/formoterol combination appear to be equally effective when used for regular maintenance treatment, based on meta-analysis of evidence from clinical trials.[63] Most of the evidence for inhaled corticosteroid/long-acting beta$_2$ agonist combination therapy is from studies using these combinations.

Less evidence from double-blind randomised controlled clinical trials is available for the newer combinations: fluticasone furoate/vilanterol and fluticasone propionate/formoterol:

- The fluticasone furoate/vilanterol combination is equivalent to a medium-to-high dose of inhaled corticosteroids.[64] In adults and adolescents already taking inhaled corticosteroids, once-daily fluticasone furoate/vilanterol 100/25 microg reduced the risk of severe flare-ups (requiring oral corticosteroids or hospitalisation) and improved lung function, compared with fluticasone furoate alone.[65] Efficacy data for the comparison of fluticasone furoate/vilanterol with other inhaled corticosteroid/long-acting beta$_2$ agonist combinations is not available.
- In adults and adolescents with persistent asthma and FEV_1 50–80% at baseline, fluticasone propionate/formoterol achieved improvement in FEV_1 comparable to that achieved with budesonide/formoterol in a 12-week randomised double-blind clinical trial.[66] Other 12-week open-label studies have reported that fluticasone propionate/formoterol was as effective as budesonide/formoterol in improving lung function in adults and adolescents with poorly controlled asthma,[67] and was as effective as fluticasone propionate/salmeterol in adults.[68]

Long-acting beta$_2$ agonists should not be used without inhaled corticosteroids in the management of asthma.[4, 69, 70, 71] Long-acting beta$_2$ agonists are well tolerated when given in combination with inhaled corticosteroids.[63, 72]

Maintenance-and-reliever regimen

The low-dose budesonide/formoterol combination can be used as both maintenance and reliever. Under this regimen, the combination is used for relief of asthma symptoms (instead of using a short-acting beta$_2$ agonist reliever), in addition to its use as regular maintenance treatment.

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Inhaled corticosteroid/long-acting beta-2 agonist combinations for adults: stepping up from inhaled corticosteroid alone

- To avoid the possibility of patients taking a long-acting beta$_2$ agonist without an inhaled corticosteroid, long-acting beta$_2$ agonists should (whenever possible) be prescribed as inhaled corticosteroid/long-acting beta$_2$ agonist combination in a single inhaler, rather than in separate inhalers. If no combination product is available for the desired medications, carefully explain to the patient that it is very important that they continue taking the inhaled corticosteroid.

Note: Before any step-up in asthma treatment is considered, inhaler technique and adherence should be assessed and corrected.

In adults who experience asthma symptoms when taking inhaled corticosteroids (any dose) the addition of a long-acting beta$_2$ agonist reduces the rate of asthma flare-ups that require treatment with oral corticosteroids, improves lung function, reduces symptoms, and also reduces requirement for short-acting beta$_2$ agonists by a small amount.[2]

Most adults with asthma that is not controlled by low-dose inhaled corticosteroid alone (despite good adherence and correct inhaler technique) will achieve better asthma control by switching to the combination of an inhaled corticosteroid and a long-acting beta$_2$ agonist.

In adults whose asthma is not well controlled by taking low-dose inhaled corticosteroids:

- the combination of an inhaled corticosteroid and a long-acting beta$_2$ agonist as maintenance treatment is a little more effective (reducing the rate of asthma flare-ups that require treatment with oral corticosteroids, improving lung function, reducing symptoms and reducing requirement for short-acting beta$_2$ agonists) than a higher dose of inhaled corticosteroids.[3]
- the addition of long-acting beta$_2$ agonists is more effective than the addition of leukotriene receptor antagonists in reducing the risk of asthma flare-ups that require treatment with oral corticosteroids.[4]
- the combination of low-dose budesonide and formoterol in a maintenance-and-reliever regimen is much more effective in reducing the risk of asthma flare-ups that require treatment with oral corticosteroids than a higher dose of inhaled corticosteroids.[73]

In adults using moderate-to-high doses of inhaled corticosteroid, the addition of a long-acting beta$_2$ agonist can reduce the inhaled corticosteroid dose requirement.[5]

The fluticasone furoate/vilanterol combination is suitable only for patients who require a moderate-to-high dose of inhaled corticosteroid in combination with a long-acting beta$_2$ agonist. It should be prescribed only as one inhalation once daily.[64] The higher dose of fluticasone furoate/vilanterol (200/25 microg) should not be used for patients with asthma who also have COPD, because of the increased risk of pneumonia.

▶ See: *Managing asthma–COPD overlap*

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Inhaled corticosteroid/long-acting beta-2 agonist combinations for adults: patients not already taking regular inhaled corticosteroid

Initial treatment with an inhaled corticosteroid/long-acting beta$_2$ agonist combination is not generally recommended for patients who have not already begun taking inhaled corticosteroids.

In patients not taking regular inhaled corticosteroids, starting preventer treatment with a combination of long-acting beta$_2$ agonist and inhaled corticosteroid:[74]

- is not more effective in reducing the risk of asthma flare-ups that require treatment with oral corticosteroids than starting with the same dose of inhaled corticosteroid alone. However, starting with combination therapy improves lung function, reduces symptoms and marginally reduces requirement for short-acting beta$_2$ agonists, compared with starting with the same dose of inhaled corticosteroid
- is less effective in reducing the risk of asthma flare-ups that require treatment with oral corticosteroids than starting with a higher dose of inhaled corticosteroid.

Note: PBS status as at March 2019: ICS/LABA combination therapy as first-line preventer treatment is not subsidised by the PBS, except for patients with frequent symptoms while taking oral corticosteroids.

Combination budesonide/formoterol maintenance-and-reliever regimen in adults and adolescents: overview of efficacy

Low-dose budesonide/formoterol combination can be used as reliever for asthma symptoms (instead of using a short-acting beta$_2$ agonist reliever), in addition to its use as regular long-term preventer treatment.[7, 8, 10, 11, 13, 17] The following formulations can be used in maintenance-and-reliever regimens:

- dry-powder inhaler (*Symbicort Turbuhaler*) 100/6 microg or 200/6 microg
- pressurised metered-dose inhaler (*Symbicort Rapihaler*) 50/3 microg or 100/3 microg.

Neither the 400/12 microg dry-powder inhaler nor the 200/6 microg pressurised metered-dose inhaler should be used in this way.

Overall, clinical trials show that budesonide/formoterol combination as maintenance and reliever reduces the risk of flare-ups that require oral corticosteroids, compared with other current preventer regimens and compared with a fixed higher dose of inhaled corticosteroids.[75]

Pooled data from five randomised controlled trials assessing budesonide/formoterol maintenance-and-reliever regimens showed that similar or better levels of asthma control were achieved with budesonide/formoterol maintenance-and-reliever compared with the conventional maintenance regimen comparators:[10]

- higher-dose budesonide
- same dose budesonide/formoterol
- higher-dose inhaled corticosteroid/long-acting beta$_2$ agonist (budesonide/formoterol or fluticasone propionate/salmeterol).

In randomised clinical trials in patients with a history of asthma flare-up within the previous 12 months (and therefore at greater risk of flare-up in the next 12 months), the use of formoterol/budesonide as maintenance-and-reliever regimen reduced the risk of asthma flare-ups that required treatment with oral corticosteroids, compared with the use of any of the following (plus a short-acting beta$_2$ agonist reliever as needed):[10, 15, 16]

- the same combination as maintenance treatment only
- higher-dose combination as maintenance treatment only
- higher-dose inhaled corticosteroids.

Meta-analysis of six randomised controlled trials found that maintenance-and-reliever treatment with budesonide/formoterol reduced the risk of severe asthma flare-ups (use of oral corticosteroids for 3 days or more, hospitalisation or emergency department visits), compared with higher-dose inhaled corticosteroid alone, or in combination with a long-acting beta$_2$ agonist.[76]

In open-label studies in which patients were not selected for a previous history of flare-ups, there was no overall difference in time to first flare-up between budesonide/formoterol as maintenance-and-reliever regimen and conventional maintenance regimens (including inhaled corticosteroid or inhaled corticosteroid/long-acting beta$_2$ agonist combinations, leukotriene receptor antagonists, xanthines or any other asthma medicines) with rapid-onset beta$_2$ agonist reliever (selected according to clinician's choice).[12] However, the inhaled corticosteroid dose was higher with conventional maintenance regimens.

Note: The fluticasone propionate/formoterol combination is approved by the Therapeutic Goods Administration only for regular maintenance therapy.

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Combination budesonide/formoterol maintenance-and-reliever regimen: dosage considerations

Starting dose

When switching from inhaled corticosteroid to budesonide/formoterol combination as maintenance and reliever, it is expected that the maintenance dose of inhaled corticosteroid will be reduced.

Most available evidence is from clinical trials using the dry-powder inhaler combination product:

- A maintenance dose of 200 budesonide/6 microg formoterol via dry-powder inhaler (1 actuation) twice daily appears to be equally effective as double this dose, regardless of the person's previous dose of inhaled corticosteroid.[6]
- For patients with poor lung function[7] or those whose asthma is not well controlled on regular inhaled corticosteroid or by the combination of an inhaled corticosteroid plus a long-acting beta$_2$ agonist combination via dry-powder inhaler, a starting dose of 200/6 microg two actuations twice daily may be more effective than lower doses as starting dose.[13]

For the newer pressurised metered-dose inhaler combination product, an equivalent maintenance dose would be 100 microg budesonide/3 microg formoterol (2 actuations twice daily).

For dose instructions:

▶ Go to: TGA-approved product information (PI) Symbicort *(budesonide and eformoterol fumarate dihydrate)* Turbuhaler *(PDF/255KB)*
Go to: TGA-approved product information (PI) Symbicort *(budesonide and eformoterol fumarate dihydrate)* Rapihaler *(PDF/306KB)*

Corticosteroid exposure

Compared with conventional inhaled corticosteroid/long-acting beta$_2$ agonist maintenance regimens, the use of budesonide/formoterol via pressurised metered-dose inhaler as maintenance and reliever reduces oral corticosteroid requirement, and may either increase, decrease or have a neutral effect on the total dose of inhaled corticosteroid (depending on the regimen).

Most available evidence is from clinical trials using the dry-powder inhaler combination product:

- In a randomised clinical trial in adults with a recent flare-up, the use of budesonide/formoterol in a maintenance-and-reliever regimen (200 microg/6 microg 2 puffs via dry-powder inhaler twice daily maintenance; 200 microg/6 microg 1 actuations as needed for relief of symptoms) resulted in higher mean daily exposure to inhaled corticosteroids, but lower exposure to systemic corticosteroids, compared with the use of budesonide/formoterol as maintenance only (200 microg/6 microg 2 actuations via dry powder inhaler twice daily).[15]
- In a randomised clinical trial in adults and adolescents, a budesonide/formoterol maintenance-and-reliever regimen (200 microg/6 microg 2 actuations via dry powder inhaler twice daily plus 200 microg/6 microg as needed) and a conventional salmeterol/fluticasone propionate maintenance regimen (50 microg/250 microg twice daily) resulted in similar mean daily inhaled corticosteroid doses, while the budesonide/formoterol maintenance-and-reliever regimen significantly reduced severe flare-ups requiring oral corticosteroids.[18]
- In another randomised clinical trial in adults and adolescents who had experienced a flare-up within the previous year, a budesonide/formoterol maintenance-and-reliever regimen (200 microg/6 microg 2 actuations via dry powder inhaler twice daily plus 200 microg/6 microg as needed) resulted in a lower mean dose of inhaled corticosteroid than a conventional maintenance dose of salmeterol/fluticasone propionate 50 microg/500 microg twice daily and reduced the rate of flare-ups requiring oral corticosteroids.[11]

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Beta-2 receptor tolerance

Short-acting beta$_2$ agonists

In laboratory studies, regular use of short-acting beta$_2$ agonists leads to receptor tolerance (down-regulation) to their bronchoprotective and bronchodilator effects.[77]

In clinical trials, regular use of short-acting beta$_2$ agonists is associated with greater instability of lung function and a higher risk of asthma flare-ups.[78, 79]

In clinical practice, frequent use of short-acting beta$_2$-agonists may lead to worsening of asthma symptoms. This may be improved by deliberately reducing short-acting beta$_2$ agonist use and, in some cases, using ipratropium bromide as an alternative reliever medicine medication to allow restoration of beta$_2$-receptor responsiveness.[80]

Long-acting beta$_2$ agonists

In laboratory studies, regular use of long-acting beta$_2$ agonists results in reduced duration of protection against airway hyperresponsiveness, and prolonged recovery of airway function after short-acting beta$_2$ agonist, which is thought to be due to receptor tolerance (down-regulation) of beta$_2$ receptors in bronchial smooth muscle and mast cells (evidence from laboratory

studies).[81] These findings have led to concerns about reduced effectiveness of beta$_2$ agonists when needed for preventing exercise-induced bronchoconstriction or reversing acute asthma due to trigger exposure.[81] Sensitivity to short-acting beta$_2$ agonists returns to normal within 72 hours of stopping long-acting beta$_2$ agonist treatment.[81]

However, the clinical effects of beta receptor tolerance in patients taking long-acting beta$_2$ agonists are unclear.[82] Clinical trials assessing regular use of long-acting beta$_2$ agonists in combination with inhaled corticosteroids have not reported clinically significant adverse effects attributable to beta receptor tolerance.[72] Two Emergency Department studies in patients with acute asthma did not observe increased risk of hospitalisation among those taking salmeterol.[83, 84]

The use of budesonide/formoterol as a reliever may result in lower total use of beta$_2$ agonist compared with the use of short-acting beta$_2$ agonist relievers, based on a study in patients taking regular maintenance budesonide/formoterol, which monitored inhaler actuations electonically.[15]

Ipratropium for adults

Regular ipratropium bromide in addition to as-needed short-acting beta$_2$ agonist does not appear to provide clinically significant benefit over as-needed short-acting beta$_2$ agonists alone.[85]

Note: Ipratropium bromide may be used in the management of severe acute asthma.

▶ See: *Managing acute asthma in clinical settings*

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Stepping down treatment in adults

Recommendations

If a patient taking moderate-dose or high-dose inhaled corticosteroid (with or without long-acting beta$_2$ agonist) has experienced good asthma control for 2–3 months and is at low risk of flare-ups, consider stepping down by one step.

- **Do not attempt dose reduction or step down if the person is about to travel, during a respiratory infection, or when at risk of a respiratory tract infection (e.g. during the colder winter months).**

Table. Risk factors for adverse asthma outcomes in adults and adolescents

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Figure. Stepped approach to adjusting asthma medication in adults and adolescents

Please view and print this figure separately: http://www.asthmahandbook.org.au/figure/show/31

Table. Guide to selecting and adjusting asthma medication for adults and older adolescents

Clinical situation	Action
Newly diagnosed asthma	**Consider low-dose ICS (plus SABA as needed)** **If symptoms severe at initial presentation, consider one of:** • **ICS plus a short course of oral corticosteroids** • **a short initial period of high-dose ICS then step down** • **(private prescription) combination ICS/LABA†** **See:** *Table. Initial treatment choices (adults and adolescents not already using a preventer)*
Good recent asthma symptom control	**If maintained 2–3 months, no flare-up in previous 12 months and low risk for flare-ups, step down where possible (unless already on low-dose ICS)**
Partial recent asthma symptom control	**Review inhaler technique and adherence – correct if suboptimal** **If no improvement, consider increasing treatment by one step and reviewing (if still no improvement, return to previous step, review diagnosis and consider referral)**
Poor recent asthma symptom control	**Review inhaler technique and adherence – correct if suboptimal** **Confirm that symptoms are likely to be due to asthma** **Consider increasing treatment until good asthma control is achieved, then step down again when possible**

Clinical situation	Action
Difficult-to-treat asthma ‡	**Consider referral for assessment or add-on options**
Patient with risk factors §	**Tailor treatment to reduce individual risk factors**

† PBS status as at March 2019: ICS/LABA combination therapy as first-line preventer treatment is not subsidised by the PBS, except for patients with frequent symptoms while taking oral corticosteroids.

‡ Poor recent asthma symptom control despite ICS/LABA combination at high–medium dose.

§ Risk factors for asthma events or adverse treatment effects, irrespective of level of recent asthma symptom control.

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Table. Definitions of ICS dose levels in adults

Inhaled corticosteroid	Daily dose (microg)		
	Low	Medium	High
Beclometasone dipropionate †	100–200	250–400	>400
Budesonide	200–400	500–800	>800
Ciclesonide	80–160	240–320	>320
*Fluticasone furoate**	—	100	200
Fluticasone propionate	100–200	250–500	>500

† Dose equivalents for *Qvar* (TGA-registered CFC-free formulation of beclometasone dipropionate).

***Fluticasone furoate is not available as a low dose. TGA-registered formulations of fluticasone furoate contain a medium or high dose of fluticasone furoate and should only be prescribed as one inhalation once daily.**

Note: The potency of generic formulations may differ from that of original formulations. Check TGA-approved product information for details.

Sources

Respiratory Expert Group, Therapeutic Guidelines Limited. *Therapeutic Guidelines: Respiratory, Version 4*. **Therapeutic Guidelines Limited, Melbourne, 2009.**

GlaxoSmithKline Australia Pty Ltd. Product Information: *Breo (fluticasone furoate; vilanterol) Ellipta*. **Therapeutic Goods Administration, Canberra, 2014. Available from: https://www.ebs.tga.gov.au/**

GlaxoSmithKline Australia Pty Ltd. Product Information: *Arnuity (fluticasone furoate) Ellipta*. **Therapeutic Goods Administration, Canberra, 2016. Available from: https://www.ebs.tga.gov.au/**

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Asset ID: 22

How this recommendation was developed

Consensus

Based on clinical experience and expert opinion (informed by evidence, where available).

During pregnancy, consider stepping down only if the woman is taking an inappropriately high dose of a medicine.

Note: Stepping down is not a priority during pregnancy because of the risk of flare-up.

How this recommendation was developed

Consensus

Based on clinical experience and expert opinion (informed by evidence, where available).

Before stepping down:

- **find out what dose and how often the person is actually taking their prescribed preventer medicines. (To elicit accurate information, ask in a non-judgemental, empathic way.)**
- **document current level of asthma control and risk factors**
- **make sure the patient's written asthma action plan is up to date.**

Table. Suggested questions to ask adults and older adolescents when assessing adherence to treatment

1. *Many people don't take their medication as prescribed. In the last four weeks:*
  - **how many days a week would you have taken your preventer medication? None at all? One? Two? (etc).**
  - **how many times a day would you take it? Morning only? Evening only? Morning and evening? (or other)**
  - **each time, how many puffs would you take? One? Two? (etc).**

2. *Do you find it easier to remember your medication in the morning, or the evening?*

Source: **Foster JM, Smith L, Bosnic-Anticevich SZ et al. Identifying patient-specific beliefs and behaviours for conversations about adherence in asthma.** *Intern Med J* **2012; 42: e136-e44. Available from: http://www.ncbi.nlm.nih.gov/pubmed/21627747**

Asset ID: 38

Table. Definition of levels of recent asthma symptom control in adults and adolescents (regardless of current treatment regimen)

Good control	Partial control	Poor control
All of: • **Daytime symptoms ≤2 days per week** • **Need for SABA reliever ≤2 days per week†** • **No limitation of activities** • **No symptoms during night or on waking**	**One or two of:** • **Daytime symptoms >2 days per week** • **Need for SABA reliever >2 days per week†** • **Any limitation of activities** • **Any symptoms during night or on waking**	**Three or more of:** • **Daytime symptoms >2 days per week** • **Need for SABA reliever >2 days per week†** • **Any limitation of activities** • **Any symptoms during night or on waking**

SABA: short-acting beta$_2$-agonist

† SABA, not including doses taken prophylactically before exercise. (Record this separately and take into account when assessing management.)

Note: Recent asthma symptom control is based on symptoms over the previous 4 weeks.

Table. Risk factors for adverse asthma outcomes in adults and adolescents

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Table. Management of risk factors for adverse asthma outcomes in adults

Risk factor	**Clinical action †**
Any risk factor for flare-ups	**Check patient has an appropriate action plan** **Carefully check inhaler technique and adherence, and identify any barriers to good adherence** **Review frequently (e.g. every 3 months)**
Hospitalisation or ED visit for asthma or any asthma flare-up during the previous 12 months	**Ask about triggers for flare-ups, and lead time**
History of intubation or intensive care unit admission for asthma	**Ensure action plan recommends early medical review when asthma worsens**
Hospitalisation or ED visit for asthma in the past month	**Emphasise importance of maintaining regular ICS use after symptoms improve** **Confirm that patient has resumed using SABA only when needed for symptoms**
High SABA use (>3 canisters per year)	**Check lung function** **If SABA use appears to be habitual, investigate causes and consider alternative strategies, e.g. short-term substitution of ipratropium for SABA**
Long-term high-dose ICS	**Consider gradual reduction of ICS dose if symptoms stable** **Monitor regularly (e.g. assessment of bone density, regular eye examinations)** **For local side-effects, ensure inhaler technique is appropriate**
Poor lung function (even if few symptoms)	**Consider 3-month trial of higher ICS dose, then recheck lung function** **Consider referral for detailed specialist investigation**
Sensitivity to unavoidable allergens (e.g. **Alternaria** *species of common moulds)*	**Refer for further investigation and management**
Exposure to cigarette smoke (smoking or environmental exposure)	**Emphasise the importance of avoiding smoke** **Provide quitting strategies** **Consider increasing ICS dose (higher dose of ICS likely to be necessary to**

Risk factor	Clinical action †
	control asthma) **Refer for assessment of asthma–COPD overlap**
Difficulty perceiving airflow limitation or the severity of exacerbations	**Regular PEF monitoring** **Action plan should recommend early review and measurement of lung function**
No current written asthma action plan	**Provide and explain written asthma action plan**

† In addition to actions applicable to all risk factors

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Asset ID: 41

How this recommendation was developed

Consensus

Based on clinical experience and expert opinion (informed by evidence, where available).

When stepping down, make small dose adjustments gradually (e.g. reduce inhaled corticosteroid by 25–50% at intervals of 2–3 months) by stepping down through the available doses.

- **The fluticasone furoate/vilanterol combination is not available in a low dose**

How this recommendation was developed

Consensus

Based on clinical experience and expert opinion (informed by evidence, where available).

If after stepping down the person experiences an overall increase in symptoms and/or decrease in lung function, they should resume their previous dose.

How this recommendation was developed

Consensus

Based on clinical experience and expert opinion (informed by evidence, where available).

For adults taking low-dose inhaled corticosteroid in combination with a long-acting beta$_2$ agonist, consider either of the following options if asthma is well controlled for 2–3 months:

- **maintain this treatment long term**
- **replace combination inhaler with an inhaled corticosteroid at the same dose.**

- **If withdrawal of long-acting beta$_2$ agonist leads to loss of asthma symptom control, this will usually be evident within the first few days and the person should resume combination treatment.**

Table. Definitions of ICS dose levels in adults

Inhaled corticosteroid	Daily dose (microg)

	Low	Medium	High
Beclometasone dipropionate †	100–200	250–400	>400
Budesonide	200–400	500–800	>800
Ciclesonide	80–160	240–320	>320
*Fluticasone furoate**	—	100	200
Fluticasone propionate	100–200	250–500	>500

† Dose equivalents for *Qvar* **(TGA-registered CFC-free formulation of beclometasone dipropionate).**

***Fluticasone furoate is not available as a low dose. TGA-registered formulations of fluticasone furoate contain a medium or high dose of fluticasone furoate and should only be prescribed as one inhalation once daily.**

Note: The potency of generic formulations may differ from that of original formulations. Check TGA-approved product information for details.

Sources

Respiratory Expert Group, Therapeutic Guidelines Limited. *Therapeutic Guidelines: Respiratory, Version 4*. **Therapeutic Guidelines Limited, Melbourne, 2009.**

GlaxoSmithKline Australia Pty Ltd. Product Information: *Breo (fluticasone furoate; vilanterol) Ellipta*. **Therapeutic Goods Administration, Canberra, 2014. Available from: https://www.ebs.tga.gov.au/**

GlaxoSmithKline Australia Pty Ltd. Product Information: *Arnuity (fluticasone furoate) Ellipta*. **Therapeutic Goods Administration, Canberra, 2016. Available from: https://www.ebs.tga.gov.au/**

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How this recommendation was developed

Consensus

Based on clinical experience and expert opinion (informed by evidence, where available), with particular reference to the following source(s):

- Reddel *et al.* 2010[1]
- Thomas *et al.* 2011[2]
- Brozek *et al.* 2012[3]

For adults with a confirmed asthma diagnosis taking low-dose inhaled corticosteroid alone, maintain treatment long term to reduce the risk of flare-ups.

- **Many patients who experience few asthma symptoms stop taking preventer treatment without discussing with their prescriber. Explain that regular low-dose inhaled corticosteroid will reduce their risk of flare-ups, even if day-to-day symptoms are infrequent.**

Table. Confirming the diagnosis of asthma in a person using preventer treatment

Please view and print this figure separately: http://www.asthmahandbook.org.au/table/show/9

Table. Definitions of ICS dose levels in adults

Inhaled corticosteroid	Daily dose (microg)

	Low	Medium	High
Beclometasone dipropionate †	100–200	250–400	>400
Budesonide	200–400	500–800	>800
Ciclesonide	80–160	240–320	>320
*Fluticasone furoate**	—	100	200
Fluticasone propionate	100–200	250–500	>500

† Dose equivalents for *Qvar* (TGA-registered CFC-free formulation of beclometasone dipropionate).

***Fluticasone furoate is not available as a low dose. TGA-registered formulations of fluticasone furoate contain a medium or high dose of fluticasone furoate and should only be prescribed as one inhalation once daily.**

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How this recommendation was developed

Consensus

Based on clinical experience and expert opinion (informed by evidence, where available), with particular reference to the following source(s):

- Rank *et al.* 2013[4]

For adults prescribed low-dose ICS for an indefinite period, explain that:

- **the main purpose of long-term low-dose ICS-based preventer is to reduce the risk of flare-ups, even if day-to-day symptoms are infrequent**
- **even if the person has not experienced asthma symptoms for some time, they should not stop taking their preventer without discussing first.**

Table. Definitions of ICS dose levels in adults

Inhaled corticosteroid	Daily dose (microg)		
	Low	Medium	High
Beclometasone dipropionate †	100–200	250–400	>400

Inhaled corticosteroid	Daily dose (microg)		
	Low	Medium	High
Budesonide	200–400	500–800	>800
Ciclesonide	80–160	240–320	>320
*Fluticasone furoate**	—	100	200
Fluticasone propionate	100–200	250–500	>500

† Dose equivalents for *Qvar* (TGA-registered CFC-free formulation of beclometasone dipropionate).

***Fluticasone furoate is not available as a low dose. TGA-registered formulations of fluticasone furoate contain a medium or high dose of fluticasone furoate and should only be prescribed as one inhalation once daily.**

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GlaxoSmithKline Australia Pty Ltd. Product Information: *Arnuity (fluticasone furoate) Ellipta*. **Therapeutic Goods Administration, Canberra, 2016. Available from: https://www.ebs.tga.gov.au/**

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How this recommendation was developed

Consensus

Based on clinical experience and expert opinion (informed by evidence, where available).

For adolescents taking low-dose inhaled corticosteroid whose asthma has been well controlled for several months, consider a trial cessation of inhaled corticosteroid.

Table. Definitions of ICS dose levels in adults

Inhaled corticosteroid	Daily dose (microg)		
	Low	Medium	High
Beclometasone dipropionate †	100–200	250–400	>400
Budesonide	200–400	500–800	>800
Ciclesonide	80–160	240–320	>320
*Fluticasone furoate**	—	100	200

Inhaled corticosteroid	Daily dose (microg)		
	Low	Medium	High
Fluticasone propionate	100–200	250–500	>500

† Dose equivalents for *Qvar* (TGA-registered CFC-free formulation of beclometasone dipropionate).

***Fluticasone furoate is not available as a low dose. TGA-registered formulations of fluticasone furoate contain a medium or high dose of fluticasone furoate and should only be prescribed as one inhalation once daily.**

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GlaxoSmithKline Australia Pty Ltd. Product Information: *Arnuity (fluticasone furoate) Ellipta*. **Therapeutic Goods Administration, Canberra, 2016. Available from: https://www.ebs.tga.gov.au/**

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Asset ID: 22

How this recommendation was developed

Consensus

Based on clinical experience and expert opinion (informed by evidence, where available).

More information

Stepping down regular asthma medicines in adults

The main aim of medical treatment for asthma is to achieve good asthma control and minimise the risks of asthma with the lowest effective dose of preventer medicines for each individual.

Stepping down is considered when the patient has experienced good asthma control for 2–3 months and is at low risk of flare-ups.

Figure. Stepped approach to adjusting asthma medication in adults and adolescents

Please view and print this figure separately: http://www.asthmahandbook.org.au/figure/show/31

General tips

It is important to ascertain the person's actual treatment regimen before stepping down, because many patients may already be taking their preventer only intermittently.

Those who deliberately avoid taking their preventer due to concerns about inhaled corticosteroids may accept regular daily treatment at a lower dose, with an action plan to deal with flare-ups.

Steps down should be planned before the patient has finished their current inhaler, so that the previous dose can be resumed immediately if asthma control deteriorates.

Patients should be advised to step back up if they or their clinician judge that their asthma is worse overall (not just after the first time they experience asthma symptoms after stepping down). Patients and clinicians should agree beforehand on criteria for worsening asthma control.

Some patients are very concerned about reducing their dose (despite the risk of treatment-related adverse effects) and may prefer to stay on high doses for long periods. To enable early detection of deterioration in control during step-down, patients can be asked to monitor their peak flow for 2 weeks before, and 3–4 weeks after, the dose reduction.

Stepping down inhaled corticosteroid dose

For many patients with well-controlled asthma taking inhaled corticosteroid/long-acting beta$_2$ agonist combinations or inhaled corticosteroids alone, the inhaled corticosteroid dose can be reduced without loss of asthma control if downward dose adjustments are made gradually.[1, 5]

The dose can be reduced by stepping down through the available formulations.

Note: TGA-registered fluticasone furoate/vilanterol combinations contain moderate-to-high doses of inhaled corticosteroid (100/25 microg and 200/25 microg respectively).

Ceasing inhaled corticosteroid

Patients with well-controlled asthma who stop taking regular low-dose inhaled corticosteroid treatment have an increased risk of flare-ups, compared with those who continue inhaled corticosteroids.[4]

It may sometimes be necessary to stop treatment temporarily in order to confirm the diagnosis of asthma in a person taking inhaled corticosteroids. In this situation, close monitoring of symptom control is needed.

Table. Confirming the diagnosis of asthma in a person using preventer treatment

Please view and print this figure separately: http://www.asthmahandbook.org.au/table/show/9

Table. Definitions of ICS dose levels in adults

Inhaled corticosteroid	Daily dose (microg)		
	Low	Medium	High
Beclometasone dipropionate †	100–200	250–400	>400
Budesonide	200–400	500–800	>800
Ciclesonide	80–160	240–320	>320
*Fluticasone furoate**	—	100	200
Fluticasone propionate	100–200	250–500	>500

† Dose equivalents for *Qvar* (TGA-registered CFC-free formulation of beclometasone dipropionate).

*Fluticasone furoate is not available as a low dose. TGA-registered formulations of fluticasone furoate contain a medium or high dose of fluticasone furoate and should only be prescribed as one inhalation once daily.

Note: The potency of generic formulations may differ from that of original formulations. Check TGA-approved product information for details.

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GlaxoSmithKline Australia Pty Ltd. Product Information: *Arnuity (fluticasone furoate) Ellipta*. Therapeutic Goods Administration, Canberra, 2016. Available from: https://www.ebs.tga.gov.au/

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Ceasing long-acting beta$_2$ agonist

Patients whose asthma is well controlled with an inhaled corticosteroid/long-acting beta$_2$ agonist combination (either as conventional maintenance treatment plus short-acting beta$_2$ agonist reliever, or as budesonide/formoterol maintenance-and-reliever therapy) can continue taking this regimen long-term. The dose can be reduced by stepping down through the available formulations.

Alternatively, for patients taking an inhaled corticosteroid/long-acting beta$_2$ agonist combination as maintenance treatment, the combination can be replaced with an inhaled corticosteroid inhaler at the same dose. However, a meta-analysis of several studies reported deterioration in asthma control after ceasing long-acting beta$_2$ agonist treatment in patients with asthma previously stabilised on inhaled corticosteroid/long-acting beta$_2$ agonist combination. Therefore, if inhaled corticosteroid/long-acting beta$_2$ agonist is replaced by inhaled corticosteroid only, patients should be advised to start taking their old combination inhaler again if asthma worsens within the first few days after switching.

Note: For patients taking fluticasone furoate/vilanterol, no studies are available to guide stepping down. Options include stepping down to inhaled corticosteroid alone (recommended in the TGA-approved Product Information),[6] or stepping down to a different inhaled corticosteroid/long-acting beta$_2$ agonist combination that will achieve a lower inhaled corticosteroid dose. (e.g. Stepping down from treatment with once-daily medium dose fluticasone furoate/vilanterol [100/25 microg] can be achieved by switching to twice-daily low-dose fluticasone propionate/salmeterol [100/50 microg or 50/25 microg]). With either option, patients need careful explanation, including clear written instructions, to avoid potential confusion when changing between inhaler devices and dosing frequencies.

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Safety of stepping down treatment during pregnancy

It may not be feasible to step down (e.g. reduce the inhaled corticosteroid dose or cease long-acting beta$_2$ agonist) during pregnancy, because this is usually accomplished over several months while monitoring asthma control.

Several studies have reported deterioration in asthma control after ceasing long-acting beta$_2$ agonist treatment in adults with asthma previously stabilised on inhaled corticosteroid/long-acting beta$_2$ agonist combination.[3, 2] If inhaled corticosteroid/long-acting beta$_2$ agonist combination is replaced by inhaled corticosteroid only, patients should be advised to start taking their old combination inhaler again if asthma worsens within the first few days after switching.

In a woman planning a pregnancy, a failed treatment trial of inhaled corticosteroid alone may demonstrate that she needs to continue taking combination therapy during pregnancy in order to maintain asthma control.

Ongoing monitoring of asthma in adults

Asthma monitoring includes both self-monitoring by patients and periodic assessments by the clinician.

Asthma management in primary care should include periodic reassessment of (both):[7]

- **recent asthma symptom control** based on symptoms over the previous 4 weeks, with or without lung function testing. In many patients in primary care, symptoms, reliever use and lung function are useful surrogate measures of the degree to which the underlying disease process is controlled.
- **risk factors** that predict poor asthma outcomes (e.g. flare-ups, accelerated decline in lung function, or treatment-related adverse effects) independent of the person's level of recent asthma symptom control.

Planned asthma check-ups should be made at intervals determined by both the individual's level of recent asthma symptom control and risk factors. The following is a guide:

- 1–3 months after each adjustment to medications
- yearly for a person with no flare-up in the past 12 months and good symptom control for at least a year
- every 6 months for a person who has had a flare-up within the past 12 months or who has other risk factors for flare-ups or life-threatening asthma (e.g. smoking, previous recording of poor lung function on spirometry, history of admission to an intensive care unit for asthma)
- at least every 3 months for a person with severe asthma, work-exacerbated asthma, poor perception of airflow limitation, frequent rhinosinusitis symptoms, or other comorbid conditions that affect asthma control
- every 4–6 weeks for pregnant women.

Note: For patients with occupational asthma, management and follow-up by a specialist with experience in occupational asthma is recommended.

▶ See: *Managing asthma during pregnancy*
See: *Work-related asthma*

Written asthma action plans for adults

Every person with asthma should have their own written asthma action plan.

When provided with appropriate self-management education, self-monitoring and medical review, individualised written action plans consistently improve asthma health outcomes if they include two to four action points, and provide instructions for use of both inhaled corticosteroid and oral corticosteroids for treatment of flare-ups.[8] Written asthma action plans are effective if based on symptoms[9] or personal best peak expiratory flow (not on percentage predicted).[8]

How to develop and review a written asthma action plan

A written asthma action plan should include all the following:

- a list of the person's usual medicines (names of medicines, doses, when to take each dose) – including treatment for related conditions such as allergic rhinitis
- clear instructions on how to change medication (including when and how to start a course of oral corticosteroids) in all the following situations:
  - when asthma is getting worse (e.g. when needing more reliever than usual, waking up with asthma, more symptoms than usual, asthma is interfering with usual activities)
  - when asthma symptoms get substantially worse (e.g. when needing reliever again within 3 hours, experiencing increasing difficulty breathing, waking often at night with asthma symptoms)
  - when peak flow falls below an agreed rate (for those monitoring peak flow each day)
  - during an asthma emergency.
- instructions on when and how to get medical care (including contact telephone numbers)
- the name of the person writing the action plan, and the date it was issued.

Table. Options for adjusting medicines in a written asthma action plan for adults

Please view and print this figure separately: http://www.asthmahandbook.org.au/table/show/42

Table. Checklist for reviewing a written asthma action plan

- Ask if the person (or parent) knows where their written asthma action plan is.
- Ask if they have used their written asthma action plan because of worsening asthma.
- Ask if the person (or parent) has had any problems using their written asthma action plan, or has any comments about whether they find it suitable and effective.
- Check that the medication recommendations are appropriate to the person's current treatment.
- Check that all action points are appropriate to the person's level of recent asthma symptom control.
- Check that the person (or parent) understands and is satisfied with the action points.
- If the written asthma action plan has been used because of worsening asthma more than once in the past 12 months: review the person's usual asthma treatment, adherence, inhaler technique, and exposure to avoidable trigger factors.
- Check that the contact details for medical care and acute care are up to date.

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Templates for written asthma action plans

Templates are available from National Asthma Council Australia:

- National Asthma Council Australia colour-coded plan, available as a printed handout that folds to wallet size and as the *Asthma Buddy* mobile site
- Asthma Cycle of Care asthma action plan
- A plan designed for patients using budesonide/formoterol combination as maintenance and reliever therapy
- Remote Indigenous Australian Asthma Action Plan
- Every Day Asthma Action Plan (designed for remote Indigenous Australians who do not use written English – may also be useful for others for whom written English is inappropriate).

Some written asthma action plans are available in community languages.

Software for developing electronic pictorial asthma action plans[10, 11] is available online.

▶ Go to: National Asthma Council Australia's *Asthma Action Plan Library*
Download: Imperial College London's *Electronic Asthma Action Plan*

Inhaled corticosteroids for adults: doses

Most of the benefit of inhaled corticosteroid is achieved with doses at the upper limit of the low-dose range (i.e. equivalent to 400 microg budesonide per day,[12, 13] 200 microg HFA beclometasone, 160 microg ciclesonide or 200 microg fluticasone propionate).

On average, higher doses provide relatively little extra benefit, but are associated with a higher risk of adverse effects.[14] However, a small proportion of individuals may need a higher dose to achieve asthma control.[14, 12, 13]

The recommendation to start inhaled corticosteroid at low dose is based on the following evidence.

A meta-analysis of results from randomised controlled trials comparing different doses of inhaled corticosteroids showed:

- An effective starting dose is 200–400 microg/day for fluticasone propionate, 400–800 microg/day for budesonide, or 200–400 microg/day beclometasone.[15]
- A starting dose higher than 800 microg/day budesonide, 400 microg/day fluticasone propionate, or 400 microg beclometasone does not provide enough clinical benefit over lower doses to warrant routinely starting with high doses.[15]
- Starting with a moderate dose of inhaled corticosteroid is as effective as commencing with a high dose and down-titrating.[15] Although it may be reasonable to use a high starting dose then reduce the dose, down-titration cannot be ensured in practice (e.g. if the person does not return for planned review).
- High doses of inhaled corticosteroids may be more effective than a moderate or low dose for controlling airway hyperresponsiveness,[15] but this may not equate to a clinical benefit.

Meta-analyses[16, 17] of inhaled corticosteroid safety have shown that the risk of local adverse effects (e.g. hoarseness, oral candidiasis) and the risk of systemic adverse effects (e.g. changes in hypothalamic-pituitary-adrenal function) increase significantly at higher doses. The risk of adrenal suppression should be considered whenever high doses are used (particularly of more potent inhaled corticosteroids), or when the patient uses concomitant medicines that inhibit cytochrome P450 (e.g. ritonavir, erythromycin or ketoconazole).

Notes

Dose equivalent for beclometasone applies to *Qvar* CFC-free formulation. Other brands may differ.

Do not use beclometasone dose recommendations from outdated or overseas guidelines based on older formulations containing CFC propellant – doses are different.

Table. Definitions of ICS dose levels in adults

Inhaled corticosteroid	Daily dose (microg)		
	Low	Medium	High
Beclometasone dipropionate †	100–200	250–400	>400
Budesonide	200–400	500–800	>800
Ciclesonide	80–160	240–320	>320
*Fluticasone furoate**	—	100	200
Fluticasone propionate	100–200	250–500	>500

† Dose equivalents for *Qvar* (TGA-registered CFC-free formulation of beclometasone dipropionate).

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Planning and conducting asthma review in adults

In this section

Planning reviews

Planning asthma review and follow-up for adults and adolescents

http://www.asthmahandbook.org.au/management/adults/reviewing-asthma/planning-reviews

Opportunistic review

Reviewing asthma opportunistically in adults

http://www.asthmahandbook.org.au/management/adults/reviewing-asthma/opportunistic-review

Respiratory symptom visits

Reviewing asthma in adults and adolescents during visits for respiratory symptoms

http://www.asthmahandbook.org.au/management/adults/reviewing-asthma/respiratory-symptom-visits

Scheduled asthma visits

Conducting asthma review in adults and adolescents at scheduled asthma visits

http://www.asthmahandbook.org.au/management/adults/reviewing-asthma/scheduled-asthma-visits

Lung function testing

Spirometry and other lung function tests in asthma review for adults and adolescents

http://www.asthmahandbook.org.au/management/adults/reviewing-asthma/lung-function

Planning asthma review and follow-up

Recommendations

Set up a system to help identify patients with asthma and to schedule asthma reviews.

How this recommendation was developed

Consensus

Based on clinical experience and expert opinion (informed by evidence, where available).

Assess recent asthma symptom control at all the following times:

- **when the person presents with uncontrolled asthma symptoms**
- **at follow-up after an asthma flare-up**
- **at follow-up 1–3 months after beginning preventer treatment or adjusting the dose**
- **at scheduled asthma review visits**
- **opportunistically at non-asthma visits**
- **every 4–6 weeks during pregnancy.**

How this recommendation was developed

Consensus

Based on clinical experience and expert opinion (informed by evidence, where available).

Validated checklists or questionnaires can be used at each visit to assess recent asthma symptom control or to screen for poor asthma control, e.g:

- *Asthma Score (Asthma Control Test)*
- **Primary care Asthma Control Screening**
- *Asthma Control Questionnaire (ACQ)*

Table. Primary care Asthma Control Screening tool (PACS)

Have you experienced any of the following more than once a week in the last month?	Yes	No
Symptoms of asthma, cough, wheeze, shortness of breath	•	•
Waking at night because of asthma	•	•
Chest tightness on waking	•	•

Have you experienced any of the following more than once a week in the last month?	Yes	No
Difficulty in performing vigorous activity like running, lifting heavy objects, exercise	•	•
Difficulty in performing moderate activities like vacuuming, climbing flights of stairs	•	•

Interpretation: 'Yes' to any question indicates that the person may have poorly controlled asthma, so more detailed assessment is needed.

Source: **LeMay KS, Armour CL, Reddel HK. Performance of a brief asthma control screening tool in community pharmacy: a cross-sectional and prospective longitudinal analysis.** *Prim Care Respir J*; **2014. Available from: http://dx.doi.org/10.4104/pcrj.2014.00011**

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How this recommendation was developed

Consensus

Based on clinical experience and expert opinion (informed by evidence, where available).

Plan regular review of risk factors for flare-ups, accelerated decline in lung function, or treatment-related adverse effects.

Table. Risk factors for adverse asthma outcomes in adults and adolescents

Please view and print this figure separately: http://www.asthmahandbook.org.au/table/show/40

Table. Management of risk factors for adverse asthma outcomes in adults

Risk factor	Clinical action †
Any risk factor for flare-ups	**Check patient has an appropriate action plan** **Carefully check inhaler technique and adherence, and identify any barriers to good adherence** **Review frequently (e.g. every 3 months)**
Hospitalisation or ED visit for asthma or any asthma flare-up during the previous 12 months	**Ask about triggers for flare-ups, and lead time**
History of intubation or intensive care unit admission for asthma	**Ensure action plan recommends early medical review when asthma worsens**
Hospitalisation or ED visit for asthma in the past month	**Emphasise importance of maintaining regular ICS use after symptoms improve** **Confirm that patient has resumed using SABA only when needed for symptoms**
High SABA use (>3 canisters per year)	**Check lung function**

Risk factor	Clinical action †
	If SABA use appears to be habitual, investigate causes and consider alternative strategies, e.g. short-term substitution of ipratropium for SABA
Long-term high-dose ICS	**Consider gradual reduction of ICS dose if symptoms stable** **Monitor regularly (e.g. assessment of bone density, regular eye examinations)** **For local side-effects, ensure inhaler technique is appropriate**
Poor lung function (even if few symptoms)	**Consider 3-month trial of higher ICS dose, then recheck lung function** **Consider referral for detailed specialist investigation**
Sensitivity to unavoidable allergens (e.g. **Alternaria** *species of common moulds)*	**Refer for further investigation and management**
Exposure to cigarette smoke (smoking or environmental exposure)	**Emphasise the importance of avoiding smoke** **Provide quitting strategies** **Consider increasing ICS dose (higher dose of ICS likely to be necessary to control asthma)** **Refer for assessment of asthma–COPD overlap**
Difficulty perceiving airflow limitation or the severity of exacerbations	**Regular PEF monitoring** **Action plan should recommend early review and measurement of lung function**
No current written asthma action plan	**Provide and explain written asthma action plan**

† In addition to actions applicable to all risk factors

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How this recommendation was developed

Adapted from existing guidance

Based on reliable clinical practice guideline(s) or position statement(s):

- Global Initiative for Asthma, 2012[1]

Review each patient's written asthma action plan at least once a year.

How this recommendation was developed

Consensus

Based on clinical experience and expert opinion (informed by evidence, where available).

When altering the medication or dose, flag the patient's medical record with a reminder to ask at next visit:

- **whether they thought the treatment change was helpful**
- **whether they are still taking that dose.**

How this recommendation was developed

Consensus

Based on clinical experience and expert opinion (informed by evidence, where available).

For patients who need long-term high-dose inhaled corticosteroids to maintain good asthma control or need frequent courses of oral corticosteroids, arrange monitoring of bone mineral density and glucose metabolism status.

Advise patients to:

- **have regular eye examinations**
- **do regular weight-bearing physical activity**
- **have adequate dietary calcium intake**
- **maintain adequate vitamin D levels.**

Table. Definitions of ICS dose levels in adults

Inhaled corticosteroid	Daily dose (microg)		
	Low	Medium	High
Beclometasone dipropionate †	100–200	250–400	>400
Budesonide	200–400	500–800	>800
Ciclesonide	80–160	240–320	>320
*Fluticasone furoate**	—	100	200
Fluticasone propionate	100–200	250–500	>500

† Dose equivalents for *Qvar* (TGA-registered CFC-free formulation of beclometasone dipropionate).

***Fluticasone furoate is not available as a low dose. TGA-registered formulations of fluticasone furoate contain a medium or high dose of fluticasone furoate and should only be prescribed as one inhalation once daily.**

Note: The potency of generic formulations may differ from that of original formulations. Check TGA-approved product information for details.

Sources

Respiratory Expert Group, Therapeutic Guidelines Limited. *Therapeutic Guidelines: Respiratory, Version 4***. Therapeutic Guidelines Limited, Melbourne, 2009.**

GlaxoSmithKline Australia Pty Ltd. Product Information: *Breo (fluticasone furoate; vilanterol) Ellipta***. Therapeutic Goods Administration, Canberra, 2014. Available from: https://www.ebs.tga.gov.au/**

GlaxoSmithKline Australia Pty Ltd. Product Information: *Arnuity (fluticasone furoate) Ellipta***. Therapeutic Goods Administration, Canberra, 2016. Available from: https://www.ebs.tga.gov.au/**

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Asset ID: 22

How this recommendation was developed

Consensus

Based on clinical experience and expert opinion (informed by evidence, where available), with particular reference to the

following source(s):

- Etminan *et al.* 2008[2]
- Suissa *et al.* 2010[3]
- Weatherall *et al.* 2009[4]
- Wisniewski *et al.* 1997[5]

When dispensing asthma medicines in pharmacies, routinely ask when was the person's last asthma review. Encourage them to visit their GP for comprehensive review as soon as possible if any of the following apply:

- **Last review was 6 months ago or earlier.**
- **The person has recently experienced poor asthma control or worsening asthma.**
- **The person does not have a current written asthma action plan.**
- **The person is experiencing acute asthma.**

How this recommendation was developed

Consensus

Based on clinical experience and expert opinion (informed by evidence, where available).

More information

Inhaled corticosteroids for adults: adverse effects

Local adverse effects

Hoarseness (dysphonia) and candidiasis are the most common local adverse effects of inhaled corticosteroids with both pressurised metered-dose inhalers and dry-powder inhalers:[6]

- The rate of of dysphonia among patients taking inhaled corticosteroids has been estimated at 5–20%.[7] However, higher rates of up to 58% have been reported in some studies.[8] The risk varies with the device used.
- The rate of oropharyngeal candidiasis among adults using inhaled corticosteroids has been estimated at 5–7%, with positive mouth culture for *Candida albicans* in approximately 25% of patients. However, higher rates of up to 70% have been reported in some studies. The risk depends on the formulation, dose and dose frequency.[7]

When taking inhaled corticosteroids via pressurised metered-dose inhalers, the use of a spacer reduces the risk of dysphonia and candidiasis.[9] Spacers improve delivery of the medicine to the airways.

Quick mouth rinsing immediately after inhaling effectively removes a high proportion of remaining medicine.[10] This may reduce the risk of oropharyngeal candidiasis ('thrush').

The incidence of dysphonia and candidiasis is significantly lower with ciclesonide than with equivalent doses of fluticasone propionate.[11] This may an important consideration for patients who experience dysphonia, particularly for those for whom voice quality is important (e.g. singers, actors, teachers). With ciclesonide, the rate of adverse effects may not differ when taken with or without a spacer.[12]

▶ Go to: National Asthma Council Australia's *Inhaler technique in adults with asthma or COPD* information paper

Systemic adverse effects

Cross-sectional population studies have reported lower bone mineral density with long-term use of high doses of inhaled corticosteroid,[5] but the effect on fracture risk in patients with asthma is unclear.

A meta-analysis of randomised controlled trials in adults older than 40 years with COPD (in which osteoporosis is more common) or asthma found no association between the use of inhaled corticosteroid and fracture risk overall, but found a slight increase in fracture risk among those using high doses.[2]

Cross-sectional studies show a dose–response relationship between inhaled corticosteroid use for asthma or COPD, and risk of cataracts in adults.[4]

Long-term inhaled corticosteroid use for asthma or COPD is associated with a small increase in the risk of developing diabetes, and in the risk of diabetes progression. These risks are greatest at higher doses (equivalent to fluticasone propionate 1000 microg/day or higher).[3]

The incidence of osteoporosis, cataracts and diabetes increases with age, and these conditions are also more common in smokers and in patients with COPD. Few studies have assessed risk specifically in patients with asthma.

Patients at risk of osteoporosis should be referred for bone density screening, screened for vitamin D and/or calcium deficiency, and provided with advice about maintaining bone health.

▶ Go to: Australian and New Zealand Bone and Mineral Society's *Vitamin D and health in adults in Australia and New Zealand: a position statement*
Go to: Osteoporosis Australia's *Building healthy bones throughout life: an evidence-informed strategy to prevent osteoporosis in Australia*

Patient concerns about adverse effects

The prevalence of side effects that patients consider troubling increases with increasing dose of inhaled corticosteroids.[13] Mid and high doses are consistently associated with a higher intensity and a higher prevalence of reported adverse effects, after controlling for other factors.[13]

A high proportion of people with asthma may have misunderstandings and fears about using inhaled corticosteroids,[14, 15] such as fears about weight gain, unwanted muscle development, bone fractures, susceptibility to infections and reduction of efficacy of the medicine over time.[14] Most people do not discuss their concerns about inhaled corticosteroid treatment with health professionals.[14] Safety concerns are a major reason for poor adherence, particularly general concerns about corticosteroids rather than concerns about specific adverse effects.[16]

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Ongoing monitoring of asthma in adults

Asthma monitoring includes both self-monitoring by patients and periodic assessments by the clinician.

Asthma management in primary care should include periodic reassessment of (both):[17]

- **recent asthma symptom control** based on symptoms over the previous 4 weeks, with or without lung function testing. In many patients in primary care, symptoms, reliever use and lung function are useful surrogate measures of the degree to which the underlying disease process is controlled.
- **risk factors** that predict poor asthma outcomes (e.g. flare-ups, accelerated decline in lung function, or treatment-related adverse effects) independent of the person's level of recent asthma symptom control.

Planned asthma check-ups should be made at intervals determined by both the individual's level of recent asthma symptom control and risk factors. The following is a guide:

- 1–3 months after each adjustment to medications
- yearly for a person with no flare-up in the past 12 months and good symptom control for at least a year
- every 6 months for a person who has had a flare-up within the past 12 months or who has other risk factors for flare-ups or life-threatening asthma (e.g. smoking, previous recording of poor lung function on spirometry, history of admission to an intensive care unit for asthma)
- at least every 3 months for a person with severe asthma, work-exacerbated asthma, poor perception of airflow limitation, frequent rhinosinusitis symptoms, or other comorbid conditions that affect asthma control
- every 4–6 weeks for pregnant women.

Note: For patients with occupational asthma, management and follow-up by a specialist with experience in occupational asthma is recommended.

▶ See: *Managing asthma during pregnancy*
See: *Work-related asthma*

Assessing recent asthma control in adults: symptoms

Questionnaires

Questionnaire-based tools can be used to standardise review of asthma symptoms, e.g.:

- Primary care Asthma Control Screening tool (also known as Pharmacy Asthma Control Screening tool)[18] – a quick screening test to detect poor asthma control, developed and validated for use with Australian patients attending primary care
- UK Royal College of Physicians '3 Questions'[19, 20]
- Asthma Score (also known as Asthma Control Test).[21]
- *Asthma Control Questionnaire (ACQ)*

The questionnaires can be completed on paper in the waiting room and scored by the practice nurse. They have also been administered via an application on hand-held personal electronic devices, [22, 23] or by telephone.[24]

Note: Clinicians and researchers should only use the versions of the ACQ and Asthma Score that have been validated for use in the

Australian population. The wording and layout of questionnaires must not be changed.

Table. Primary care Asthma Control Screening tool (PACS)

Have you experienced any of the following more than once a week in the last month?	Yes	No
Symptoms of asthma, cough, wheeze, shortness of breath	•	•
Waking at night because of asthma	•	•
Chest tightness on waking	•	•
Difficulty in performing vigorous activity like running, lifting heavy objects, exercise	•	•
Difficulty in performing moderate activities like vacuuming, climbing flights of stairs	•	•

Interpretation: 'Yes' to any question indicates that the person may have poorly controlled asthma, so more detailed assessment is needed.

Source: LeMay KS, Armour CL, Reddel HK. Performance of a brief asthma control screening tool in community pharmacy: a cross-sectional and prospective longitudinal analysis. *Prim Care Respir J*; 2014. Available from: http://dx.doi.org/10.4104/pcrj.2014.00011

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Table. UK Royal College of Physicians '3 Questions' screening tool

In the last month:	Yes	No
Have you had difficulty sleeping because of your asthma symptoms (including cough)?	•	•
Have you had your usual asthma symptoms during the day (cough, wheeze, chest tightness or breathlessness)?	•	•
Has your asthma interfered with your usual activities (e.g. housework, work/school etc)?	•	•

Inerpetation:

No to all three questions indicates good control.

Yes to 2 or 3 questions indicates poor control.

Yes to 1 question indicates that more detailed questioning is needed to assess level of asthma control (using another validated questionnaire or by asking about frequency of daytime symptoms, reliever requirement, limitation of activities and symptoms at night or on waking during the previous month).

Note: This test provides a quick and easy way of confirming someone's asthma control is good, or identifying those who need more assessments.

Sources

Thomas M, Gruffydd-Jones K, Stonham C *et al.* Assessing asthma control in routine clinical practice: use of the Royal College of Physicians '3 Questions'. *Prim Care Respir J* 2009; 18: 83-8. Available from: http://www.nature.com/articles/pcrj200845

Pinnock H, Burton C, Campbell S *et al.* Clinical implications of the Royal College of Physicians three questions in routine asthma care:

a real-life validation study. *Prim Care Respir J* 2012; 21: 288-94. Available from: http://www.nature.com/articles/pcrj201252

Asset ID: 37

▶ See: *Asthma Score*

Symptom-guided management

Data from one UK study suggest that, for the majority of patients attending primary care, asthma symptoms are concordant with eosinophilic airway inflammation, and that symptoms can therefore be used as a guide to changing anti-inflammatory treatment.[25]

However, if symptoms do not improve as expected after a change in treatment, or if the person continues to experience flare-ups, it is necessary to measure lung function and consider other possible causes:

- Respiratory symptoms in a person with asthma may be due to non-asthma factors (e.g. cough due to post-nasal drip, shortness of breath due to obesity). Increasing the preventer treatment in such patients could result in unnecessarily high doses. A careful history (with lung function measurement in some patients) is necessary to confirm that symptoms are due to asthma, before deciding to change a person's treatment.
- Patients vary in their ability to perceive airflow limitation, so symptoms may be an unreliable measure of asthma control in some patients. Spirometry can help identify if the person is a poor perceiver of airflow limitation (e.g. person is unable to feel the difference when FEV_1 increases or decreases by 15%).

▶ See: *Diagnosing asthma in adults*

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Assessing asthma control in adults: spirometry

Spirometry is necessary when making the diagnosis of asthma and when establishing the patient's baseline and personal best status.

In ongoing asthma management, spirometry is useful in the following clinical situations:

- During a flare-up, spirometry provides objective evidence about the severity of bronchoconstriction.
- After a dose adjustment (either an increase or a decrease), change in lung function measured by spirometry provides additional information about the response to treatment.
- Spirometry can help identify if the person's symptoms may be due to non-asthma conditions (e.g. for a patient with frequent respiratory symptoms, FEV_1 above 80–90% predicted should prompt consideration of an alternative cause).
- Spirometry can help identify if the person is a poor perceiver of airflow limitation (e.g. person is unable to feel the difference when FEV_1 increases or decreases by 15%).
- Repeating spirometry over time may identify lung function decline that is more rapid than expected decline due to ageing alone, so the person can be referred for specialist review. (Spirometry should be repeated approximately every 1–2 years in most patients but more frequently as indicated by individual needs.)

There are limits to the amount of information that can be gained from spirometry alone:

- For an individual, spirometry readings are not closely reproducible between visits, so only a change in FEV_1 of greater than 0.2 L and 12% from baseline can be considered clinically meaningful in adults.[26]
- Older people with long-standing asthma may develop fixed (irreversible or incompletely reversible) airflow limitation. Reliance solely on lung function expressed as percentage predicted value as a guide to adjusting preventer treatment would risk dose-escalation and over-treatment in these patients.
- At the population level, spirometry correlates poorly with symptom-based measures of asthma control,[27] so in individual patients it is not possible to predict lung function from symptoms or vice versa.

To obtain reliable, good-quality readings, the spirometer must be well maintained and correctly calibrated, and the operator must be adequately trained and experienced.

▶ Go to: National Asthma Council Australia's *Spirometry Resources*

Self-monitoring in adults using peak expiratory flow

Peak flow monitoring is no longer routinely used in Australia, but is recommended for patients with severe asthma, a history of frequent flare-ups, or poor perception of airflow limitation.

Peak expiratory flow can be monitored at home using a mechanical or electronic peak flow meter, either regularly every day or when symptoms are worse. For patients who are willing to measure peak flow regularly, morning and evening readings can be plotted on a graph or recorded in a diary.

When peak flow monitoring results are recorded on a graph, the same chart should be used consistently so that patterns can be recognised. Flare-ups are easier to detect when the chart or image has a low ratio of width to height (aspect ratio), i.e. is compressed horizontally.[28]

When a person's written asthma action plan is based on peak expiratory flow, instructions should be based on personal best, rather than predicted values. Personal best can be determined as the highest reading over the previous 2 weeks. When a person begins high-dose inhaled corticosteroid treatment, personal best peak expiratory flow reaches a plateau within a few weeks with twice daily monitoring.[29]

▶ Go to: The National Asthma Council Australia and Woolcock Institute *Peak Flow Chart*

Assessing risk factors for adverse asthma outcomes in adults

Predicting poor asthma outcomes

As well as assessing recent asthma symptom control, it is necessary to assess each patient's risk of future asthma events or adverse treatment effects. (Recent asthma symptom control and risk of adverse events are both components of overall asthma control.)

Table. Risk factors for adverse asthma outcomes in adults and adolescents Please view and print this figure separately: http://www.asthmahandbook.org.au/table/show/40

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Table. Risk factors for adverse asthma outcomes in adults and adolescents

Risk factors for adverse asthma outcomes in adults and adolescents

	Medical history	Investigation findings	Other factors
Factors associated with increased risk of flare-ups	Poor asthma control Any asthma flare-up during the previous 12 months Other concurrent chronic lung disease	Poor lung function (even if few symptoms) Difficulty perceiving airflow limitation or the severity of flare-ups Eosinophilic airway inflammation§	Exposure to cigarette smoke (smoking or environmental exposure) Socioeconomic disadvantage Use of illegal substances Major psychosocial problems Mental illness
Factors associated with increased risk of life-threatening asthma	Intubation or admission to intensive care unit due to asthma (ever) 2 or more hospitalisations for asthma in past year 3 or more ED visits for asthma in the past year Hospitalisation or ED visit for asthma in the past month High short-acting $beta_2$ agonist use	Sensitivity to an unavoidable allergen (e.g. *Alternaria* species of common moulds)	Inadequate treatment Experience of side-effects of OCS use (may contribute to under-treatment or delayed presentation to hospital during flare-ups) Lack of written asthma action plan Socioeconomic disadvantage Living alone Mental illness

	Medical history	Investigation findings	Other factors
	• Dispensing of 3 or more canisters in a year (average 1.6 puffs per day) is associated with increased risk of flare-ups in adults and children. • Dispensing 12 or more canisters in a year (average 6.6 puffs per day) is associated with increased risk of asthma death. History of delayed presentation to hospital during flare-ups History of sudden-onset acute asthma Cardiovascular disease		Use of alcohol or illegal substances Poor access to health care (e.g. rural/remote region)
Factors associated with accelerated decline in lung function	Chronic mucus hypersecretion Severe asthma flare-up in a patient not taking ICS	Poor lung function Eosinophilic airway inflammation§	Exposure to cigarette smoke (smoking or environmental exposure) Occupational asthma
Factors associated with treatment-related adverse events	Long-term high-dose ICS Frequent use of OCS		Anxiety disorder (due to increased sensitivity to asthma symptoms and reluctance to reduce ICS dose when asthma well controlled) Euphoria with OCS use

§ White cell differential count on a peripheral blood sample is not currently recommended routinely in the investigation and management of asthma, but might be undertaken in the investigation of severe asthma to help guide biologic therapy.

▶ See: *Monoclonal antibody therapy*

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Table. Management of risk factors for adverse asthma outcomes in adults

Risk factor	Clinical action †
Any risk factor for flare-ups	Check patient has an appropriate action plan Carefully check inhaler technique and adherence, and identify any barriers to good adherence Review frequently (e.g. every 3 months)
Hospitalisation or ED visit for asthma or any asthma flare-up during the previous 12 months	Ask about triggers for flare-ups, and lead time
History of intubation or intensive care unit admission for asthma	Ensure action plan recommends early medical review when asthma worsens
Hospitalisation or ED visit for asthma in the past month	Emphasise importance of maintaining regular ICS use after symptoms improve Confirm that patient has resumed using SABA only when needed for symptoms
High SABA use (>3 canisters per year)	Check lung function If SABA use appears to be habitual, investigate causes and consider alternative strategies, e.g. short-term substitution of ipratropium for SABA
Long-term high-dose ICS	Consider gradual reduction of ICS dose if symptoms stable Monitor regularly (e.g. assessment of bone density, regular eye examinations) For local side-effects, ensure inhaler technique is appropriate
Poor lung function (even if few symptoms)	Consider 3-month trial of higher ICS dose, then recheck lung function Consider referral for detailed specialist investigation
Sensitivity to unavoidable allergens (e.g. **Alternaria** *species of common moulds)*	Refer for further investigation and management

Risk factor	Clinical action †
Exposure to cigarette smoke (smoking or environmental exposure)	Emphasise the importance of avoiding smoke Provide quitting strategies Consider increasing ICS dose (higher dose of ICS likely to be necessary to control asthma) Refer for assessment of asthma–COPD overlap
Difficulty perceiving airflow limitation or the severity of exacerbations	Regular PEF monitoring Action plan should recommend early review and measurement of lung function
No current written asthma action plan	Provide and explain written asthma action plan

† In addition to actions applicable to all risk factors

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Poor clinical control, as indicated by frequent asthma symptoms and frequent reliever use, is a very strong predictor of the risk of flare-ups in the future. Any asthma flare-up during the previous 12 months indicates higher risk of flare-up over the next 12 months. A history of artificial ventilation due to acute asthma, and admission to an intensive care unit due to acute asthma have been associated with increased risk of near-fatal asthma,[30] but there is not enough evidence to indicate how long this risk may persist over a person's lifetime. Other risk factors indicate increased probability of future flare-ups or accelerated decline in lung function, independent of the person's level of recent asthma symptom control.[21, 31]

Other factors may increase a person's risk of treatment-associated adverse effects. The most important of these are prescription of high dose treatment and frequent courses of oral steroids.

People with risk factors need more frequent asthma review, a carefully tailored written asthma action plan, and close attention to adherence and correct inhaler technique.

Inflammatory markers

Inflammatory markers, such as sputum eosinophil percentage or exhaled nitric oxide, are used in research and for managing severe asthma in patients attending secondary or tertiary care. Elevated sputum eosinophil levels and, to a lesser extent, elevated exhaled nitric oxide, are associated with increased risk of flare-ups. At present, treatment based on inflammatory markers is not recommended for routine use in primary care.

The value of inflammatory markers is being evaluated:

- Adjusting asthma treatment by monitoring exhaled nitric oxide does not reduce the rate of flare-ups or improve asthma control in adults and children, compared with adjusting treatment according to clinical symptoms or spirometry, based on a meta-analysis of randomised controlled clinical trials.[32] However, many of the studies were not optimally designed to answer this question,[33] and some comparator regimens did not match current recommended treatment options.
- In some studies, asthma treatment algorithms based on monitoring sputum eosinophil counts reduced flare-ups, compared with control-based management.[17, 34] However, most studies assessing treatment guided by sputum eosinophilia have been conducted in selected populations in a few research centres, and therefore may not apply to the general community population. Assessment of sputum inflammatory cells is not generally available at present even in secondary care.
- Limited evidence[25] suggests that patients whose symptoms do not match their degree of eosinophilic inflammation may benefit more from treatment monitoring using sputum eosinophil count than other patients.
- Monitoring inflammatory markers might enable safer down-titration of maintenance inhaled corticosteroid doses.

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Health system initiatives that support asthma care

Chronic Disease Management Medicare items

Patients with asthma are eligible for Chronic Disease Management Medicare items.[35] These include:

- Preparation of a GP Management Plan (Item 721)
- Review of a GP Management Plan (Item 732)
- Coordination of Team Care Arrangements (Item 723) for patients who need ongoing care from a multidisciplinary team of at least three health or care providers
- Coordination of a Review of Team Care Arrangements (Item 732)
- Contribution to a multidisciplinary care plan being prepared by another health or care provider (Item 729)
- Contribution to a multidisciplinary care plan being prepared for a resident of an aged care facility (Item 731).

GPs can be assisted by practice nurses, Aboriginal and Torres Strait Islander health practitioners, Aboriginal health workers and other health professionals.[35]

▶ Go to: Australian Government Department of Health's *Chronic Disease Management (CDM) Medicare Items* webpage

Asthma cycle of care

The *Asthma cycle of care* is an Australian Government initiative to support primary care health professionals (GPs, other medical practitioners and trainees) to provide asthma care. It is implemented through the *Practice Incentives Program (PIP) Asthma Incentive* and applies to the clinical care of people with moderate-to-severe asthma, generally defined as people with (any of):[36]

- symptoms on most days
- use of preventative medication
- bronchodilator use at least three times per week
- hospital attendance or admission following an acute asthma flare-up.

The *Asthma cycle of care* involves at least two asthma-related consultations within 12 months for a patient with moderate-to-severe asthma, of which at least one visit is a planned asthma review. Each consultation includes:

- documenting the diagnosis, assessing asthma severity and assessing level of recent asthma symptom control
- reviewing the patient's use of and access to asthma medicines and inhaler devices
- providing a written asthma action plan (or documented alternative, if the patient is unable to use a written action plan)
- providing asthma self-management education
- reviewing the written or documented asthma action plan.

▶ Go to: Australian Government Department of Health's *Asthma cycle of care*
Go to: Medicare's *Practice Incentive Program (PIP)*

The Personally Controlled eHealth Record System

The eHealth record is an electronic record for a patient that contains a summary of their health information. Patients can choose to register for an eHealth record. Authorised healthcare professionals can access a patient's record and upload information to the record if their healthcare organisation has registered for the eHealth record system.

▶ Go to: Australian Government Department of Health's *eHealth Resources for Healthcare Providers*

Health system initiatives for Aboriginal and Torres Strait Islander people

Health system initiatives to support the care of Aboriginal and Torres Strait Islander people include:

- Health Assessment Medicare items
- The Indigenous Chronic Disease Package
- The Asthma Spacer Ordering System.

▶ See: *Asthma in Aboriginal and Torres Strait Islander peoples*

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Reviewing asthma opportunistically

Recommendations

At requests for repeat asthma scripts and whenever otherwise appropriate, consider screening for poor asthma control using the Primary care Asthma Control Screening.

Table. Primary care Asthma Control Screening tool (PACS)

Have you experienced any of the following more than once a week in the last month?	Yes	No
Symptoms of asthma, cough, wheeze, shortness of breath	•	•
Waking at night because of asthma	•	•
Chest tightness on waking	•	•
Difficulty in performing vigorous activity like running, lifting heavy objects, exercise	•	•
Difficulty in performing moderate activities like vacuuming, climbing flights of stairs	•	•

Interpretation: 'Yes' to any question indicates that the person may have poorly controlled asthma, so more detailed assessment is needed.

Source: **LeMay KS, Armour CL, Reddel HK. Performance of a brief asthma control screening tool in community pharmacy: a cross-sectional and prospective longitudinal analysis.** *Prim Care Respir J*; **2014. Available from: http://dx.doi.org/10.4104/pcrj.2014.00011**

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If the patient answers 'yes' to any question, further assessment is needed.

How this recommendation was developed

Consensus

Based on clinical experience and expert opinion (informed by evidence, where available).

At requests for repeat asthma scripts, always ask the person which asthma medicines they are using, using a non-judgemental and empathic manner (ask about both reliever and preventer use.)

If the person is not using prescribed preventer, use non-judgemental questions to find out why.

Table. Suggested questions to ask adults and older adolescents when assessing adherence to treatment

Source: **Foster JM, Smith L, Bosnic-Anticevich SZ et al. Identifying patient-specific beliefs and behaviours for conversations about adherence in asthma.** *Intern Med J* **2012; 42: e136-e44. Available from: http://www.ncbi.nlm.nih.gov/pubmed/21627747**

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How this recommendation was developed

Consensus

Based on clinical experience and expert opinion (informed by evidence, where available).

More information

Adherence to preventer treatment: adults and adolescents

Most patients do not take their preventer medication as often as prescribed, particularly when symptoms improve, or are mild or infrequent. Whenever asthma control is poor despite apparently adequate treatment, poor adherence, as well as poor inhaler technique, are probable reasons to consider.

Poor adherence may be intentional and/or unintentional. Intentional poor adherence may be due to the person's belief that the medicine is not necessary, or to perceived or actual adverse effects. Unintentional poor adherence may be due to forgetting or cost barriers.

Common barriers to the correct use of preventers include:

- being unable to afford the cost of medicines or consultations to adjust the regimen
- concerns about side effects
- interference of the regimen with the person's lifestyle
- forgetting to take medicines
- lack of understanding of the reason for taking the medicines
- inability to use the inhaler device correctly due to physical or cognitive factors
- health beliefs that are in conflict with the belief that the prescribed medicines are effective, necessary or safe (e.g. a belief that the prescribed preventer dose is 'too strong' or only for flare-ups, a belief that asthma can be overcome by psychological effort, a belief that complementary and alternative therapies are more effective or appropriate than prescribed medicines, mistrust of the health professional).

Adherence to preventers is significantly improved when patients are given the opportunity to negotiate the treatment regimen based on their goals and preferences.[1]

Assessment of adherence requires an open, non-judgemental approach.

Accredited pharmacists who undertake Home Medicines Reviews can assess adherence while conducting a review.

Table. Suggested questions to ask adults and older adolescents when assessing adherence to treatment

1. *Many people don't take their medication as prescribed. In the last four weeks:*
   - how many days a week would you have taken your preventer medication? None at all? One? Two? (etc).
   - how many times a day would you take it? Morning only? Evening only? Morning and evening? (or other)
   - each time, how many puffs would you take? One? Two? (etc).

2. *Do you find it easier to remember your medication in the morning, or the evening?*

Source: Foster JM, Smith L, Bosnic-Anticevich SZ et al. Identifying patient-specific beliefs and behaviours for conversations about adherence in asthma. *Intern Med J* 2012; 42: e136-e44. Available from: http://www.ncbi.nlm.nih.gov/pubmed/21627747

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▶ Go to: Medicare's *Home Medicines Review (HMR)*

Health system initiatives that support asthma care

Chronic Disease Management Medicare items

Patients with asthma are eligible for Chronic Disease Management Medicare items.[2] These include:

- Preparation of a GP Management Plan (Item 721)
- Review of a GP Management Plan (Item 732)
- Coordination of Team Care Arrangements (Item 723) for patients who need ongoing care from a multidisciplinary team of at least three health or care providers
- Coordination of a Review of Team Care Arrangements (Item 732)
- Contribution to a multidisciplinary care plan being prepared by another health or care provider (Item 729)
- Contribution to a multidisciplinary care plan being prepared for a resident of an aged care facility (Item 731).

GPs can be assisted by practice nurses, Aboriginal and Torres Strait Islander health practitioners, Aboriginal health workers and other health professionals.[2]

▶ Go to: Australian Government Department of Health's *Chronic Disease Management (CDM) Medicare Items* webpage

Asthma cycle of care

The *Asthma cycle of care* is an Australian Government initiative to support primary care health professionals (GPs, other medical practitioners and trainees) to provide asthma care. It is implemented through the *Practice Incentives Program (PIP) Asthma Incentive* and applies to the clinical care of people with moderate-to-severe asthma, generally defined as people with (any of):[3]

- symptoms on most days
- use of preventative medication
- bronchodilator use at least three times per week
- hospital attendance or admission following an acute asthma flare-up.

The *Asthma cycle of care* involves at least two asthma-related consultations within 12 months for a patient with moderate-to-severe asthma, of which at least one visit is a planned asthma review. Each consultation includes:

- documenting the diagnosis, assessing asthma severity and assessing level of recent asthma symptom control
- reviewing the patient's use of and access to asthma medicines and inhaler devices
- providing a written asthma action plan (or documented alternative, if the patient is unable to use a written action plan)
- providing asthma self-management education
- reviewing the written or documented asthma action plan.

▶ Go to: Australian Government Department of Health's *Asthma cycle of care*
Go to: Medicare's *Practice Incentive Program (PIP)*

The Personally Controlled eHealth Record System

The eHealth record is an electronic record for a patient that contains a summary of their health information. Patients can choose to register for an eHealth record. Authorised healthcare professionals can access a patient's record and upload information to the record if their healthcare organisation has registered for the eHealth record system.

▶ Go to: Australian Government Department of Health's *eHealth Resources for Healthcare Providers*

Health system initiatives for Aboriginal and Torres Strait Islander people

Health system initiatives to support the care of Aboriginal and Torres Strait Islander people include:

- Health Assessment Medicare items
- The Indigenous Chronic Disease Package
- The Asthma Spacer Ordering System.

▶ See: *Asthma in Aboriginal and Torres Strait Islander peoples*

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Reviewing asthma during visits for respiratory symptoms

Recommendations

When a person presents with respiratory symptoms, assess the cause, considering causes other than asthma.

How this recommendation was developed

Consensus

Based on clinical experience and expert opinion (informed by evidence, where available).

If current symptoms are probably due to asthma, assess:

- **level of recent asthma symptom control including symptoms and reliever use**
- **flare-ups during the previous 12 months**
- **lung function (if possible)**
- **other risk factors (e.g. smoking, exposure to other triggers) or comorbid conditions**
- **current treatment, including adherence to preventer if prescribed. Do not assume the person is taking the dose most recently prescribed. Ask which asthma medicines the person is using, in a non-judgmental, empathic manner.**
- **inhaler technique. Watch the person use their inhaler.**
- **whether the person has a written asthma action plan. If so, ask if they have followed it and whether it has helped.**

Table. Definition of levels of recent asthma symptom control in adults and adolescents (regardless of current treatment regimen)

Good control	Partial control	Poor control
All of: • **Daytime symptoms ≤2 days per week** • **Need for SABA reliever ≤2 days per week†** • **No limitation of activities** • **No symptoms during night or on waking**	**One or two of:** • **Daytime symptoms >2 days per week** • **Need for SABA reliever >2 days per week†** • **Any limitation of activities** • **Any symptoms during night or on waking**	**Three or more of:** • **Daytime symptoms >2 days per week** • **Need for SABA reliever >2 days per week†** • **Any limitation of activities** • **Any symptoms during night or on waking**

SABA: short-acting beta$_2$-agonist

† SABA, not including doses taken prophylactically before exercise. (Record this separately and take into account when assessing management.)

Note: Recent asthma symptom control is based on symptoms over the previous 4 weeks.

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Table. Risk factors for adverse asthma outcomes in adults and adolescents

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Table. Management of risk factors for adverse asthma outcomes in adults

Risk factor	**Clinical action †**
Any risk factor for flare-ups	**Check patient has an appropriate action plan** **Carefully check inhaler technique and adherence, and identify any barriers to good adherence** **Review frequently (e.g. every 3 months)**
Hospitalisation or ED visit for asthma or any asthma flare-up during the previous 12 months	**Ask about triggers for flare-ups, and lead time**
History of intubation or intensive care unit admission for asthma	**Ensure action plan recommends early medical review when asthma worsens**
Hospitalisation or ED visit for asthma in the past month	**Emphasise importance of maintaining regular ICS use after symptoms improve** **Confirm that patient has resumed using SABA only when needed for symptoms**
High SABA use (>3 canisters per year)	**Check lung function** **If SABA use appears to be habitual, investigate causes and consider alternative strategies, e.g. short-term substitution of ipratropium for SABA**
Long-term high-dose ICS	**Consider gradual reduction of ICS dose if symptoms stable** **Monitor regularly (e.g. assessment of bone density, regular eye examinations)** **For local side-effects, ensure inhaler technique is appropriate**
Poor lung function (even if few symptoms)	**Consider 3-month trial of higher ICS dose, then recheck lung function** **Consider referral for detailed specialist investigation**
Sensitivity to unavoidable allergens (e.g. **Alternaria** *species of common moulds)*	**Refer for further investigation and management**
Exposure to cigarette smoke (smoking or environmental exposure)	**Emphasise the importance of avoiding smoke** **Provide quitting strategies** **Consider increasing ICS dose (higher dose of ICS likely to be necessary to control asthma)** **Refer for assessment of asthma–COPD overlap**

Risk factor	Clinical action †
Difficulty perceiving airflow limitation or the severity of exacerbations	**Regular PEF monitoring** **Action plan should recommend early review and measurement of lung function**
No current written asthma action plan	**Provide and explain written asthma action plan**

† In addition to actions applicable to all risk factors

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Table. Suggested questions to ask adults and older adolescents when assessing adherence to treatment

1. *Many people don't take their medication as prescribed. In the last four weeks:*
- **how many days a week would you have taken your preventer medication? None at all? One? Two? (etc).**
- **how many times a day would you take it? Morning only? Evening only? Morning and evening? (or other)**
- **each time, how many puffs would you take? One? Two? (etc).**

2. *Do you find it easier to remember your medication in the morning, or the evening?*

Source: **Foster JM, Smith L, Bosnic-Anticevich SZ et al. Identifying patient-specific beliefs and behaviours for conversations about adherence in asthma.** *Intern Med J* **2012; 42: e136-e44. Available from: http://www.ncbi.nlm.nih.gov/pubmed/21627747**

Asset ID: 38

How this recommendation was developed

Consensus

Based on clinical experience and expert opinion (informed by evidence, where available).

More information

Ongoing monitoring of asthma in adults

Asthma monitoring includes both self-monitoring by patients and periodic assessments by the clinician.

Asthma management in primary care should include periodic reassessment of (both):[1]

- **recent asthma symptom control** based on symptoms over the previous 4 weeks, with or without lung function testing. In many patients in primary care, symptoms, reliever use and lung function are useful surrogate measures of the degree to which the underlying disease process is controlled.
- **risk factors** that predict poor asthma outcomes (e.g. flare-ups, accelerated decline in lung function, or treatment-related adverse effects) independent of the person's level of recent asthma symptom control.

Planned asthma check-ups should be made at intervals determined by both the individual's level of recent asthma symptom control and risk factors. The following is a guide:

- 1–3 months after each adjustment to medications
- yearly for a person with no flare-up in the past 12 months and good symptom control for at least a year
- every 6 months for a person who has had a flare-up within the past 12 months or who has other risk factors for flare-ups or life-threatening asthma (e.g. smoking, previous recording of poor lung function on spirometry, history of admission to an intensive care unit for asthma)
- at least every 3 months for a person with severe asthma, work-exacerbated asthma, poor perception of airflow limitation, frequent

rhinosinusitis symptoms, or other comorbid conditions that affect asthma control
- every 4–6 weeks for pregnant women.

Note: For patients with occupational asthma, management and follow-up by a specialist with experience in occupational asthma is recommended.

▶ See: *Managing asthma during pregnancy*
See: *Work-related asthma*

Assessing recent asthma control in adults: symptoms

Questionnaires

Questionnaire-based tools can be used to standardise review of asthma symptoms, e.g.:

- Primary care Asthma Control Screening tool (also known as Pharmacy Asthma Control Screening tool)[2] – a quick screening test to detect poor asthma control, developed and validated for use with Australian patients attending primary care
- UK Royal College of Physicians '3 Questions'[3, 4]
- Asthma Score (also known as Asthma Control Test).[5]
- *Asthma Control Questionnaire (ACQ)*

The questionnaires can be completed on paper in the waiting room and scored by the practice nurse. They have also been administered via an application on hand-held personal electronic devices, [6, 7] or by telephone.[8]

Note: Clinicians and researchers should only use the versions of the ACQ and Asthma Score that have been validated for use in the Australian population. The wording and layout of questionnaires must not be changed.

Table. Primary care Asthma Control Screening tool (PACS)

Have you experienced any of the following more than once a week in the last month?	Yes	No
Symptoms of asthma, cough, wheeze, shortness of breath	•	•
Waking at night because of asthma	•	•
Chest tightness on waking	•	•
Difficulty in performing vigorous activity like running, lifting heavy objects, exercise	•	•
Difficulty in performing moderate activities like vacuuming, climbing flights of stairs	•	•

Interpretation: 'Yes' to any question indicates that the person may have poorly controlled asthma, so more detailed assessment is needed.

Source: LeMay KS, Armour CL, Reddel HK. Performance of a brief asthma control screening tool in community pharmacy: a cross-sectional and prospective longitudinal analysis. *Prim Care Respir J*; 2014. Available from: http://dx.doi.org/10.4104/pcrj.2014.00011

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Table. UK Royal College of Physicians '3 Questions' screening tool

In the last month:	Yes	No
Have you had difficulty sleeping because of your asthma symptoms (including cough)?	•	•

In the last month:	Yes	No
Have you had your usual asthma symptoms during the day (cough, wheeze, chest tightness or breathlessness)?	•	•
Has your asthma interfered with your usual activities (e.g. housework, work/school etc)?	•	•

Inerpetation:

No to all three questions indicates good control.

Yes to 2 or 3 questions indicates poor control.

Yes to 1 question indicates that more detailed questioning is needed to assess level of asthma control (using another validated questionnaire or by asking about frequency of daytime symptoms, reliever requirement, limitation of activities and symptoms at night or on waking during the previous month).

Note: This test provides a quick and easy way of confirming someone's asthma control is good, or identifying those who need more assessments.

Sources

Thomas M, Gruffydd-Jones K, Stonham C *et al.* Assessing asthma control in routine clinical practice: use of the Royal College of Physicians '3 Questions'. *Prim Care Respir J* 2009; 18: 83-8. Available from: http://www.nature.com/articles/pcrj200845

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Asset ID: 37

▶ See: *Asthma Score*

Symptom-guided management

Data from one UK study suggest that, for the majority of patients attending primary care, asthma symptoms are concordant with eosinophilic airway inflammation, and that symptoms can therefore be used as a guide to changing anti-inflammatory treatment.[9]

However, if symptoms do not improve as expected after a change in treatment, or if the person continues to experience flare-ups, it is necessary to measure lung function and consider other possible causes:

- Respiratory symptoms in a person with asthma may be due to non-asthma factors (e.g. cough due to post-nasal drip, shortness of breath due to obesity). Increasing the preventer treatment in such patients could result in unnecessarily high doses. A careful history (with lung function measurement in some patients) is necessary to confirm that symptoms are due to asthma, before deciding to change a person's treatment.
- Patients vary in their ability to perceive airflow limitation, so symptoms may be an unreliable measure of asthma control in some patients. Spirometry can help identify if the person is a poor perceiver of airflow limitation (e.g. person is unable to feel the difference when FEV_1 increases or decreases by 15%).

▶ See: *Diagnosing asthma in adults*

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Assessing asthma control in adults: spirometry

Spirometry is necessary when making the diagnosis of asthma and when establishing the patient's baseline and personal best status.

In ongoing asthma management, spirometry is useful in the following clinical situations:

- During a flare-up, spirometry provides objective evidence about the severity of bronchoconstriction.
- After a dose adjustment (either an increase or a decrease), change in lung function measured by spirometry provides additional information about the response to treatment.
- Spirometry can help identify if the person's symptoms may be due to non-asthma conditions (e.g. for a patient with frequent respiratory symptoms, FEV_1 above 80–90% predicted should prompt consideration of an alternative cause).
- Spirometry can help identify if the person is a poor perceiver of airflow limitation (e.g. person is unable to feel the difference when FEV_1 increases or decreases by 15%).
- Repeating spirometry over time may identify lung function decline that is more rapid than expected decline due to ageing alone, so

the person can be referred for specialist review. (Spirometry should be repeated approximately every 1–2 years in most patients but more frequently as indicated by individual needs.)

There are limits to the amount of information that can be gained from spirometry alone:

- For an individual, spirometry readings are not closely reproducible between visits, so only a change in FEV_1 of greater than 0.2 L and 12% from baseline can be considered clinically meaningful in adults.[10]
- Older people with long-standing asthma may develop fixed (irreversible or incompletely reversible) airflow limitation. Reliance solely on lung function expressed as percentage predicted value as a guide to adjusting preventer treatment would risk dose-escalation and over-treatment in these patients.
- At the population level, spirometry correlates poorly with symptom-based measures of asthma control,[11] so in individual patients it is not possible to predict lung function from symptoms or vice versa.

To obtain reliable, good-quality readings, the spirometer must be well maintained and correctly calibrated, and the operator must be adequately trained and experienced.

▶ Go to: National Asthma Council Australia's *Spirometry Resources*

Assessing risk factors for adverse asthma outcomes in adults

Predicting poor asthma outcomes

As well as assessing recent asthma symptom control, it is necessary to assess each patient's risk of future asthma events or adverse treatment effects. (Recent asthma symptom control and risk of adverse events are both components of overall asthma control.)

Table. Risk factors for adverse asthma outcomes in adults and adolescents Please view and print this figure separately: http://www.asthmahandbook.org.au/table/show/40

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Table. Risk factors for adverse asthma outcomes in adults and adolescents

Risk factors for adverse asthma outcomes in adults and adolescents

	Medical history	Investigation findings	Other factors
Factors associated with increased risk of flare-ups	Poor asthma control Any asthma flare-up during the previous 12 months Other concurrent chronic lung disease	Poor lung function (even if few symptoms) Difficulty perceiving airflow limitation or the severity of flare-ups Eosinophilic airway inflammation§	Exposure to cigarette smoke (smoking or environmental exposure) Socioeconomic disadvantage Use of illegal substances Major psychosocial problems Mental illness
Factors associated with increased risk of life-threatening asthma	Intubation or admission to intensive care unit due to asthma (ever) 2 or more hospitalisations for asthma in past year 3 or more ED visits for asthma in the past year Hospitalisation or ED visit	Sensitivity to an unavoidable allergen (e.g. *Alternaria* species of common moulds)	Inadequate treatment Experience of side-effects of OCS use (may contribute to under-treatment or delayed presentation to hospital during flare-ups) Lack of written asthma action plan

	Medical history	Investigation findings	Other factors
	for asthma in the past month High short-acting beta$_2$ agonist use • Dispensing of 3 or more canisters in a year (average 1.6 puffs per day) is associated with increased risk of flare-ups in adults and children. • Dispensing 12 or more canisters in a year (average 6.6 puffs per day) is associated with increased risk of asthma death. History of delayed presentation to hospital during flare-ups History of sudden-onset acute asthma Cardiovascular disease		Socioeconomic disadvantage Living alone Mental illness Use of alcohol or illegal substances Poor access to health care (e.g. rural/remote region)
Factors associated with accelerated decline in lung function	Chronic mucus hypersecretion Severe asthma flare-up in a patient not taking ICS	Poor lung function Eosinophilic airway inflammation§	Exposure to cigarette smoke (smoking or environmental exposure) Occupational asthma
Factors associated with treatment-related adverse events	Long-term high-dose ICS Frequent use of OCS		Anxiety disorder (due to increased sensitivity to asthma symptoms and reluctance to reduce ICS dose when asthma well controlled) Euphoria with OCS use

§ White cell differential count on a peripheral blood sample is not currently recommended routinely in the investigation and management of asthma, but might be undertaken in the investigation of severe asthma to help guide biologic therapy.

▶ See: *Monoclonal antibody therapy*

Sources

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Table. Management of risk factors for adverse asthma outcomes in adults

Risk factor	Clinical action †
Any risk factor for flare-ups	Check patient has an appropriate action plan Carefully check inhaler technique and adherence, and identify any barriers to good adherence Review frequently (e.g. every 3 months)
Hospitalisation or ED visit for asthma or any asthma flare-up during the previous 12 months	Ask about triggers for flare-ups, and lead time
History of intubation or intensive care unit admission for asthma	Ensure action plan recommends early medical review when asthma worsens
Hospitalisation or ED visit for asthma in the past month	Emphasise importance of maintaining regular ICS use after symptoms improve Confirm that patient has resumed using SABA only when needed for symptoms
High SABA use (>3 canisters per year)	Check lung function If SABA use appears to be habitual, investigate causes and consider alternative strategies, e.g. short-term substitution of ipratropium for SABA
Long-term high-dose ICS	Consider gradual reduction of ICS dose if symptoms stable Monitor regularly (e.g. assessment of bone density, regular eye examinations) For local side-effects, ensure inhaler technique is appropriate
Poor lung function (even if few	Consider 3-month trial of higher ICS dose, then recheck lung function

Risk factor	Clinical action †
symptoms)	Consider referral for detailed specialist investigation
Sensitivity to unavoidable allergens (e.g. **Alternaria** *species of common moulds)*	Refer for further investigation and management
Exposure to cigarette smoke (smoking or environmental exposure)	Emphasise the importance of avoiding smoke Provide quitting strategies Consider increasing ICS dose (higher dose of ICS likely to be necessary to control asthma) Refer for assessment of asthma–COPD overlap
Difficulty perceiving airflow limitation or the severity of exacerbations	Regular PEF monitoring Action plan should recommend early review and measurement of lung function
No current written asthma action plan	Provide and explain written asthma action plan

† In addition to actions applicable to all risk factors

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Poor clinical control, as indicated by frequent asthma symptoms and frequent reliever use, is a very strong predictor of the risk of flare-ups in the future. Any asthma flare-up during the previous 12 months indicates higher risk of flare-up over the next 12 months. A history of artificial ventilation due to acute asthma, and admission to an intensive care unit due to acute asthma have been associated with increased risk of near-fatal asthma,[12] but there is not enough evidence to indicate how long this risk may persist over a person's lifetime. Other risk factors indicate increased probability of future flare-ups or accelerated decline in lung function, independent of the person's level of recent asthma symptom control.[5, 13]

Other factors may increase a person's risk of treatment-associated adverse effects. The most important of these are prescription of high dose treatment and frequent courses of oral steroids.

People with risk factors need more frequent asthma review, a carefully tailored written asthma action plan, and close attention to adherence and correct inhaler technique.

Inflammatory markers

Inflammatory markers, such as sputum eosinophil percentage or exhaled nitric oxide, are used in research and for managing severe asthma in patients attending secondary or tertiary care. Elevated sputum eosinophil levels and, to a lesser extent, elevated exhaled nitric oxide, are associated with increased risk of flare-ups. At present, treatment based on inflammatory markers is not recommended for routine use in primary care.

The value of inflammatory markers is being evaluated:

- Adjusting asthma treatment by monitoring exhaled nitric oxide does not reduce the rate of flare-ups or improve asthma control in adults and children, compared with adjusting treatment according to clinical symptoms or spirometry, based on a meta-analysis of randomised controlled clinical trials.[14] However, many of the studies were not optimally designed to answer this question,[15] and some comparator regimens did not match current recommended treatment options.
- In some studies, asthma treatment algorithms based on monitoring sputum eosinophil counts reduced flare-ups, compared with control-based management.[1, 16] However, most studies assessing treatment guided by sputum eosinophilia have been conducted in selected populations in a few research centres, and therefore may not apply to the general community population. Assessment of sputum inflammatory cells is not generally available at present even in secondary care.
- Limited evidence[9] suggests that patients whose symptoms do not match their degree of eosinophilic inflammation may benefit more from treatment monitoring using sputum eosinophil count than other patients.
- Monitoring inflammatory markers might enable safer down-titration of maintenance inhaled corticosteroid doses.

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Correct use of inhaler devices

Checking and correcting inhaler technique is essential to effective asthma management.

Most patients with asthma or COPD do not use their inhalers properly,[17, 18,19, 19, 20] and most have not had their technique checked or corrected by a health professional.

Incorrect inhaler technique when using maintenance treatments increases the risk of severe flare-ups and hospitalisation for people with asthma or COPD.[17, 18, 21, 22, 23, 24]

Poor asthma symptom control is often due to incorrect inhaler technique.[25, 26]

Incorrect inhaler technique when using inhaled corticosteroids increases the risk of local side effects like dysphonia and oral thrush.

The steps for using an inhaler device correctly differ between brands. Checklists of correct steps for each inhaler type and how-to videos are available from the National Asthma Council website.

▶ Go to: National Asthma Council Australia's *Using your inhaler* webpage for information, patient resources and videos on inhaler technique
Go to: National Asthma Council Australia's information paper for health professionals on *Inhaler technique for people with asthma or COPD*
Go to: NPS MedicineWise information on *Inhaler devices for respiratory medicines*

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Written asthma action plans for adults

Every person with asthma should have their own written asthma action plan.

When provided with appropriate self-management education, self-monitoring and medical review, individualised written action plans consistently improve asthma health outcomes if they include two to four action points, and provide instructions for use of both inhaled corticosteroid and oral corticosteroids for treatment of flare-ups.[27] Written asthma action plans are effective if based on symptoms[28] or personal best peak expiratory flow (not on percentage predicted).[27]

How to develop and review a written asthma action plan

A written asthma action plan should include all the following:

- a list of the person's usual medicines (names of medicines, doses, when to take each dose) – including treatment for related conditions such as allergic rhinitis
- clear instructions on how to change medication (including when and how to start a course of oral corticosteroids) in all the following situations:
  - when asthma is getting worse (e.g. when needing more reliever than usual, waking up with asthma, more symptoms than usual, asthma is interfering with usual activities)
  - when asthma symptoms get substantially worse (e.g. when needing reliever again within 3 hours, experiencing increasing difficulty breathing, waking often at night with asthma symptoms)
  - when peak flow falls below an agreed rate (for those monitoring peak flow each day)
  - during an asthma emergency.
- instructions on when and how to get medical care (including contact telephone numbers)
- the name of the person writing the action plan, and the date it was issued.

Table. Options for adjusting medicines in a written asthma action plan for adults

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Table. Checklist for reviewing a written asthma action plan

- Ask if the person (or parent) knows where their written asthma action plan is.
- Ask if they have used their written asthma action plan because of worsening asthma.
- Ask if the person (or parent) has had any problems using their written asthma action plan, or has any comments about whether they find it suitable and effective.
- Check that the medication recommendations are appropriate to the person's current treatment.
- Check that all action points are appropriate to the person's level of recent asthma symptom control.
- Check that the person (or parent) understands and is satisfied with the action points.
- If the written asthma action plan has been used because of worsening asthma more than once in the past 12 months: review

the person's usual asthma treatment, adherence, inhaler technique, and exposure to avoidable trigger factors.
- Check that the contact details for medical care and acute care are up to date.

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Templates for written asthma action plans

Templates are available from National Asthma Council Australia:

- National Asthma Council Australia colour-coded plan, available as a printed handout that folds to wallet size and as the *Asthma Buddy* mobile site
- Asthma Cycle of Care asthma action plan
- A plan designed for patients using budesonide/formoterol combination as maintenance and reliever therapy
- Remote Indigenous Australian Asthma Action Plan
- Every Day Asthma Action Plan (designed for remote Indigenous Australians who do not use written English – may also be useful for others for whom written English is inappropriate).

Some written asthma action plans are available in community languages.

Software for developing electronic pictorial asthma action plans[29, 30] is available online.

▶ Go to: National Asthma Council Australia's *Asthma Action Plan Library*
Download: Imperial College London's *Electronic Asthma Action Plan*

Health system initiatives that support asthma care

Chronic Disease Management Medicare items

Patients with asthma are eligible for Chronic Disease Management Medicare items.[31] These include:

- Preparation of a GP Management Plan (Item 721)
- Review of a GP Management Plan (Item 732)
- Coordination of Team Care Arrangements (Item 723) for patients who need ongoing care from a multidisciplinary team of at least three health or care providers
- Coordination of a Review of Team Care Arrangements (Item 732)
- Contribution to a multidisciplinary care plan being prepared by another health or care provider (Item 729)
- Contribution to a multidisciplinary care plan being prepared for a resident of an aged care facility (Item 731).

GPs can be assisted by practice nurses, Aboriginal and Torres Strait Islander health practitioners, Aboriginal health workers and other health professionals.[31]

▶ Go to: Australian Government Department of Health's *Chronic Disease Management (CDM) Medicare Items* webpage

Asthma cycle of care

The *Asthma cycle of care* is an Australian Government initiative to support primary care health professionals (GPs, other medical practitioners and trainees) to provide asthma care. It is implemented through the *Practice Incentives Program (PIP) Asthma Incentive* and applies to the clinical care of people with moderate-to-severe asthma, generally defined as people with (any of):[32]

- symptoms on most days
- use of preventative medication
- bronchodilator use at least three times per week
- hospital attendance or admission following an acute asthma flare-up.

The *Asthma cycle of care* involves at least two asthma-related consultations within 12 months for a patient with moderate-to-severe asthma, of which at least one visit is a planned asthma review. Each consultation includes:

- documenting the diagnosis, assessing asthma severity and assessing level of recent asthma symptom control
- reviewing the patient's use of and access to asthma medicines and inhaler devices
- providing a written asthma action plan (or documented alternative, if the patient is unable to use a written action plan)
- providing asthma self-management education
- reviewing the written or documented asthma action plan.

▶ Go to: Australian Government Department of Health's *Asthma cycle of care*
Go to: Medicare's *Practice Incentive Program (PIP)*

The Personally Controlled eHealth Record System

The eHealth record is an electronic record for a patient that contains a summary of their health information. Patients can choose to register for an eHealth record. Authorised healthcare professionals can access a patient's record and upload information to the record if their healthcare organisation has registered for the eHealth record system.

▶ Go to: Australian Government Department of Health's *eHealth Resources for Healthcare Providers*

Health system initiatives for Aboriginal and Torres Strait Islander people

Health system initiatives to support the care of Aboriginal and Torres Strait Islander people include:

- Health Assessment Medicare items
- The Indigenous Chronic Disease Package
- The Asthma Spacer Ordering System.

▶ See: *Asthma in Aboriginal and Torres Strait Islander peoples*

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Conducting asthma review at scheduled asthma visits

Recommendations

Validated checklists or questionnaires can be used at each visit to assess recent asthma symptom control or to screen for poor asthma control, e.g:

- *Asthma Score (Asthma Control Test)*
- **Primary care Asthma Control Screening**
- *Asthma Control Questionnaire (ACQ)*

Table. Primary care Asthma Control Screening tool (PACS)

Have you experienced any of the following more than once a week in the last month?	Yes	No
Symptoms of asthma, cough, wheeze, shortness of breath	•	•
Waking at night because of asthma	•	•
Chest tightness on waking	•	•
Difficulty in performing vigorous activity like running, lifting heavy objects, exercise	•	•
Difficulty in performing moderate activities like vacuuming, climbing flights of stairs	•	•

Interpretation: 'Yes' to any question indicates that the person may have poorly controlled asthma, so more detailed assessment is needed.

Source: **LeMay KS, Armour CL, Reddel HK. Performance of a brief asthma control screening tool in community pharmacy: a cross-sectional and prospective longitudinal analysis.** *Prim Care Respir J*; **2014. Available from: http://dx.doi.org/10.4104/pcrj.2014.00011**

Asset ID: 87

How this recommendation was developed

Consensus

Based on clinical experience and expert opinion (informed by evidence, where available).

At scheduled asthma visits, assess (all of):

- **any problems or issues the person is having with their asthma**

- **current level of control based on symptoms and reliever use during the previous 4 weeks**
- **flare-ups during the previous 12 months**
- **lung function (every 1–2 years for most people; more often when good asthma control has been lost or not achieved, or when the person has a known risk factor for accelerated loss of lung function)**
- **other risk factors (e.g. smoking, exposure to other triggers) or comorbid conditions**
- **current treatment, including adherence to preventer if prescribed. Do not assume the person is taking the dose most recently prescribed. Ask which asthma medicines the person is using, in a non-judgmental, empathic manner.**
- **inhaler technique**
- **whether the person has a written asthma action plan and knows how to use it, and whether it is up to date.**

Table. Definition of levels of recent asthma symptom control in adults and adolescents (regardless of current treatment regimen)

Good control	Partial control	Poor control
All of: • **Daytime symptoms ≤2 days per week** • **Need for SABA reliever ≤2 days per week†** • **No limitation of activities** • **No symptoms during night or on waking**	**One or two of:** • **Daytime symptoms >2 days per week** • **Need for SABA reliever >2 days per week†** • **Any limitation of activities** • **Any symptoms during night or on waking**	**Three or more of:** • **Daytime symptoms >2 days per week** • **Need for SABA reliever >2 days per week†** • **Any limitation of activities** • **Any symptoms during night or on waking**

SABA: short-acting beta$_2$-agonist

† SABA, not including doses taken prophylactically before exercise. (Record this separately and take into account when assessing management.)

Note: Recent asthma symptom control is based on symptoms over the previous 4 weeks.

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Table. Risk factors for adverse asthma outcomes in adults and adolescents

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Table. Management of risk factors for adverse asthma outcomes in adults

Risk factor	Clinical action †
Any risk factor for flare-ups	**Check patient has an appropriate action plan** **Carefully check inhaler technique and adherence, and identify any barriers to good adherence** **Review frequently (e.g. every 3 months)**
Hospitalisation or ED visit for asthma or any asthma flare-up during the previous 12 months	**Ask about triggers for flare-ups, and lead time**

Risk factor	Clinical action †
History of intubation or intensive care unit admission for asthma	**Ensure action plan recommends early medical review when asthma worsens**
Hospitalisation or ED visit for asthma in the past month	**Emphasise importance of maintaining regular ICS use after symptoms improve** **Confirm that patient has resumed using SABA only when needed for symptoms**
High SABA use (>3 canisters per year)	**Check lung function** **If SABA use appears to be habitual, investigate causes and consider alternative strategies, e.g. short-term substitution of ipratropium for SABA**
Long-term high-dose ICS	**Consider gradual reduction of ICS dose if symptoms stable** **Monitor regularly (e.g. assessment of bone density, regular eye examinations)** **For local side-effects, ensure inhaler technique is appropriate**
Poor lung function (even if few symptoms)	**Consider 3-month trial of higher ICS dose, then recheck lung function** **Consider referral for detailed specialist investigation**
Sensitivity to unavoidable allergens (e.g. **Alternaria** *species of common moulds)*	**Refer for further investigation and management**
Exposure to cigarette smoke (smoking or environmental exposure)	**Emphasise the importance of avoiding smoke** **Provide quitting strategies** **Consider increasing ICS dose (higher dose of ICS likely to be necessary to control asthma)** **Refer for assessment of asthma–COPD overlap**
Difficulty perceiving airflow limitation or the severity of exacerbations	**Regular PEF monitoring** **Action plan should recommend early review and measurement of lung function**
No current written asthma action plan	**Provide and explain written asthma action plan**

† In addition to actions applicable to all risk factors

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Table. Suggested questions to ask adults and older adolescents when assessing adherence to treatment

1. *Many people don't take their medication as prescribed. In the last four weeks:*

- **how many days a week would you have taken your preventer medication? None at all? One? Two? (etc).**
- **how many times a day would you take it? Morning only? Evening only? Morning and evening? (or other)**
- **each time, how many puffs would you take? One? Two? (etc).**

2. *Do you find it easier to remember your medication in the morning, or the evening?*

Source: **Foster JM, Smith L, Bosnic-Anticevich SZ et al. Identifying patient-specific beliefs and behaviours for conversations about adherence in asthma.** *Intern Med J* **2012; 42: e136-e44. Available from: http://www.ncbi.nlm.nih.gov/pubmed/21627747**

Asset ID: 38

How this recommendation was developed

Consensus

Based on clinical experience and expert opinion (informed by evidence, where available).

More information

Ongoing monitoring of asthma in adults

Asthma monitoring includes both self-monitoring by patients and periodic assessments by the clinician.

Asthma management in primary care should include periodic reassessment of (both):[1]

- **recent asthma symptom control** based on symptoms over the previous 4 weeks, with or without lung function testing. In many patients in primary care, symptoms, reliever use and lung function are useful surrogate measures of the degree to which the underlying disease process is controlled.
- **risk factors** that predict poor asthma outcomes (e.g. flare-ups, accelerated decline in lung function, or treatment-related adverse effects) independent of the person's level of recent asthma symptom control.

Planned asthma check-ups should be made at intervals determined by both the individual's level of recent asthma symptom control and risk factors. The following is a guide:

- 1–3 months after each adjustment to medications
- yearly for a person with no flare-up in the past 12 months and good symptom control for at least a year
- every 6 months for a person who has had a flare-up within the past 12 months or who has other risk factors for flare-ups or life-threatening asthma (e.g. smoking, previous recording of poor lung function on spirometry, history of admission to an intensive care unit for asthma)
- at least every 3 months for a person with severe asthma, work-exacerbated asthma, poor perception of airflow limitation, frequent rhinosinusitis symptoms, or other comorbid conditions that affect asthma control
- every 4–6 weeks for pregnant women.

Note: For patients with occupational asthma, management and follow-up by a specialist with experience in occupational asthma is recommended.

▶ See: *Managing asthma during pregnancy*
See: *Work-related asthma*

Assessing recent asthma control in adults: symptoms

Questionnaires

Questionnaire-based tools can be used to standardise review of asthma symptoms, e.g.:

- Primary care Asthma Control Screening tool (also known as Pharmacy Asthma Control Screening tool)[2] – a quick screening test to detect poor asthma control, developed and validated for use with Australian patients attending primary care
- UK Royal College of Physicians '3 Questions'[3, 4]
- Asthma Score (also known as Asthma Control Test).[5]
- *Asthma Control Questionnaire (ACQ)*

The questionnaires can be completed on paper in the waiting room and scored by the practice nurse. They have also been administered via an application on hand-held personal electronic devices, [6, 7] or by telephone.[8]

Note: Clinicians and researchers should only use the versions of the ACQ and Asthma Score that have been validated for use in the Australian population. The wording and layout of questionnaires must not be changed.

Table. Primary care Asthma Control Screening tool (PACS)

Have you experienced any of the following more than once a week in the last month?	Yes	No
Symptoms of asthma, cough, wheeze, shortness of breath	•	•
Waking at night because of asthma	•	•
Chest tightness on waking	•	•
Difficulty in performing vigorous activity like running, lifting heavy objects, exercise	•	•
Difficulty in performing moderate activities like vacuuming, climbing flights of stairs	•	•

Interpretation: 'Yes' to any question indicates that the person may have poorly controlled asthma, so more detailed assessment is needed.

Source: LeMay KS, Armour CL, Reddel HK. Performance of a brief asthma control screening tool in community pharmacy: a cross-sectional and prospective longitudinal analysis. *Prim Care Respir J*; 2014. Available from: http://dx.doi.org/10.4104/pcrj.2014.00011

Asset ID: 87

Table. UK Royal College of Physicians '3 Questions' screening tool

In the last month:	Yes	No
Have you had difficulty sleeping because of your asthma symptoms (including cough)?	•	•
Have you had your usual asthma symptoms during the day (cough, wheeze, chest tightness or breathlessness)?	•	•
Has your asthma interfered with your usual activities (e.g. housework, work/school etc)?	•	•

Inerpetation:

No to all three questions indicates good control.

Yes to 2 or 3 questions indicates poor control.

Yes to 1 question indicates that more detailed questioning is needed to assess level of asthma control (using another validated questionnaire or by asking about frequency of daytime symptoms, reliever requirement, limitation of activities and symptoms at night or on waking during the previous month).

Note: This test provides a quick and easy way of confirming someone's asthma control is good, or identifying those who need more assessments.

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Asset ID: 37

▶ See: *Asthma Score*

Symptom-guided management

Data from one UK study suggest that, for the majority of patients attending primary care, asthma symptoms are concordant with eosinophilic airway inflammation, and that symptoms can therefore be used as a guide to changing anti-inflammatory treatment.[9]

However, if symptoms do not improve as expected after a change in treatment, or if the person continues to experience flare-ups, it is necessary to measure lung function and consider other possible causes:

- Respiratory symptoms in a person with asthma may be due to non-asthma factors (e.g. cough due to post-nasal drip, shortness of breath due to obesity). Increasing the preventer treatment in such patients could result in unnecessarily high doses. A careful history (with lung function measurement in some patients) is necessary to confirm that symptoms are due to asthma, before deciding to change a person's treatment.
- Patients vary in their ability to perceive airflow limitation, so symptoms may be an unreliable measure of asthma control in some patients. Spirometry can help identify if the person is a poor perceiver of airflow limitation (e.g. person is unable to feel the difference when FEV_1 increases or decreases by 15%).

▶ See: *Diagnosing asthma in adults*

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Assessing asthma control in adults: spirometry

Spirometry is necessary when making the diagnosis of asthma and when establishing the patient's baseline and personal best status.

In ongoing asthma management, spirometry is useful in the following clinical situations:

- During a flare-up, spirometry provides objective evidence about the severity of bronchoconstriction.
- After a dose adjustment (either an increase or a decrease), change in lung function measured by spirometry provides additional information about the response to treatment.
- Spirometry can help identify if the person's symptoms may be due to non-asthma conditions (e.g. for a patient with frequent respiratory symptoms, FEV_1 above 80–90% predicted should prompt consideration of an alternative cause).
- Spirometry can help identify if the person is a poor perceiver of airflow limitation (e.g. person is unable to feel the difference when FEV_1 increases or decreases by 15%).
- Repeating spirometry over time may identify lung function decline that is more rapid than expected decline due to ageing alone, so the person can be referred for specialist review. (Spirometry should be repeated approximately every 1–2 years in most patients but more frequently as indicated by individual needs.)

There are limits to the amount of information that can be gained from spirometry alone:

- For an individual, spirometry readings are not closely reproducible between visits, so only a change in FEV_1 of greater than 0.2 L and 12% from baseline can be considered clinically meaningful in adults.[10]
- Older people with long-standing asthma may develop fixed (irreversible or incompletely reversible) airflow limitation. Reliance solely on lung function expressed as percentage predicted value as a guide to adjusting preventer treatment would risk dose-escalation and over-treatment in these patients.
- At the population level, spirometry correlates poorly with symptom-based measures of asthma control,[11] so in individual patients it is not possible to predict lung function from symptoms or vice versa.

To obtain reliable, good-quality readings, the spirometer must be well maintained and correctly calibrated, and the operator must be adequately trained and experienced.

▶ Go to: National Asthma Council Australia's *Spirometry Resources*

Assessing risk factors for adverse asthma outcomes in adults

Predicting poor asthma outcomes

As well as assessing recent asthma symptom control, it is necessary to assess each patient's risk of future asthma events or adverse treatment effects. (Recent asthma symptom control and risk of adverse events are both components of overall asthma control.)

Table. Risk factors for adverse asthma outcomes in adults and adolescents Please view and print this figure

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Table. Risk factors for adverse asthma outcomes in adults and adolescents

Risk factors for adverse asthma outcomes in adults and adolescents

	Medical history	**Investigation findings**	**Other factors**
Factors associated with increased risk of flare-ups	Poor asthma control Any asthma flare-up during the previous 12 months Other concurrent chronic lung disease	Poor lung function (even if few symptoms) Difficulty perceiving airflow limitation or the severity of flare-ups Eosinophilic airway inflammation[§]	Exposure to cigarette smoke (smoking or environmental exposure) Socioeconomic disadvantage Use of illegal substances Major psychosocial problems Mental illness
Factors associated with increased risk of life-threatening asthma	Intubation or admission to intensive care unit due to asthma (ever) 2 or more hospitalisations for asthma in past year 3 or more ED visits for asthma in the past year Hospitalisation or ED visit for asthma in the past month High short-acting beta$_2$ agonist use • Dispensing of 3 or more canisters in a year (average 1.6 puffs per day) is associated with increased risk of flare-ups in adults and children. • Dispensing 12 or more canisters in a year (average 6.6 puffs per day) is associated with increased risk of asthma death.	Sensitivity to an unavoidable allergen (e.g. *Alternaria* species of common moulds)	Inadequate treatment Experience of side-effects of OCS use (may contribute to under-treatment or delayed presentation to hospital during flare-ups) Lack of written asthma action plan Socioeconomic disadvantage Living alone Mental illness Use of alcohol or illegal substances Poor access to health care (e.g. rural/remote region)

	Medical history	Investigation findings	Other factors
	History of delayed presentation to hospital during flare-ups History of sudden-onset acute asthma Cardiovascular disease		
Factors associated with accelerated decline in lung function	Chronic mucus hypersecretion Severe asthma flare-up in a patient not taking ICS	Poor lung function Eosinophilic airway inflammation§	Exposure to cigarette smoke (smoking or environmental exposure) Occupational asthma
Factors associated with treatment-related adverse events	Long-term high-dose ICS Frequent use of OCS		Anxiety disorder (due to increased sensitivity to asthma symptoms and reluctance to reduce ICS dose when asthma well controlled) Euphoria with OCS use

§ White cell differential count on a peripheral blood sample is not currently recommended routinely in the investigation and management of asthma, but might be undertaken in the investigation of severe asthma to help guide biologic therapy.

▶ See: *Monoclonal antibody therapy*

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Table. Management of risk factors for adverse asthma outcomes in adults

Risk factor	Clinical action †
Any risk factor for flare-ups	Check patient has an appropriate action plan

Risk factor	Clinical action †
	Carefully check inhaler technique and adherence, and identify any barriers to good adherence Review frequently (e.g. every 3 months)
Hospitalisation or ED visit for asthma or any asthma flare-up during the previous 12 months	Ask about triggers for flare-ups, and lead time
History of intubation or intensive care unit admission for asthma	Ensure action plan recommends early medical review when asthma worsens
Hospitalisation or ED visit for asthma in the past month	Emphasise importance of maintaining regular ICS use after symptoms improve Confirm that patient has resumed using SABA only when needed for symptoms
High SABA use (>3 canisters per year)	Check lung function If SABA use appears to be habitual, investigate causes and consider alternative strategies, e.g. short-term substitution of ipratropium for SABA
Long-term high-dose ICS	Consider gradual reduction of ICS dose if symptoms stable Monitor regularly (e.g. assessment of bone density, regular eye examinations) For local side-effects, ensure inhaler technique is appropriate
Poor lung function (even if few symptoms)	Consider 3-month trial of higher ICS dose, then recheck lung function Consider referral for detailed specialist investigation
Sensitivity to unavoidable allergens (e.g. **Alternaria** *species of common moulds)*	Refer for further investigation and management
Exposure to cigarette smoke (smoking or environmental exposure)	Emphasise the importance of avoiding smoke Provide quitting strategies Consider increasing ICS dose (higher dose of ICS likely to be necessary to control asthma) Refer for assessment of asthma–COPD overlap
Difficulty perceiving airflow limitation or the severity of exacerbations	Regular PEF monitoring Action plan should recommend early review and measurement of lung function
No current written asthma action plan	Provide and explain written asthma action plan

† In addition to actions applicable to all risk factors

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Poor clinical control, as indicated by frequent asthma symptoms and frequent reliever use, is a very strong predictor of the risk of flare-ups in the future. Any asthma flare-up during the previous 12 months indicates higher risk of flare-up over the next 12 months. A history of artificial ventilation due to acute asthma, and admission to an intensive care unit due to acute asthma have been associated with increased risk of near-fatal asthma,[12] but there is not enough evidence to indicate how long this risk may persist over a person's lifetime. Other risk factors indicate increased probability of future flare-ups or accelerated decline in lung function, independent of the person's level of recent asthma symptom control.[5, 13]

Other factors may increase a person's risk of treatment-associated adverse effects. The most important of these are prescription of high dose treatment and frequent courses of oral steroids.

People with risk factors need more frequent asthma review, a carefully tailored written asthma action plan, and close attention to adherence and correct inhaler technique.

Inflammatory markers

Inflammatory markers, such as sputum eosinophil percentage or exhaled nitric oxide, are used in research and for managing severe asthma in patients attending secondary or tertiary care. Elevated sputum eosinophil levels and, to a lesser extent, elevated exhaled nitric oxide, are associated with increased risk of flare-ups. At present, treatment based on inflammatory markers is not recommended for routine use in primary care.

The value of inflammatory markers is being evaluated:

- Adjusting asthma treatment by monitoring exhaled nitric oxide does not reduce the rate of flare-ups or improve asthma control in adults and children, compared with adjusting treatment according to clinical symptoms or spirometry, based on a meta-analysis of randomised controlled clinical trials.[14] However, many of the studies were not optimally designed to answer this question,[15] and some comparator regimens did not match current recommended treatment options.
- In some studies, asthma treatment algorithms based on monitoring sputum eosinophil counts reduced flare-ups, compared with control-based management.[1, 16] However, most studies assessing treatment guided by sputum eosinophilia have been conducted in selected populations in a few research centres, and therefore may not apply to the general community population. Assessment of sputum inflammatory cells is not generally available at present even in secondary care.
- Limited evidence[9] suggests that patients whose symptoms do not match their degree of eosinophilic inflammation may benefit more from treatment monitoring using sputum eosinophil count than other patients.
- Monitoring inflammatory markers might enable safer down-titration of maintenance inhaled corticosteroid doses.

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Correct use of inhaler devices

Checking and correcting inhaler technique is essential to effective asthma management.

Most patients with asthma or COPD do not use their inhalers properly,[17, 18,19, 19, 20] and most have not had their technique checked or corrected by a health professional.

Incorrect inhaler technique when using maintenance treatments increases the risk of severe flare-ups and hospitalisation for people with asthma or COPD.[17, 18, 21, 22, 23, 24]

Poor asthma symptom control is often due to incorrect inhaler technique.[25, 26]

Incorrect inhaler technique when using inhaled corticosteroids increases the risk of local side effects like dysphonia and oral thrush.

The steps for using an inhaler device correctly differ between brands. Checklists of correct steps for each inhaler type and how-to videos are available from the National Asthma Council website.

▶ Go to: National Asthma Council Australia's *Using your inhaler* webpage for information, patient resources and videos on inhaler technique
Go to: National Asthma Council Australia's information paper for health professionals on *Inhaler technique for people with asthma or COPD*
Go to: NPS MedicineWise information on *Inhaler devices for respiratory medicines*

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Written asthma action plans for adults

Every person with asthma should have their own written asthma action plan.

When provided with appropriate self-management education, self-monitoring and medical review, individualised written action plans consistently improve asthma health outcomes if they include two to four action points, and provide instructions for use of both inhaled corticosteroid and oral corticosteroids for treatment of flare-ups.[27] Written asthma action plans are effective if based on symptoms[28] or personal best peak expiratory flow (not on percentage predicted).[27]

How to develop and review a written asthma action plan

A written asthma action plan should include all the following:

- a list of the person's usual medicines (names of medicines, doses, when to take each dose) – including treatment for related conditions such as allergic rhinitis
- clear instructions on how to change medication (including when and how to start a course of oral corticosteroids) in all the following situations:
  - when asthma is getting worse (e.g. when needing more reliever than usual, waking up with asthma, more symptoms than usual, asthma is interfering with usual activities)
  - when asthma symptoms get substantially worse (e.g. when needing reliever again within 3 hours, experiencing increasing difficulty breathing, waking often at night with asthma symptoms)
  - when peak flow falls below an agreed rate (for those monitoring peak flow each day)
  - during an asthma emergency.
- instructions on when and how to get medical care (including contact telephone numbers)
- the name of the person writing the action plan, and the date it was issued.

Table. Options for adjusting medicines in a written asthma action plan for adults

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Table. Checklist for reviewing a written asthma action plan

- Ask if the person (or parent) knows where their written asthma action plan is.
- Ask if they have used their written asthma action plan because of worsening asthma.
- Ask if the person (or parent) has had any problems using their written asthma action plan, or has any comments about whether they find it suitable and effective.
- Check that the medication recommendations are appropriate to the person's current treatment.
- Check that all action points are appropriate to the person's level of recent asthma symptom control.
- Check that the person (or parent) understands and is satisfied with the action points.
- If the written asthma action plan has been used because of worsening asthma more than once in the past 12 months: review the person's usual asthma treatment, adherence, inhaler technique, and exposure to avoidable trigger factors.
- Check that the contact details for medical care and acute care are up to date.

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Templates for written asthma action plans

Templates are available from National Asthma Council Australia:

- National Asthma Council Australia colour-coded plan, available as a printed handout that folds to wallet size and as the *Asthma Buddy* mobile site
- Asthma Cycle of Care asthma action plan
- A plan designed for patients using budesonide/formoterol combination as maintenance and reliever therapy
- Remote Indigenous Australian Asthma Action Plan
- Every Day Asthma Action Plan (designed for remote Indigenous Australians who do not use written English – may also be useful for others for whom written English is inappropriate).

Some written asthma action plans are available in community languages.

Software for developing electronic pictorial asthma action plans[29, 30] is available online.

▶ Go to: National Asthma Council Australia's *Asthma Action Plan Library*
Download: Imperial College London's *Electronic Asthma Action Plan*

Health system initiatives that support asthma care

Chronic Disease Management Medicare items

Patients with asthma are eligible for Chronic Disease Management Medicare items.[31] These include:

- Preparation of a GP Management Plan (Item 721)
- Review of a GP Management Plan (Item 732)
- Coordination of Team Care Arrangements (Item 723) for patients who need ongoing care from a multidisciplinary team of at least three health or care providers
- Coordination of a Review of Team Care Arrangements (Item 732)
- Contribution to a multidisciplinary care plan being prepared by another health or care provider (Item 729)
- Contribution to a multidisciplinary care plan being prepared for a resident of an aged care facility (Item 731).

GPs can be assisted by practice nurses, Aboriginal and Torres Strait Islander health practitioners, Aboriginal health workers and other health professionals.[31]

▶ Go to: Australian Government Department of Health's *Chronic Disease Management (CDM) Medicare Items* webpage

Asthma cycle of care

The *Asthma cycle of care* is an Australian Government initiative to support primary care health professionals (GPs, other medical practitioners and trainees) to provide asthma care. It is implemented through the *Practice Incentives Program (PIP) Asthma Incentive* and applies to the clinical care of people with moderate-to-severe asthma, generally defined as people with (any of):[32]

- symptoms on most days
- use of preventative medication
- bronchodilator use at least three times per week
- hospital attendance or admission following an acute asthma flare-up.

The *Asthma cycle of care* involves at least two asthma-related consultations within 12 months for a patient with moderate-to-severe asthma, of which at least one visit is a planned asthma review. Each consultation includes:

- documenting the diagnosis, assessing asthma severity and assessing level of recent asthma symptom control
- reviewing the patient's use of and access to asthma medicines and inhaler devices
- providing a written asthma action plan (or documented alternative, if the patient is unable to use a written action plan)
- providing asthma self-management education
- reviewing the written or documented asthma action plan.

▶ Go to: Australian Government Department of Health's *Asthma cycle of care*
Go to: Medicare's *Practice Incentive Program (PIP)*

The Personally Controlled eHealth Record System

The eHealth record is an electronic record for a patient that contains a summary of their health information. Patients can choose to register for an eHealth record. Authorised healthcare professionals can access a patient's record and upload information to the record if their healthcare organisation has registered for the eHealth record system.

▶ Go to: Australian Government Department of Health's *eHealth Resources for Healthcare Providers*

Health system initiatives for Aboriginal and Torres Strait Islander people

Health system initiatives to support the care of Aboriginal and Torres Strait Islander people include:

- Health Assessment Medicare items
- The Indigenous Chronic Disease Package
- The Asthma Spacer Ordering System.

▶ See: *Asthma in Aboriginal and Torres Strait Islander peoples*

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Spirometry and other lung function tests in asthma review for adults

In this section

Spirometry

Performing spirometry in asthma review in adults and adolescents

http://www.asthmahandbook.org.au/management/adults/reviewing-asthma/lung-function/spirometry

Other lung function tests

The roles of peak flow meters and hand-held lung function measuring devices in asthma monitoring for adults and adolescents

http://www.asthmahandbook.org.au/management/adults/reviewing-asthma/lung-function/other-devices

Performing spirometry in asthma review in adults

Recommendations

Perform or arrange spirometry at baseline and after symptoms stabilise (3–6 months) to establish the person's personal best as the basis for future comparison.

Note: If reliable equipment and appropriately trained staff are available, spirometry can be performed in primary care. If not, refer to an appropriate provider such as an accredited respiratory function laboratory.

How this recommendation was developed

Consensus

Based on clinical experience and expert opinion (informed by evidence, where available).

Perform spirometry before and after bronchodilator. Ask patients to use their own reliever inhaler and take the opportunity to check inhaler technique.

Note: Spirometry is reimbursed by MBS only if pre- and post-bronchodilator readings are taken and a permanently recorded tracing is retained.

How this recommendation was developed

Consensus

Based on clinical experience and expert opinion (informed by evidence, where available).

Do not advise patients to skip their preventer before a spirometry visit, but document whether the person has taken a combination preventer that contains a long-acting beta$_2$ agonist on the day of spirometry.

Note: Patients referred to a respiratory function laboratory may be asked to skip certain medicines before a spirometry visit.

How this recommendation was developed

Consensus

Based on clinical experience and expert opinion (informed by evidence, where available).

Measure lung function using spirometry when:

- **making or confirming the diagnosis**
- **assessing future risk**
- **person has been experiencing worsening asthma control or a flare-up**
- **monitoring response after dose adjustment**
- **periodically reviewing asthma (every 1–2 years for most patients).**

How this recommendation was developed

Consensus

Based on clinical experience and expert opinion (informed by evidence, where available).

Record spirometry at every asthma visit for:

- **patients with severe asthma**
- **patients who are known to have poor perception of airflow limitation (e.g. those who do not feel any different with a 15% decrease**

or increase in FEV_1).

How this recommendation was developed

Consensus

Based on clinical experience and expert opinion (informed by evidence, where available).

When spirometry findings are markedly discordant with symptoms (e.g. normal spirometry in a patient with frequent symptoms, or FEV_1 <70% predicted in a patient with no symptoms), consider the possibility of an alternative diagnosis and consider referral for specialist assessment.

How this recommendation was developed

Consensus

Based on clinical experience and expert opinion (informed by evidence, where available).

More information

Assessing asthma control in adults: spirometry

Spirometry is necessary when making the diagnosis of asthma and when establishing the patient's baseline and personal best status.

In ongoing asthma management, spirometry is useful in the following clinical situations:

- During a flare-up, spirometry provides objective evidence about the severity of bronchoconstriction.
- After a dose adjustment (either an increase or a decrease), change in lung function measured by spirometry provides additional information about the response to treatment.
- Spirometry can help identify if the person's symptoms may be due to non-asthma conditions (e.g. for a patient with frequent respiratory symptoms, FEV_1 above 80–90% predicted should prompt consideration of an alternative cause).
- Spirometry can help identify if the person is a poor perceiver of airflow limitation (e.g. person is unable to feel the difference when FEV_1 increases or decreases by 15%).
- Repeating spirometry over time may identify lung function decline that is more rapid than expected decline due to ageing alone, so the person can be referred for specialist review. (Spirometry should be repeated approximately every 1–2 years in most patients but more frequently as indicated by individual needs.)

There are limits to the amount of information that can be gained from spirometry alone:

- For an individual, spirometry readings are not closely reproducible between visits, so only a change in FEV_1 of greater than 0.2 L and 12% from baseline can be considered clinically meaningful in adults.[1]
- Older people with long-standing asthma may develop fixed (irreversible or incompletely reversible) airflow limitation. Reliance solely on lung function expressed as percentage predicted value as a guide to adjusting preventer treatment would risk dose-escalation and over-treatment in these patients.
- At the population level, spirometry correlates poorly with symptom-based measures of asthma control,[2] so in individual patients it is not possible to predict lung function from symptoms or vice versa.

To obtain reliable, good-quality readings, the spirometer must be well maintained and correctly calibrated, and the operator must be adequately trained and experienced.

▶ Go to: National Asthma Council Australia's *Spirometry Resources*

Spirometry in diagnosis and monitoring

Spirometry is the best lung function test for diagnosing asthma and for measuring lung function when assessing asthma control. Spirometry can:

- detect airflow limitation
- measure the degree of airflow limitation compared with predicted normal airflow (or with personal best)
- demonstrate whether airflow limitation is reversible.

It should be performed by well-trained operators with well-maintained and calibrated equipment.[3, 4]

Before performing spirometry, check if the person has any contraindications (e.g. myocardial infarction, angina, aneurysm, recent

surgery, suspected pulmonary embolism, suspected pneumothorax, fractured ribs). Advise them to stop if they become dizzy.

Clearly explain and physically demonstrate correct spirometry technique: [5]

- Sit upright with legs uncrossed and feet flat on the floor and do not lean forward.
- Breathe in rapidly until lungs feel absolutely full. (Coaching is essential to do this properly.)
- Do not pause for more than 1 second.
- Place mouthpiece in mouth and close lips to form a tight seal.
- Blast air out as hard and fast as possible and for as long as possible, until the lungs are completely empty or you are unable to blow out any longer.
- Remove mouthpiece.

▶ Go to: National Asthma Council Australia's spirometry technique video, *Performing spirometry in primary care*

Repeat the test until you obtain three acceptable tests and these meet repeatability criteria.

Acceptability of test

A test is acceptable if all the following apply:

- forced expiration started immediately after full inspiration
- expiration started rapidly
- maximal expiratory effort was maintained throughout the test, with no stops
- the patient did not cough during the test
- the patient did not stop early (before 6 seconds for adults and children over 10 years, or before 3 seconds for children under 10 years).

Record the highest FEV_1 and FVC result from the three acceptable tests, even if they come from separate blows.[5]

Repeatability criteria

Repeatability criteria for a set of acceptable tests are met if both of the following apply:[3]

- the difference between the highest and second-highest values for FEV_1 is less than 150 mL
- the difference between the highest and second-highest values for FVC is less than 150 mL.

For most people, it is not practical to make more than eight attempts to meet acceptability and repeatability criteria.[5]

Testing bronchodilator response (reversibility of airflow limitation)

Repeat spirometry 10-15 minutes after giving 4 separate puffs of salbutamol (100 microg/actuation) via a pressurised metered-dose inhaler and spacer.[5] (For patients who have reported unacceptable side-effects with 400 microg, 2 puffs can be used.)

For adults and adolescents, record a clinically important bronchodilator response if FEV_1 increases by ≥ 200 mL and ≥ 12%.[5]

For children, record a clinically important bronchodilator response if FEV_1 increases by ≥ 12%.[5]

▶ Go to: National Asthma Council Australia's *Spirometry Resources*

Last reviewed version 2.0

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Using other lung function tests in asthma review in adults

Recommendations

When reviewing asthma, do not use occasional office readings from a peak flow meter in place of spirometry to assess lung function.

How this recommendation was developed

Consensus

Based on clinical experience and expert opinion (informed by evidence, where available).

Consider asking patients to carry out 2–8 weeks of peak flow monitoring in these situations:

- **to help confirm the diagnosis of asthma**
- **to help identify a trigger (e.g. in the diagnosis of work-related asthma)**
- **to document improvement after starting treatment (where the benefit would outweigh the burden of monitoring)**
- **to monitor safety after a planned dose reduction (especially in an anxious patient).**

Notes

For patients with suspected work-related asthma, consider offering referral for specialist assessment as soon as possible.

Patients should record peak flow results on a chart in preference to a diary. Patients' ability to recognise flare-ups depends on the proportions of the chart, so use the standardised National Asthma Council Australia and Woolcock Institute *Peak Flow Chart*

How this recommendation was developed

Consensus

Based on clinical experience and expert opinion (informed by evidence, where available).

Consider long-term peak flow monitoring for patients with:

- **severe asthma**
- **frequent or sudden flare-ups**
- **poor perception of airflow limitation.**

How this recommendation was developed

Consensus

Based on clinical experience and expert opinion (informed by evidence, where available).

If the person uses a peak flow meter to monitor asthma at home, ask them to bring their peak flow meter and their peak flow chart or diary to the review. Record any clinically important variation in lung function. Ask about the circumstances around the time of any apparent flare-ups. Regularly check the person's peak flow measurement technique.

How this recommendation was developed

Consensus

Based on clinical experience and expert opinion (informed by evidence, where available).

When reviewing asthma, do not use occasional office readings from a hand-held lung function-measuring device (portable device that measures FEV_1 and/or FEV_6, but not FVC) to assess lung function in place of spirometry.

How this recommendation was developed

Consensus

Based on clinical experience and expert opinion (informed by evidence, where available).

More information

Self-monitoring in adults using peak expiratory flow

Peak flow monitoring is no longer routinely used in Australia, but is recommended for patients with severe asthma, a history of frequent flare-ups, or poor perception of airflow limitation.

Peak expiratory flow can be monitored at home using a mechanical or electronic peak flow meter, either regularly every day or when symptoms are worse. For patients who are willing to measure peak flow regularly, morning and evening readings can be plotted on a graph or recorded in a diary.

When peak flow monitoring results are recorded on a graph, the same chart should be used consistently so that patterns can be recognised. Flare-ups are easier to detect when the chart or image has a low ratio of width to height (aspect ratio), i.e. is compressed horizontally.[1]

When a person's written asthma action plan is based on peak expiratory flow, instructions should be based on personal best, rather than predicted values. Personal best can be determined as the highest reading over the previous 2 weeks. When a person begins high-dose inhaled corticosteroid treatment, personal best peak expiratory flow reaches a plateau within a few weeks with twice daily monitoring.[2]

▶ Go to: The National Asthma Council Australia and Woolcock Institute *Peak Flow Chart*

References

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2. Reddel HK, Marks GB, Jenkins CR. When can personal best peak flow be determined for asthma action plans?. *Thorax*. 2004; 59: 922-4. Available from: http://www.ncbi.nlm.nih.gov/pmc/articles/PMC1746886/

Managing flare-ups in adults

Recommendations

Advise patients that if they experience a flare-up (e.g. worsening symptoms over hours or days, or needing reliever again within a few hours), they should increase their reliever use to control symptoms. Include these instructions in the patient's written asthma action plan.

Table. Severity classification for flare-ups (exacerbations)

Severity	Definition	Example/s
Mild	Worsening of asthma control that is only just outside the normal range of variation for the individual (documented when patient is well)	More symptoms than usual, needing reliever more than usual (e.g. >3 times within a week for a person who normally needs their reliever less often), waking up with asthma, asthma is interfering with usual activities A gradual reduction in PEF† over several days
Moderate	Events that are (all of): • troublesome or distressing to the patient • require a change in treatment • not life-threatening • do not require hospitalisation.	More symptoms than usual, increasing difficulty breathing, waking often at night with asthma symptoms
Severe	Events that require urgent action by the patient (or carers) and health professionals to prevent a serious outcome such as hospitalisation or death from asthma	Needing reliever again within 3 hours, difficulty with normal activity

† Applies to patients who monitor their asthma using a peak expiratory flow meter (single PEF measurements in clinic not recommended for assessing severity of flare-ups).

Note: the ATS/ERS Task Force recommended that severe exacerbations should be defined in clinical trials as the use of oral corticosteroids for 3 or more days. However, this definition is not applicable to clinical practice.

Source: **Reddel H, Taylor D, Bateman E** *et al.* **An official American Thoracic Society/European Respiratory Society statement: asthma control and exacerbations: standardizing endpoints for clinical asthma trials and clinical practice.** *Am J Respir Crit Care Med* **2009; 180: 59-99. Available at: http://www.thoracic.org/statements**

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Table. Options for adjusting medicines in a written asthma action plan for adults

Please view and print this figure separately: http://www.asthmahandbook.org.au/table/show/42

How this recommendation was developed

Consensus

Based on clinical experience and expert opinion (informed by evidence, where available).

Advise patients to keep taking regular preventer during a flare-up (even if they need oral corticosteroids).

How this recommendation was developed

Consensus

Based on clinical experience and expert opinion (informed by evidence, where available).

For patients using a pressurised metered-dose inhaler reliever, advise (and state in a written asthma action plan) to use a spacer during a flare-up to increase the amount of medicine deposited within the airways.

How this recommendation was developed

Consensus

Based on clinical experience and expert opinion (informed by evidence, where available), with particular reference to the following source(s):

- Hall *et al.* 2011[1]
- Lipworth and Clark, 1998[2]

Prescribe an increase in preventer and/or a course of oral corticosteroids for patients with (any of):

- **acute asthma symptoms that recur within 3 hours of taking a rapid-onset beta$_2$ agonist reliever**
- **increasing difficulty breathing over one or more days**
- **night-time asthma symptoms that interfere with sleep over more than one night in a row**
- **peak flow below a pre-defined level (for those monitoring peak flow each day; level determined based on individual's personal best and history of peak flow levels before and during flare-ups).**

How this recommendation was developed

Consensus

Based on clinical experience and expert opinion (informed by evidence, where available).

When prescribing oral corticosteroids, the recommended daily dose is oral prednisolone 37.5–50 mg for 5–10 days. It is usually not necessary to taper the dose for courses of less than 14 days.

Notes

Dose tapering may be necessary for patients who experience adverse effects.

If a patient needs to take prednisolone for more than 2 weeks, the dose should be tapered before ceasing.

Pregnancy is not a contraindication for oral corticosteroids. Oral prednisolone is rated category A for pregnancy.

How this recommendation was developed

Consensus

Based on clinical experience and expert opinion (informed by evidence, where available), with particular reference to the following source(s):

- Cydulka and Emerman, 1998[3]
- Hasegawa *et al.* 2000[4]
- Jones *et al.* 2002[5]
- O'Driscoll *et al.* 1993[6]
- Rowe *et al.* 2007[7]

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To increase the preventer dose during a flare-up in patients taking regular maintenance inhaled corticosteroid or combination inhaled corticosteroid/long-acting beta$_2$ agonist, consider advising them to quadruple the dose of inhaled corticosteroid by giving an extra inhaler at the onset of a flare-up (e.g. use an extra high-dose inhaled corticosteroid inhaler, in addition to usual dose with usual inhaler, for 2 weeks).

- **Taking short-term high doses of inhaled corticosteroid may not be appropriate for some people, e.g. people who cannot risk dysphonia (e.g. singers, actors, teachers) and people who cannot afford the extra medicine.**

How this recommendation was developed

Consensus

Based on clinical experience and expert opinion (informed by evidence, where available), with particular reference to the following source(s):

- FitzGerald *et al.* 2000[8]
- Levy *et al.* 1996[9]
- Oborne *et al.* 2009[10]
- Quon *et al.* 2010[11]
- Reddel and Barnes, 2006[12]
- Rodrigo, 2006[13]

In patients taking maintenance combination fluticasone propionate/salmeterol, ensure that the total daily dose of salmeterol is 100 microg/day during a flare-up.

Note: For example, if a patient is currently taking fluticasone propionate/salmeterol 250/25 microg via pressurised metered-dose inhaler at a dose of 1 puff twice daily, they should increase this to 2 puffs twice daily during worsening asthma. An extra fluticasone propionate inhaler may also be prescribed for 1–2 weeks so that the inhaled corticosteroid component can be increased while the salmeterol dose remains at 100 microg/day.

How this recommendation was developed

Consensus

Based on clinical experience and expert opinion (informed by evidence, where available)

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To increase the preventer dose during a flare-up in patients taking budesonide/formoterol as maintenance-and-reliever regimen using a dry-powder inhaler, advise the person to:

- **take one extra inhalation of their budesonide/formoterol combination inhaler when they need relief from asthma symptoms (up to a maximum of 12 inhalations per day in total, including maintenance doses)**
- **take action (e.g. contact GP or start a course of oral corticosteroids) if they need more than 6 reliever inhalations of their budesonide/formoterol combination inhaler per day for more than 2–3 days (or as instructed in their written asthma action plan)**
- **go to the emergency department or GP if they need more than 12 reliever inhalations of their budesonide/formoterol combination inhaler in one day (keep taking as needed while waiting).**

How this recommendation was developed

Consensus

Based on clinical experience and expert opinion (informed by evidence, where available), with particular reference to the following source(s):

- AstraZeneca Pty Ltd 2010[14]

To increase the preventer dose during a flare-up in patients taking budesonide/formoterol as maintenance-and-reliever regimen using a pressurised metered-dose inhaler, advise the person to:

- **take two extra inhalations of their budesonide/formoterol combination inhaler when they need relief from asthma symptoms (up to a maximum of 24 inhalations per day in total, including maintenance doses)**
- **take action (e.g. contact GP or start a course of oral corticosteroids) if they need more than 12 reliever inhalations of their budesonide/formoterol combination inhaler per day for more than 2–3 days (or as instructed in their written asthma action plan)**
- **go to the emergency department or GP if they need more than 24 reliever inhalations of their budesonide/formoterol combination inhaler in one day (keep taking as needed while waiting).**

How this recommendation was developed

Consensus

Based on clinical experience and expert opinion (informed by evidence, where available), with particular reference to the following source(s):

- AstraZeneca Pty Ltd 2012[15]

Advise patients when to reduce their preventer medication back to normal (e.g. after 2 weeks), and to reduce reliever use once symptoms have improved.

How this recommendation was developed

Consensus

Based on clinical experience and expert opinion (informed by evidence, where available).

Make the decision to prescribe antibiotics or not during respiratory tract infections in people with asthma according to the same considerations for people without asthma.

How this recommendation was developed

Consensus

Based on clinical experience and expert opinion (informed by evidence, where available).

More information

Definition and recognition of flare-ups (exacerbations)

An asthma flare-up is a worsening (exacerbation) of asthma symptoms and lung function, compared with the person's previous status (i.e. outside the patient's usual range of day-to-day variation).[16]

The onset of asthma flare-ups varies widely. Flare-ups are usually progressive (over days or weeks), but in some adults acute asthma can occur suddenly over a few hours.[16, 17, 18]

The patient's experience of symptoms may be a more sensitive indicator of the onset of a flare-up than peak expiratory flow monitoring, because symptoms usually increase before deterioration in lung function is detected.[19] However, some people perceive symptoms poorly and may have a clinically significant decline in lung function without a marked change in symptoms.[20]

Patients need clear instructions in their written asthma action plan about how to monitor symptoms and how to recognise a flare-up (e.g. worsening symptoms and increasing reliever use). For most patients, a daily diary is not needed to monitor asthma, but current

status (including symptom frequency, frequency of reliever use, limitation of activity) should be documented at every doctor visit so that the clinician can recognise any change.

Table. Severity classification for flare-ups (exacerbations)

Severity	Definition	Example/s
Mild	Worsening of asthma control that is only just outside the normal range of variation for the individual (documented when patient is well)	More symptoms than usual, needing reliever more than usual (e.g. >3 times within a week for a person who normally needs their reliever less often), waking up with asthma, asthma is interfering with usual activities A gradual reduction in PEF† over several days
Moderate	Events that are (all of): • troublesome or distressing to the patient • require a change in treatment • not life-threatening • do not require hospitalisation.	More symptoms than usual, increasing difficulty breathing, waking often at night with asthma symptoms
Severe	Events that require urgent action by the patient (or carers) and health professionals to prevent a serious outcome such as hospitalisation or death from asthma	Needing reliever again within 3 hours, difficulty with normal activity

† Applies to patients who monitor their asthma using a peak expiratory flow meter (single PEF measurements in clinic not recommended for assessing severity of flare-ups).

Note: the ATS/ERS Task Force recommended that severe exacerbations should be defined in clinical trials as the use of oral corticosteroids for 3 or more days. However, this definition is not applicable to clinical practice.

Source: Reddel H, Taylor D, Bateman E *et al.* An official American Thoracic Society/European Respiratory Society statement: asthma control and exacerbations: standardizing endpoints for clinical asthma trials and clinical practice. *Am J Respir Crit Care Med* 2009; 180: 59-99. Available at: http://www.thoracic.org/statements

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Managing flare-ups in adults: self-management

Moderate flare-ups (e.g. nocturnal wakening, increased need for reliever, PEF reduction <20% from best) can usually be managed without a hospital visit.

Patients should be able to manage most flare-ups using their written asthma action plan. Asthma action plans that include instructions both for increasing the dose of inhaled corticosteroid and for starting oral corticosteroids (in addition to reliever as needed) during flare-ups are effective in reducing the risk of needing Emergency Department visits or hospital admissions.[21]

Written asthma action plans based on symptoms and those based on peak expiratory flow are equally effective.[21]

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Managing flare-ups in adults: oral corticosteroids

The use of oral corticosteroids is accepted as part of the management of severe asthma flare-ups, including in most asthma clinical trials.

Most clinical trials that have specifically evaluated the use of oral corticosteroids to manage flare-ups have been conducted in patients

attending emergency departments. Oral corticosteroids courses of 5–10 days are effective in regaining control of asthma after an acute flare-up.[3, 4, 5, 6, 7] A 5-day course of prednisolone 40 mg per day may be as effective as a 10-day course in adults.[5]

Abruptly ceasing oral prednisolone after a short course appears to be equally effective as tapering over a longer period. Tapering the dose does not reduce the risk of suppression of adrenal function.[3, 6] The dose should be tapered if oral corticosteroids have been taken for more than 2 weeks.

Action plans for worsening asthma that include instructions for the use of oral corticosteroids as well as instructions to increase the dose of inhaled corticosteroid, are effective in improving lung function and reducing hospital admissions.[21]

Managing flare-ups in adults: adjusting inhaled corticosteroid dose

Several randomised clinical trials have assessed whether increasing the inhaled corticosteroid dose is an effective strategy in avoiding the need for oral corticosteroids or acute medical care during flare-ups in adults with asthma taking daily maintenance inhaled corticosteroid or daily maintenance inhaled corticosteroid/long-acting beta$_2$ agonist combination treatment.

There is some evidence that quadrupling the maintenance dose of inhaled corticosteroids,[10] or treating with a high dose of inhaled corticosteroids,[8, 9, 13] reduces the severity of asthma flare-ups. For patients taking inhaled corticosteroid/long-acting beta$_2$ agonist combinations, this can be achieved by adding a separate high-dose inhaled corticosteroid inhaler to the patient's usual maintenance treatment for 7–14 days. This strategy may be useful for patients who experience clinically important side-effects with oral corticosteroids, but may not be suitable for patients who cannot afford the extra medicine or who experience hoarseness with high dose inhaled corticosteroid.

However, overall evidence from randomised clinical trials does not support the use of inhaled corticosteroids as a substitute for oral corticosteroids during most flare-ups in adults:

- A self-initiated increase (e.g. increasing the dose by a factor of two to five) after asthma worsened did not reduce the overall risk of flare-ups requiring rescue oral corticosteroids in a meta-analysis of randomised controlled clinical trials mainly in adults.[11]
- Doubling the dose in response to specific criteria for worsening lung function (with or without worsening asthma symptoms) did not reduce the proportion of people who needed oral corticosteroids.[12] However, in two of the three clinical trials that evaluated the efficacy of doubling the dose, patients did not begin taking the higher dose (active or placebo) until approximately one week after asthma began to worsen. Therefore, there is insufficient evidence to judge the effectiveness of doubling the dose of inhaled corticosteroid at the first sign of worsening symptoms.
- In another clinical trial,[10] patients taking a range of inhaled corticosteroid-based regimens at baseline were randomised to one of two treatment strategies when any of the following occurred: when peak expiratory flow rate fell (by 15% or more on 2 consecutive days, or by 30% or more on 1 day), when they believed their asthma was worsening, or they developed a cold. Treatment strategies were (1) increasing the dose of inhaled corticosteroid to four times higher than the maintenance dose, regardless of baseline regimen, or (2) continuing usual dose. Overall, the group randomised to the increased dose strategy did not have a reduced risk of flare-ups that required oral corticosteroid treatment.[10] However, fewer than one quarter of patients started the study inhaler. Among those patients who did begin taking the high-dose (or placebo) inhaler due to perceived worsening asthma, quadrupling the dose was associated with a significant (almost halving) reduction in the rate of severe flare-up.[10]

Managing flare-ups in adults: adjusting budesonide/formoterol maintenance-and-reliever treatment

When asthma symptoms worsen, patients taking budesonide/formoterol 100/6 microg or 200/6 microg as maintenance-and-reliever treatment can increase as-needed inhalations:

- for budesonide/formoterol 100/6 microg or 200/6 microg via dry-powder inhaler, up to a maximum of 12 actuations per day (total of maintenance and reliever inhalations) [14]
- for budesonide/formoterol 50/3 microg or 100/3 microg via pressurised metered-dose inhaler, up to a maximum of 24 actuations per day (total of maintenance and reliever inhalations).[15]

A written asthma action plan template developed by Australian clinicians for adults using budesonide/formoterol maintenance and reliever regimen suggests that the patient should commence oral corticosteroids and/or see a doctor after 2–3 days if asthma is worsening, or symptoms are not improving, despite taking 6 reliever inhalations of budesonide/formoterol per day in addition to maintenance doses.

▶ Go to: National Asthma Council Australia's written asthma action plan for adults using budesonide/formoterol maintenance and reliever regimen in the *Asthma Action Plan Library*

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Self-monitoring in adults using peak expiratory flow

Peak flow monitoring is no longer routinely used in Australia, but is recommended for patients with severe asthma, a history of frequent

flare-ups, or poor perception of airflow limitation.

Peak expiratory flow can be monitored at home using a mechanical or electronic peak flow meter, either regularly every day or when symptoms are worse. For patients who are willing to measure peak flow regularly, morning and evening readings can be plotted on a graph or recorded in a diary.

When peak flow monitoring results are recorded on a graph, the same chart should be used consistently so that patterns can be recognised. Flare-ups are easier to detect when the chart or image has a low ratio of width to height (aspect ratio), i.e. is compressed horizontally.[22]

When a person's written asthma action plan is based on peak expiratory flow, instructions should be based on personal best, rather than predicted values. Personal best can be determined as the highest reading over the previous 2 weeks. When a person begins high-dose inhaled corticosteroid treatment, personal best peak expiratory flow reaches a plateau within a few weeks with twice daily monitoring.[23]

▶ Go to: The National Asthma Council Australia and Woolcock Institute *Peak Flow Chart*

Acute respiratory tract infections

Although people with asthma are no more likely to experience viral upper respiratory tract infection than people without asthma, they are more likely to experience symptoms of lower respiratory tract infection.[24]

In patients with asthma, respiratory tract infections often lead to asthma flare-ups.

During viral infections, inhaled short-acting beta$_2$ agonists may have reduced effectiveness and there may be a reduced bronchodilator response in lung function.[25]

Worsening asthma may be misdiagnosed as a respiratory tract infection, and respiratory tract infections may be misdiagnosed as asthma, because acute bronchitis in patients with no evidence of asthma may be associated with a short-term reduction in lung function.

- If spirometry during a respiratory tract infection shows reduced FEV1 and lack of acute response to bronchodilator in a person with suspected asthma, spirometry should be repeated after the person recovers. Apparent non-reversible airflow limitation may be due to viral infection.

Antibiotics and asthma management

Most respiratory tract infections are due to viruses rather than bacteria. The decision about whether or not to use antibiotics for treatment of respiratory tract infections in people with asthma should be made on the same basis as in people without asthma.

Long-term therapy with macrolides may have an anti-inflammatory effect, but there is not enough evidence to recommend this routinely for managing asthma.[26, 27, 28]

▶ Go to: National Prescribing Service (NPS) MedicineWise information on *Medicines and treatments for respiratory tract infections*

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Providing self-management support for adults

In this section

Education

Providing adults and adolescents with information, skills and tools for asthma self-management

http://www.asthmahandbook.org.au/management/adults/self-management/education

Action plans

Preparing and reviewing written asthma action plans for adults

http://www.asthmahandbook.org.au/management/adults/self-management/action-plans

Providing information, skills and tools for asthma self-management for adults

Recommendations

Provide or arrange education in asthma self-management, including (all of):

- **self-monitoring of asthma control based on symptoms (and peak expiratory flow monitoring, if used)**
- **inhaler technique**
- **a written asthma action plan**
- **the importance of regular medical review.**

How this recommendation was developed

Consensus

Based on clinical experience and expert opinion (informed by evidence, where available), with particular reference to the following source(s):

- Gibson *et al.* 2002[1]
- Gibson *et al.* 2002[2]
- Gibson and Powell, 2004[3]
- National Asthma Council Australia, 2008[4]
- Powell and Gibson, 2002[5]

Assess each patient's inhaler technique at every opportunity, even for patients who have been using the inhaler for many years.

- **Have the patient demonstrate their inhaler technique, while checking against a checklist of steps for the specific device.**
- **Demonstrate correct technique using a placebo device and correct any specific errors identified.**
- **Have the patient repeat the demonstration to check they can now use the device correctly. If necessary, repeat instruction until the patient has all steps correct.**
- **Provide the checklist as a reminder, and write down or highlight any steps that were done incorrectly (e.g. on a sticker attached to their inhaler or on a pictorial instruction sheet).**

Note: Watch the person use their inhaler – don't just ask if they think they know how to use it properly.

Checklists of steps, and videos demonstrating correct technique, for various types of inhalers are available on National Asthma Council Australia's website.

▶ **Go to: National Asthma Council Australia's *How-to videos* webpage for information and videos on inhaler technique**
Go to: National Asthma Council Australia's information paper for health professionals on *Inhaler technique for people with asthma or COPD*
Go to: NPS MedicineWise's *Asthma: inhaler device checklist*

How this recommendation was developed

Evidence-based recommendation

Based on literature search and formulated by multidisciplinary working group

Key evidence considered:

- Basheti *et al.* 2013[6]
- National Asthma Council Australia, 2018[7]
- The Inhaler Error Steering Committee, 2013[8]
- Basheti et al. 2008[9]

- Basheti et al. 2017[10]
- Bosnic-Anticevich et al. 2010[11]
- Capanoglu et al. 2015[12]
- Crane et al. 2014[13]
- Giraud et al. 2011[14]
- Lavorini 2014[15]
- Newman 2014[16]
- Hesso et al 2016[17]

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Advise patients to seek emergency medical care immediately if they experience any of these danger signs:

- **severe breathing problems**
- **symptoms get worse very quickly**
- **reliever has little or no effect**
- **difficulty saying sentences**
- **blue lips**
- **drowsiness.**

The person and their family should know that they must call an ambulance and give asthma first aid if they see any of these danger signs.

How this recommendation was developed

Consensus

Based on clinical experience and expert opinion (informed by evidence, where available).

More information

Asthma self-management for adults

Effective self-management requires:

- adherence to the agreed treatment regimen
- correct use of inhaler devices for asthma medicines
- monitoring asthma control (symptoms, with addition of peak expiratory flow for some patients)
- having an up-to-date written asthma action plan and following it when asthma worsens
- management of triggers or avoidance (if appropriate)
- regular medical review.

Self-monitoring of asthma

Self-monitoring by the patient, based on symptoms and/or peak expiratory flow, is an important component of effective asthma self-management.[1]

For most patients, a daily diary is not necessary. Patients should be trained to take note if their symptoms worsen or their reliever use increases, so they can implement their written asthma action plan and/or get medical care as appropriate.

Internet-based self-management algorithms in which patients adjust their treatment monthly on the basis of control scores have been reported to be more effective than usual care.[18] In patients with partly and uncontrolled asthma, weekly self-monitoring and monthly treatment adjustment may improve asthma control.[19]

Asthma self-management education

Patients need careful asthma education to enable them to manage their asthma effectively.

Education in asthma self-management that involves self-monitoring (by either peak expiratory flow or symptoms), regular medical review and a written action plan improves health outcomes for adults with asthma.[1] Training programs that enable people to adjust their medication using a written action plan appear to be more effective than other forms of asthma self-management.[1]

Information alone does not appear to improve health outcomes in adults with asthma, although perceived symptoms may improve.[2]

Structured group asthma education programs are available in some regions. Contact Asthma Australia in your state or territory for information about available asthma education programs.

▶ Go to: *Asthma Australia*
See: *Asthma triggers*
See: *Inhaler devices and technique*

Adherence to preventer treatment: adults and adolescents

Most patients do not take their preventer medication as often as prescribed, particularly when symptoms improve, or are mild or infrequent. Whenever asthma control is poor despite apparently adequate treatment, poor adherence, as well as poor inhaler technique, are probable reasons to consider.

Poor adherence may be intentional and/or unintentional. Intentional poor adherence may be due to the person's belief that the medicine is not necessary, or to perceived or actual adverse effects. Unintentional poor adherence may be due to forgetting or cost barriers.

Common barriers to the correct use of preventers include:

- being unable to afford the cost of medicines or consultations to adjust the regimen
- concerns about side effects
- interference of the regimen with the person's lifestyle
- forgetting to take medicines
- lack of understanding of the reason for taking the medicines
- inability to use the inhaler device correctly due to physical or cognitive factors
- health beliefs that are in conflict with the belief that the prescribed medicines are effective, necessary or safe (e.g. a belief that the prescribed preventer dose is 'too strong' or only for flare-ups, a belief that asthma can be overcome by psychological effort, a belief that complementary and alternative therapies are more effective or appropriate than prescribed medicines, mistrust of the health professional).

Adherence to preventers is significantly improved when patients are given the opportunity to negotiate the treatment regimen based on their goals and preferences.[20]

Assessment of adherence requires an open, non-judgemental approach.

Accredited pharmacists who undertake Home Medicines Reviews can assess adherence while conducting a review.

Table. Suggested questions to ask adults and older adolescents when assessing adherence to treatment

1. *Many people don't take their medication as prescribed. In the last four weeks:*
   - how many days a week would you have taken your preventer medication? None at all? One? Two? (etc).
   - how many times a day would you take it? Morning only? Evening only? Morning and evening? (or other)
   - each time, how many puffs would you take? One? Two? (etc).
2. *Do you find it easier to remember your medication in the morning, or the evening?*

Source: Foster JM, Smith L, Bosnic-Anticevich SZ et al. Identifying patient-specific beliefs and behaviours for conversations about adherence in asthma. *Intern Med J* 2012; 42: e136-e44. Available from: http://www.ncbi.nlm.nih.gov/pubmed/21627747

Asset ID: 38

▶ Go to: Medicare's *Home Medicines Review (HMR)*

Written asthma action plans for adults

Every person with asthma should have their own written asthma action plan.

When provided with appropriate self-management education, self-monitoring and medical review, individualised written action plans consistently improve asthma health outcomes if they include two to four action points, and provide instructions for use of both inhaled corticosteroid and oral corticosteroids for treatment of flare-ups.[3] Written asthma action plans are effective if based on symptoms[5] or personal best peak expiratory flow (not on percentage predicted).[3]

How to develop and review a written asthma action plan

A written asthma action plan should include all the following:

- a list of the person's usual medicines (names of medicines, doses, when to take each dose) – including treatment for related conditions such as allergic rhinitis
- clear instructions on how to change medication (including when and how to start a course of oral corticosteroids) in all the following situations:
  - when asthma is getting worse (e.g. when needing more reliever than usual, waking up with asthma, more symptoms than usual, asthma is interfering with usual activities)
  - when asthma symptoms get substantially worse (e.g. when needing reliever again within 3 hours, experiencing increasing difficulty breathing, waking often at night with asthma symptoms)
  - when peak flow falls below an agreed rate (for those monitoring peak flow each day)
  - during an asthma emergency.
- instructions on when and how to get medical care (including contact telephone numbers)
- the name of the person writing the action plan, and the date it was issued.

Table. Options for adjusting medicines in a written asthma action plan for adults

Please view and print this figure separately: http://www.asthmahandbook.org.au/table/show/42

Table. Checklist for reviewing a written asthma action plan

- Ask if the person (or parent) knows where their written asthma action plan is.
- Ask if they have used their written asthma action plan because of worsening asthma.
- Ask if the person (or parent) has had any problems using their written asthma action plan, or has any comments about whether they find it suitable and effective.
- Check that the medication recommendations are appropriate to the person's current treatment.
- Check that all action points are appropriate to the person's level of recent asthma symptom control.
- Check that the person (or parent) understands and is satisfied with the action points.
- If the written asthma action plan has been used because of worsening asthma more than once in the past 12 months: review the person's usual asthma treatment, adherence, inhaler technique, and exposure to avoidable trigger factors.
- Check that the contact details for medical care and acute care are up to date.

Asset ID: 43

Templates for written asthma action plans

Templates are available from National Asthma Council Australia:

- National Asthma Council Australia colour-coded plan, available as a printed handout that folds to wallet size and as the *Asthma Buddy* mobile site
- Asthma Cycle of Care asthma action plan
- A plan designed for patients using budesonide/formoterol combination as maintenance and reliever therapy
- Remote Indigenous Australian Asthma Action Plan
- Every Day Asthma Action Plan (designed for remote Indigenous Australians who do not use written English – may also be useful for others for whom written English is inappropriate).

Some written asthma action plans are available in community languages.

Software for developing electronic pictorial asthma action plans[21, 22] is available online.

▶ Go to: National Asthma Council Australia's *Asthma Action Plan Library*
Download: Imperial College London's *Electronic Asthma Action Plan*

Correct use of inhaler devices

Checking and correcting inhaler technique is essential to effective asthma management.

Most patients with asthma or COPD do not use their inhalers properly,[23, 24,25, 25, 26] and most have not had their technique checked or corrected by a health professional.

Incorrect inhaler technique when using maintenance treatments increases the risk of severe flare-ups and hospitalisation for people with asthma or COPD.[23, 24, 27, 28, 29, 30]

Poor asthma symptom control is often due to incorrect inhaler technique.[31, 32]

Incorrect inhaler technique when using inhaled corticosteroids increases the risk of local side effects like dysphonia and oral thrush.

The steps for using an inhaler device correctly differ between brands. Checklists of correct steps for each inhaler type and how-to videos are available from the National Asthma Council website.

▶ Go to: National Asthma Council Australia's *Using your inhaler* webpage for information, patient resources and videos on inhaler technique
Go to: National Asthma Council Australia's information paper for health professionals on *Inhaler technique for people with asthma or COPD*
Go to: NPS MedicineWise information on *Inhaler devices for respiratory medicines*

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Self-monitoring in adults using peak expiratory flow

Peak flow monitoring is no longer routinely used in Australia, but is recommended for patients with severe asthma, a history of frequent flare-ups, or poor perception of airflow limitation.

Peak expiratory flow can be monitored at home using a mechanical or electronic peak flow meter, either regularly every day or when symptoms are worse. For patients who are willing to measure peak flow regularly, morning and evening readings can be plotted on a graph or recorded in a diary.

When peak flow monitoring results are recorded on a graph, the same chart should be used consistently so that patterns can be recognised. Flare-ups are easier to detect when the chart or image has a low ratio of width to height (aspect ratio), i.e. is compressed horizontally.[33]

When a person's written asthma action plan is based on peak expiratory flow, instructions should be based on personal best, rather than predicted values. Personal best can be determined as the highest reading over the previous 2 weeks. When a person begins high-dose inhaled corticosteroid treatment, personal best peak expiratory flow reaches a plateau within a few weeks with twice daily monitoring.[34]

▶ Go to: The National Asthma Council Australia and Woolcock Institute *Peak Flow Chart*

'Wheeze-detecting' devices

Some hand-held devices and smart phone applications are marketed for detecting and measuring wheeze by audio recording and analysis.

There is not enough evidence to recommend these devices and apps for use in monitoring asthma symptoms or asthma control in adults or children, or in distinguishing wheeze from other airway sounds in children.

- Reliance on these devices could result in over- or under-treatment.

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Psychosocial factors affecting asthma self-management

Psychosocial factors can affect asthma symptoms and outcomes in children and adults. These can include biological, individual, family and community-level factors, which can have synergistic effects in an individual with asthma.[35] Mechanisms may include effects of stress on the immune system[35] and effects of life circumstances on patients' and families' ability to manage asthma.

Relationships between psychosocial and cultural factors

Important influences on asthma outcomes include the person's asthma knowledge and beliefs, confidence in ability to self-manage, perceived barriers to healthcare, socioeconomic status, and healthcare system navigation skills, and by the quality of interaction and communication between patient and healthcare provider.[36] There is a complex interrelationship between:[36]

- patient factors (e.g. health literacy, health beliefs, ethnicity, educational level, social support, cultural beliefs, comorbidities, mental health)
- healthcare provider factors (e.g. communication skills, teaching abilities, available time, educational resources and skills in working with people from different backgrounds)
- healthcare system factors (e.g. the complexity of the system, the healthcare delivery model, the degree to which the system is oriented towards chronic disease management or acute care, and the degree to which the system is sensitive to sociocultural needs).

Health literacy

'Health literacy' refers to the individual's capacity to obtain, process, and understand basic health information and services they need to make appropriate health decisions.[37] A person's level of health literacy is influenced by various factors including skills in reading,

writing, numeracy, speaking, listening, cultural and conceptual knowledge.[36]

Inadequate health literacy is recognised as a risk factor for poorer health outcomes and less effective use of health care services.[36] Poor health literacy has been associated with poor asthma control,[38] poor knowledge of medications,[39] and incorrect inhaler technique.[39] Aspects of health literacy that have been associated with poorer asthma outcomes in adults include reading skills, listening skills, numeracy skills, and combinations of these.[36] Studies assessing the association between parents' health literacy and children's asthma have reported inconsistent findings.[36] Overall, there is not enough evidence to prove that low health literacy causes poor asthma control or inadequate self-management.[36]

Australian research suggests that there are probably many Australians with limited health literacy.[40] It may be possible to identify some groups of patients more likely to have inadequate health literacy, such as people living in regions with low socioeconomic status, and those with low English literacy (e.g. people with limited education, members of some ethnic minorities, immigrants, and the elderly).[36] However, even well-educated patients might have trouble with basic health literacy skills.[36]

Attempting to assess every patient's health literacy is impractical and may be embarrassing for the person and time-consuming for the health professional.[36] Instead, it may be more effective for health professionals simply to assume that all patients have limited health literacy.[36] Accordingly, all self-management skills need to be explained carefully, simply and repeatedly, and all written material should be clear and easy to read. Special consideration is needed for patients from culturally and linguistically diverse communities, including Aboriginal and Torres Strait Islander people.

Psychosocial support and improving health literacy

Psychosocial interventions that include asthma education may improve health-related quality of life for children and adolescents with asthma and their families.[41] However, simply providing education might not improve a person's health literacy, since it also depends on other factors like socioeconomic status, social support, and is influence by the provider and the healthcare system.[36]

Asthma Australia provides personal support and information for people with asthma and parents of children with asthma through the Asthma Australia Information line by telephone on 1800 Asthma (1800 278 462) or online.

▶ Go to: *Asthma Australia*

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Preparing written asthma action plans for adults

Recommendations

For every person with asthma, develop an individualised written asthma action plan that is appropriate for their treatment regimen, asthma severity, culture, language, literacy level, and ability to self-manage.

How this recommendation was developed

Consensus

Based on clinical experience and expert opinion (informed by evidence, where available).

A written asthma action plan should include all of the following:

- **the person's usual asthma and allergy medicines**
- **clear instructions on how to change medication (including when and how to start a course of oral corticosteroids)**
- **when and how to get medical care, including during an emergency**
- **name of the person preparing the plan**
- **the date.**

Note: A range of templates is available from National Asthma Council Australia's *Asthma Action Plan Library*.

Table. Options for adjusting medicines in a written asthma action plan for adults

Please view and print this figure separately: http://www.asthmahandbook.org.au/table/show/42

How this recommendation was developed

Consensus

Based on clinical experience and expert opinion (informed by evidence, where available).

Ensure the person has a prescription for any medicines they may need to follow their action plan (e.g. prednisolone). Explain which medicines they should have available at all times, or when to fill prescriptions to have medicines available (e.g. before travel).

How this recommendation was developed

Consensus

Based on clinical experience and expert opinion (informed by evidence, where available).

Review the written asthma action plan every year, and whenever there is a significant change in treatment or asthma status.

How this recommendation was developed

Consensus

Based on clinical experience and expert opinion (informed by evidence, where available).

When reviewing a written asthma action plan, consider the following:

- **Does the person know where their written asthma action plan is?**
- **Have they used it? If so, any problems?**
- **Are listed medicines and instruction for actions current and appropriate?**

- **Are contact details for medical care and acute care up to date?**

Table. Checklist for reviewing a written asthma action plan

- **Ask if the person (or parent) knows where their written asthma action plan is.**
- **Ask if they have used their written asthma action plan because of worsening asthma.**
- **Ask if the person (or parent) has had any problems using their written asthma action plan, or has any comments about whether they find it suitable and effective.**
- **Check that the medication recommendations are appropriate to the person's current treatment.**
- **Check that all action points are appropriate to the person's level of recent asthma symptom control.**
- **Check that the person (or parent) understands and is satisfied with the action points.**
- **If the written asthma action plan has been used because of worsening asthma more than once in the past 12 months: review the person's usual asthma treatment, adherence, inhaler technique, and exposure to avoidable trigger factors.**
- **Check that the contact details for medical care and acute care are up to date.**

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How this recommendation was developed

Consensus

Based on clinical experience and expert opinion (informed by evidence, where available).

For people who are unable to read a written asthma action plan easily due to poor eyesight or when written English is inappropriate, consider a pictorial action plan.

How this recommendation was developed

Consensus

Based on clinical experience and expert opinion (informed by evidence, where available).

For every person with a history of anaphylaxis (or risk factors), also provide a written anaphylaxis plan.

How this recommendation was developed

Consensus

Based on clinical experience and expert opinion (informed by evidence, where available).

More information

Written asthma action plans for adults

Every person with asthma should have their own written asthma action plan.

When provided with appropriate self-management education, self-monitoring and medical review, individualised written action plans consistently improve asthma health outcomes if they include two to four action points, and provide instructions for use of both inhaled corticosteroid and oral corticosteroids for treatment of flare-ups.[1] Written asthma action plans are effective if based on symptoms[2] or personal best peak expiratory flow (not on percentage predicted).[1]

How to develop and review a written asthma action plan

A written asthma action plan should include all the following:

- a list of the person's usual medicines (names of medicines, doses, when to take each dose) – including treatment for related conditions such as allergic rhinitis
- clear instructions on how to change medication (including when and how to start a course of oral corticosteroids) in all the following situations:
  - when asthma is getting worse (e.g. when needing more reliever than usual, waking up with asthma, more symptoms than usual,

asthma is interfering with usual activities)
    - when asthma symptoms get substantially worse (e.g. when needing reliever again within 3 hours, experiencing increasing difficulty breathing, waking often at night with asthma symptoms)
    - when peak flow falls below an agreed rate (for those monitoring peak flow each day)
    - during an asthma emergency.
- instructions on when and how to get medical care (including contact telephone numbers)
- the name of the person writing the action plan, and the date it was issued.

Table. Options for adjusting medicines in a written asthma action plan for adults

Please view and print this figure separately: http://www.asthmahandbook.org.au/table/show/42

Table. Checklist for reviewing a written asthma action plan

- Ask if the person (or parent) knows where their written asthma action plan is.
- Ask if they have used their written asthma action plan because of worsening asthma.
- Ask if the person (or parent) has had any problems using their written asthma action plan, or has any comments about whether they find it suitable and effective.
- Check that the medication recommendations are appropriate to the person's current treatment.
- Check that all action points are appropriate to the person's level of recent asthma symptom control.
- Check that the person (or parent) understands and is satisfied with the action points.
- If the written asthma action plan has been used because of worsening asthma more than once in the past 12 months: review the person's usual asthma treatment, adherence, inhaler technique, and exposure to avoidable trigger factors.
- Check that the contact details for medical care and acute care are up to date.

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Templates for written asthma action plans

Templates are available from National Asthma Council Australia:

- National Asthma Council Australia colour-coded plan, available as a printed handout that folds to wallet size and as the *Asthma Buddy* mobile site
- Asthma Cycle of Care asthma action plan
- A plan designed for patients using budesonide/formoterol combination as maintenance and reliever therapy
- Remote Indigenous Australian Asthma Action Plan
- Every Day Asthma Action Plan (designed for remote Indigenous Australians who do not use written English – may also be useful for others for whom written English is inappropriate).

Some written asthma action plans are available in community languages.

Software for developing electronic pictorial asthma action plans[3, 4] is available online.

▶ Go to: National Asthma Council Australia's *Asthma Action Plan Library*
Download: Imperial College London's *Electronic Asthma Action Plan*

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Severe asthma in adults and adolescents

In this section

Identifying severe asthma in adults and adolescents

Recommendations

If a patient continues to experience poor control of asthma, frequent flare-ups, or poor quality of life due to asthma, despite regular treatment with a high dose of an inhaled corticosteroid plus a long-acting beta$_2$ agonist, make a full assessment to rule out common problems (including poor inhaler technique and suboptimal adherence) before applying the label of severe asthma.

Note: Severe asthma is defined as asthma that remains uncontrolled despite regular treatment with high-dose inhaled corticosteroids plus long-acting beta$_2$ agonist or with maintenance oral corticosteroids, or asthma that requires this level of treatment (Step 4) to prevent it becoming uncontrolled.

Table. Definitions of ICS dose levels in adults

Inhaled corticosteroid	Daily dose (microg)		
	Low	Medium	High
Beclometasone dipropionate †	100–200	250–400	>400
Budesonide	200–400	500–800	>800
Ciclesonide	80–160	240–320	>320
*Fluticasone furoate**	—	100	200
Fluticasone propionate	100–200	250–500	>500

† Dose equivalents for *Qvar* (TGA-registered CFC-free formulation of beclometasone dipropionate).

***Fluticasone furoate is not available as a low dose. TGA-registered formulations of fluticasone furoate contain a medium or high dose of fluticasone furoate and should only be prescribed as one inhalation once daily.**

Note: The potency of generic formulations may differ from that of original formulations. Check TGA-approved product information for details.

Sources

Respiratory Expert Group, Therapeutic Guidelines Limited. *Therapeutic Guidelines: Respiratory, Version 4*. **Therapeutic Guidelines Limited, Melbourne, 2009.**

GlaxoSmithKline Australia Pty Ltd. Product Information: *Breo (fluticasone furoate; vilanterol) Ellipta*. **Therapeutic Goods Administration, Canberra, 2014. Available from: https://www.ebs.tga.gov.au/**

GlaxoSmithKline Australia Pty Ltd. Product Information: *Arnuity (fluticasone furoate) Ellipta*. **Therapeutic Goods Administration, Canberra, 2016. Available from: https://www.ebs.tga.gov.au/**

Last reviewed version 2.0

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Table. Definition of levels of recent asthma symptom control in adults and adolescents (regardless of current treatment regimen)

Good control	Partial control	Poor control

SABA: short-acting beta$_2$-agonist

† SABA, not including doses taken prophylactically before exercise. (Record this separately and take into account when assessing management.)

Note: Recent asthma symptom control is based on symptoms over the previous 4 weeks.

Last reviewed version 2.0

Asset ID: 33

Figure. Stepped approach to adjusting asthma medication in adults and adolescents

Please view and print this figure separately: http://www.asthmahandbook.org.au/figure/show/31

How this recommendation was developed

Consensus

Based on clinical experience and expert opinion (informed by evidence, where available).

Last reviewed version 2.0

Confirm the diagnosis of asthma by:

- **reviewing documentation of demonstrated variable expiratory airflow limitation**
- **identifying and investigating any signs and symptoms that could suggest an alternative diagnosis or comorbidity (e.g. upper airway dysfunction, bronchiectasis, cardiac disease, de-conditioning).**

Table. Findings that increase or decrease the probability of asthma in adults

Asthma is more likely to explain the symptoms if any of these apply	Asthma is less likely to explain the symptoms if any of these apply
More than one of these symptoms: • **wheeze** • **breathlessness** • **chest tightness** • **cough** **Symptoms recurrent or seasonal** **Symptoms worse at night or in the early morning** **History of allergies (e.g. allergic rhinitis, atopic dermatitis)** **Symptoms obviously triggered by exercise, cold air, irritants, medicines (e.g. aspirin or beta blockers), allergies, viral infections, laughter** **Family history of asthma or allergies** **Symptoms began in childhood** **Widespread wheeze audible on chest auscultation** **FEV$_1$ or PEF lower than predicted, without other**	**Dizziness, light-headedness, peripheral tingling** **Isolated cough with no other respiratory symptoms** **Chronic sputum production** **No abnormalities on physical examination of chest when symptomatic (over several visits)** **Change in voice** **Symptoms only present during upper respiratory tract infections** **Heavy smoker (now or in past)** **Cardiovascular disease** **Normal spirometry or PEF when symptomatic (despite repeated tests)**

Asthma is more likely to explain the symptoms if any of these apply	Asthma is less likely to explain the symptoms if any of these apply
explanation Eosinophilia or raised blood IgE level, without other explanation Symptoms rapidly relieved by a SABA bronchodilator	

Adapted from:

Respiratory Expert Group, Therapeutic Guidelines Limited. *Therapeutic Guidelines: Respiratory, Version 4*. **Therapeutic Guidelines Limited, Melbourne, 2009.**

British Thoracic Society (BTS) Scottish Intercollegiate Guidelines Network (SIGN). *British Guideline on the Management of Asthma. A national clinical guideline*. **BTS/SIGN, Edinburgh; 2012. Available from: https://www.brit-thoracic.org.uk/guidelines-and-quality-standards/asthma-guideline/.**

Asset ID: 2

Table. Differential diagnosis of severe asthma in adults

Clinical feature	Alternative diagnoses or comorbidity*
Dyspnoea prominent	Obesity and inactivity with deconditioning COPD Alpha-1 antitrypsin deficiency Heart disease Pulmonary hypertension Central airway stenosis Tracheobronchomalacia Interstitial lung disease Bronchiolitis obliterans Lung cancer Tracheal stricture Pulmonary embolism
Cough prominent	Upper airway dysfunction Upper airway cough syndrome Adverse drug reaction (e.g. angiotensin-converting enzyme inhibitors, beta-adrenergic blockers) Bronchiolitis obliterans Lung cancer Herpetic tracheobronchitis Tracheal stricture

Clinical feature	Alternative diagnoses or comorbidity*
Chronic sputum production	COPD Bronchiectasis Allergic bronchopulmonary aspergillosis Cystic fibrosis
History of exposure to tobacco smoke/biomass fuels	COPD Lung cancer
Dizziness or lightheadedness	Dysfunctional breathing/hyperventilation syndrome Tachyarrhythmias
Sudden-onset symptoms	Vocal cord dysfunction (paradoxical vocal cord movement) Panic attacks with hyperventilation Pulmonary embolism
Irritative triggers, tightness in upper chest/neck, dysphonia	Vocal cord dysfunction (paradoxical vocal cord movement)
Symptoms triggered by food or posture	Symptomatic gastro-oesophageal reflux disease
Night waking	Obstructive sleep apnoea Symptomatic gastro-oesophageal reflux disease Heart failure
Chest crackles	Bronchiectasis Heart failure Interstitial lung disease Hypersensitivity pneumonitis
Respiratory symptoms with sinusitis and/or nasal polyposis[#]	Eosinophilic granulomatosis with polyangiitis (Churg–Strauss syndrome) Aspirin-exacerbated respiratory disease
Respiratory symptoms with gastrointestinal symptoms	Cystic fibrosis Hypereosinophilic syndrome
Onset related to menstrual cycle	Premenstrual (catamenial) asthma
Eosinophilia	Chronic eosinophilic pneumonia Eosinophilic granulomatosis with polyangiitis (Churg–Strauss syndrome)

Clinical feature	Alternative diagnoses or comorbidity*
	Hypereosinophilic syndrome Hypersensitivity pneumonia Parasitic infection

***Most of the differential diagnoses listed can also occur with asthma.**

#especially if evidence of other organ involvement (skin, mononeuritis multiplex, cardiac)

Sources: Israel and Reddel (2017),[1] Chung et al (2014),[2] Maltby et al (2016),[3] Papi et al (2018),[4] FitzGerald et al (2017)[5]

Last reviewed version 2.0

Asset ID: 115

▶ See: *Diagnosing asthma in adults*

How this recommendation was developed

Consensus

Based on clinical experience and expert opinion (informed by evidence, where available).

Last reviewed version 2.0

Reassess whether the person's current symptoms are likely to be due to asthma, or likely due to a comorbidity or alternative diagnosis.

Note: Consider contributing factors like anxiety, obesity, symptomatic gastroesophageal reflux disease, rhinosinusitis, hormonal influences (e.g. premenstrual asthma, menarche, menopause, thyroid disorders).

Table. Differential diagnosis of severe asthma in adults

Clinical feature	Alternative diagnoses or comorbidity*
Dyspnoea prominent	Obesity and inactivity with deconditioning COPD Alpha-1 antitrypsin deficiency Heart disease Pulmonary hypertension Central airway stenosis Tracheobronchomalacia Interstitial lung disease Bronchiolitis obliterans Lung cancer Tracheal stricture Pulmonary embolism
Cough prominent	Upper airway dysfunction Upper airway cough syndrome

Clinical feature	Alternative diagnoses or comorbidity*
	Adverse drug reaction (e.g. angiotensin-converting enzyme inhibitors, beta-adrenergic blockers) Bronchiolitis obliterans Lung cancer Herpetic tracheobronchitis Tracheal stricture
Chronic sputum production	COPD Bronchiectasis Allergic bronchopulmonary aspergillosis Cystic fibrosis
History of exposure to tobacco smoke/biomass fuels	COPD Lung cancer
Dizziness or lightheadedness	Dysfunctional breathing/hyperventilation syndrome Tachyarrhythmias
Sudden-onset symptoms	Vocal cord dysfunction (paradoxical vocal cord movement) Panic attacks with hyperventilation Pulmonary embolism
Irritative triggers, tightness in upper chest/neck, dysphonia	Vocal cord dysfunction (paradoxical vocal cord movement)
Symptoms triggered by food or posture	Symptomatic gastro-oesophageal reflux disease
Night waking	Obstructive sleep apnoea Symptomatic gastro-oesophageal reflux disease Heart failure
Chest crackles	Bronchiectasis Heart failure Interstitial lung disease Hypersensitivity pneumonitis
Respiratory symptoms with sinusitis and/or nasal polyposis[#]	Eosinophilic granulomatosis with polyangiitis (Churg–Strauss syndrome) Aspirin-exacerbated respiratory disease

Clinical feature	Alternative diagnoses or comorbidity*
Respiratory symptoms with gastrointestinal symptoms	Cystic fibrosis Hypereosinophilic syndrome
Onset related to menstrual cycle	Premenstrual (catamenial) asthma
Eosinophilia	Chronic eosinophilic pneumonia Eosinophilic granulomatosis with polyangiitis (Churg–Strauss syndrome) Hypereosinophilic syndrome Hypersensitivity pneumonia Parasitic infection

***Most of the differential diagnoses listed can also occur with asthma.**

#especially if evidence of other organ involvement (skin, mononeuritis multiplex, cardiac)

Sources: Israel and Reddel (2017),[1] Chung et al (2014),[2] Maltby et al (2016),[3] Papi et al (2018),[4] FitzGerald et al (2017)[5]

Last reviewed version 2.0

Asset ID: 115

How this recommendation was developed

Consensus

Based on clinical experience and expert opinion (informed by evidence, where available).

Last reviewed version 2.0

Recheck adherence to inhaled corticosteroid-based preventer.

▶ See: *Assessing and maximising patients' adherence to asthma treatment*

How this recommendation was developed

Consensus

Based on clinical experience and expert opinion (informed by evidence, where available).

Last reviewed version 2.0

Recheck inhaler technique.

▶ See: *Inhaler devices and technique*

How this recommendation was developed

Consensus

Based on clinical experience and expert opinion (informed by evidence, where available).

Last reviewed version 2.0

Assess use of short-acting beta$_2$ agonist reliever to identify overuse:

- **Ask how many puffs taken per day.**

- **Ask how long reliever puffer lasts.**
- **Check prescribing records.**
- **Ask if patient also uses non-prescription ('over-the counter') reliever.**
- **Dispensing of 3 or more canisters in a year (average 1.6 puffs per day) is associated with increased risk of flare-ups. Dispensing 12 or more canisters in a year (average 6.6 puffs per day) is associated with increased risk of asthma death.**

Note: My Health Record may include over-the-counter dispensing information for reliever

How this recommendation was developed

Consensus

Based on clinical experience and expert opinion (informed by evidence, where available).

Last reviewed version 2.0

Assess any comorbid conditions that could be contributing to respiratory symptoms, poor quality of life or flare-ups, or compromising self-management, such as allergic rhinitis, chronic rhinosinusitis, symptomatic gastro-oesophageal reflux disease, obstructive sleep apnoea, obesity, deconditioning, mental health problems (e.g. anxiety, depression) or other psychosocial problems, or upper airway dysfunction.

Table. Differential diagnosis of severe asthma in adults

Clinical feature	Alternative diagnoses or comorbidity*
Dyspnoea prominent	**Obesity and inactivity with deconditioning** **COPD** **Alpha-1 antitrypsin deficiency** **Heart disease** **Pulmonary hypertension** **Central airway stenosis** **Tracheobronchomalacia** **Interstitial lung disease** **Bronchiolitis obliterans** **Lung cancer** **Tracheal stricture** **Pulmonary embolism**
Cough prominent	**Upper airway dysfunction** **Upper airway cough syndrome** **Adverse drug reaction (e.g. angiotensin-converting enzyme inhibitors, beta-adrenergic blockers)** **Bronchiolitis obliterans** **Lung cancer** **Herpetic tracheobronchitis** **Tracheal stricture**

Clinical feature	Alternative diagnoses or comorbidity*
Chronic sputum production	COPD Bronchiectasis Allergic bronchopulmonary aspergillosis Cystic fibrosis
History of exposure to tobacco smoke/biomass fuels	COPD Lung cancer
Dizziness or lightheadedness	Dysfunctional breathing/hyperventilation syndrome Tachyarrhythmias
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Respiratory symptoms with sinusitis and/or nasal polyposis[#]	Eosinophilic granulomatosis with polyangiitis (Churg–Strauss syndrome) Aspirin-exacerbated respiratory disease
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Eosinophilia	Chronic eosinophilic pneumonia Eosinophilic granulomatosis with polyangiitis (Churg–Strauss syndrome)

Clinical feature	Alternative diagnoses or comorbidity*
	Hypereosinophilic syndrome Hypersensitivity pneumonia Parasitic infection

***Most of the differential diagnoses listed can also occur with asthma.**

#especially if evidence of other organ involvement (skin, mononeuritis multiplex, cardiac)

Sources: Israel and Reddel (2017),[1] Chung et al (2014),[2] Maltby et al (2016),[3] Papi et al (2018),[4] FitzGerald et al (2017)[5]

Last reviewed version 2.0

Asset ID: 115

▶ See: *Comorbid conditions and asthma*

How this recommendation was developed

Consensus

Based on clinical experience and expert opinion (informed by evidence, where available).

Last reviewed version 2.0

Assess and manage exposure to asthma triggers at home or work (e.g. cigarette smoke, allergens, irritants, infections, moulds/dampness, indoor or outdoor air pollution).

Table. Summary of asthma triggers

Please view and print this figure separately: http://www.asthmahandbook.org.au/table/show/52

How this recommendation was developed

Consensus

Based on clinical experience and expert opinion (informed by evidence, where available).

Last reviewed version 2.0

Consider the possible presence of aspirin-exacerbated respiratory disease. If suspected, refer for assessment.

Note: The syndrome of aspirin-exacerbated respiratory disease is characterised by airway inflammation including asthma, nasal polyposis, and flare-ups (which may be severe) in response to NSAIDs.

How this recommendation was developed

Consensus

Based on clinical experience and expert opinion (informed by evidence, where available).

Last reviewed version 2.0

Optimise the person's treatment regimen and review after each change, e.g:

- **For a patient taking inhaled corticosteroid plus a long-acting beta$_2$ agonist as maintenance therapy with as-needed short-acting beta$_2$ agonist as reliever, consider changing to low-dose budesonide plus formoterol as single maintenance-and-reliever therapy to reduce the risk of flare-ups.**
- **Consider a trial of add-on tiotropium by mist inhaler.**
- **Consider a trial of high-dose inhaled corticosteroids for 3–6 months.**
- **Consider a trial of add-on montelukast.**

Cease ineffective therapies.

Note: Review inhaler technique and adherence before trialling changes to the treatment regimen.

There is very little evidence supporting the use of add-on montelukast for severe asthma. Limited evidence supports its use in the management of aspirin-exacerbated respiratory disease.

- **If using an inhaled corticosteroid and a long-acting beta$_2$ agonist in separate inhalers, warn the patient about the serious risk of stopping the inhaled corticosteroid, and give clear written instructions not to use the long-acting beta$_2$ agonist on its own.**
- **Warn patients about potential neuropsychiatric effects of montelukast.**

Note: PBS status as at March 2019:

Adults: Tiotropium is subsidised by the PBS when used in combination with maintenance ICS+LABA treatment, for people with ≥ one documented severe exacerbation that required systemic corticosteroids in the previous 12 months despite maintenance treatment with inhaled corticosteroid (equivalent to 800 microg budesonide/day or higher) in combination with a long-acting beta2 agonist, and correct inhaler technique has been assessed, demonstrated and documented.

Adolescents aged up to 17 years: Tiotropium is subsidised by the PBS when used in combination with maintenance ICS+LABA treatment, for patients with severe asthma treated by (or in consultation with) a specialist, with frequent moderate exacerbations or ≥ one documented severe exacerbation that required systemic corticosteroids in the previous 12 months despite maintenance treatment with a medium-to-high dose of inhaled corticosteroid in combination with a long-acting beta2 agonist, and correct inhaler technique has been assessed, demonstrated and documented (see PBS for details).

PBS status as at March 2019: Montelukast treatment is not subsidised by the PBS for people aged 15 years or over. However, generic formulations are available as non-PBS prescriptions at lower cost to patients than in the past.

▶ Go to: *PBS listings*

How this recommendation was developed

Consensus

Based on clinical experience and expert opinion (informed by evidence, where available).

Last reviewed version 2.0

Provide every patient with an individualised written asthma action plan and update it regularly (at least yearly, and whenever treatment is changed).

▶ See: *Preparing written asthma action plans for adults*

How this recommendation was developed

Consensus

Based on clinical experience and expert opinion (informed by evidence, where available).

Last reviewed version 2.0

Identify patients with possible severe asthma who might benefit from monoclonal antibody therapy, and offer referral for specialist assessment without delay (after checking inhaler technique and adherence):

- **Add-on treatment with omalizumab can be considered for adults and adolescents with uncontrolled severe allergic asthma.**
- **Add-on treatment with benralizumab or mepolizumab can be considered for adults and adolescents aged 12 years and over with uncontrolled severe eosinophilic asthma.**

Note: PBS status as at March 2019: In addition to specific criteria for each agent, all the following must be documented before an adult or adolescent is eligible for any monoclonal antibody asthma treatment:

- **asthma present for at least 1 year**
- **diagnosis of asthma (specific criteria apply) confirmed and documented by a specialist (respiratory physician, clinical immunologist, allergist or general physician experienced in the management of patients with severe asthma)**
- **treatment by the same specialist for at least 6 months or asthma diagnosis by a multidisciplinary severe asthma clinic team**
- **inadequate asthma control despite documentaed adherence to optimised standard treatment (that includes high-dose inhaled corticosteroid plus long-acting beta$_2$ agonist for at least 12 months), with at least one severe flare-up requiring hospitalisation or systemic corticosteroids in the past year.**

Note: Tests to determine severe asthma phenotype, determine eligibility (e.g. skin prick testing, blood eosinophil count) and predict whether monoclonal antibody therapy is likely to be effective (e.g. FeNO, eosinophil count) need not be completed in primary care – it is preferable that these are arranged by the specialist.

Monoclonal antibody treatments for severe asthma can only be prescribed for patients attending a public hospital or approved private hospital.

▶ **Go to:** *National Asthma Council Australia's monoclonal antibody therapy information paper*

▶ **Go to:** *PBS listings*

How this recommendation was developed

Consensus

Based on clinical experience and expert opinion (informed by evidence, where available), with particular reference to named source(s):

- Bleecker et al. 2016[6]
- FitzGerald et al. 2016[7]
- Nair et al. 2017[8]
- Wang et al, 2016[9]
- Bel et al. 2014[10]
- Ortega et al. 2014[11]
- Lai et al. 2015[12]
- Norman et al. 2013[13]
- Normansell et al. 2014[14]
- Abraham et al. 2016[15]
- Gibson et al. 2016[16]

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Refer a patient with severe asthma to a specialist for assessment if:

- **prolonged high-dose inhaled corticosteroids are needed to control asthma**
- **the person requires maintenance oral corticosteroid treatment or frequently requires courses of oral corticosteroids**
- **despite maintenance preventer treatment, the person has been using frequent short-acting beta$_2$ agonist reliever for a prolonged period (e.g. 6–8 puffs per day for several weeks), and common causes of poor asthma control have been investigated and ruled out**
- **the person experiences frequent or sudden flare-ups**
- **food allergy is present or suspected.**

- **For most patients, high doses of inhaled corticosteroids should be used for short periods only.**

Note: Offer referral to a respiratory physician, if possible.

Offer referral to a severe asthma clinic for multidisciplinary care, if available.

If referral to a respiratory physician is not possible, refer to a general physician, allergist or clinical immunologist with expertise in managing severe asthma.

If specialist referral is not possible, obtain specialist advice.

Table. Definitions of ICS dose levels in adults

Inhaled corticosteroid	Daily dose (microg)		
	Low	Medium	High
Beclometasone dipropionate †	100–200	250–400	>400
Budesonide	200–400	500–800	>800
Ciclesonide	80–160	240–320	>320
*Fluticasone furoate**	—	100	200

Inhaled corticosteroid	Daily dose (microg)		
	Low	Medium	High
Fluticasone propionate	100–200	250–500	>500

† Dose equivalents for *Qvar* (TGA-registered CFC-free formulation of beclometasone dipropionate).

***Fluticasone furoate is not available as a low dose. TGA-registered formulations of fluticasone furoate contain a medium or high dose of fluticasone furoate and should only be prescribed as one inhalation once daily.**

Note: The potency of generic formulations may differ from that of original formulations. Check TGA-approved product information for details.

Sources

Respiratory Expert Group, Therapeutic Guidelines Limited. *Therapeutic Guidelines: Respiratory, Version 4*. **Therapeutic Guidelines Limited, Melbourne, 2009.**

GlaxoSmithKline Australia Pty Ltd. Product Information: *Breo (fluticasone furoate; vilanterol) Ellipta*. **Therapeutic Goods Administration, Canberra, 2014. Available from: https://www.ebs.tga.gov.au/**

GlaxoSmithKline Australia Pty Ltd. Product Information: *Arnuity (fluticasone furoate) Ellipta*. **Therapeutic Goods Administration, Canberra, 2016. Available from: https://www.ebs.tga.gov.au/**

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Asset ID: 22

How this recommendation was developed

Consensus

Based on clinical experience and expert opinion (informed by evidence, where available).

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More information

What is severe asthma?

Definitions

Severe asthma is asthma that remains uncontrolled despite high-dose inhaled corticosteroids plus long-acting beta$_2$ agonist (with correct inhaler technique and good adherence) or maintenance oral corticosteroids, or that requires such treatment to prevent it becoming uncontrolled.[2]

Severe asthma is sometimes also called ‘severe refractory asthma' or 'severe treatment-resistant asthma'. However, the introduction of monoclonal antibody therapies has demonstrated that significant improvements can be seen in asthma that was previously termed ‘refractory’.

Asthma is considered to be uncontrolled if any of the following are identified:

- poor symptom control, e.g. during previous 4 weeks any of:
  - symptoms during night or on waking
  - limitation of activities due to asthma
  - daytime symptoms on more than 2 days per week
  - need for short-acting beta$_2$ agonist reliever on more than 2 days per week (not including doses taken prophylactically before exercise).
- frequent severe flare-ups (e.g. more than one flare-up requiring treatment with oral corticosteroids in the previous year)
- serious flare-ups (e.g. hospital admission, intensive care unit admission, or mechanical ventilation in the previous year)
- persistent airflow limitation (e.g. detected by spirometry).

Patients with severe asthma are a subgroup of those with difficult-to-treat asthma. Difficult-to-treat asthma is defined as asthma that remains uncontrolled despite treatment with a high dose of an inhaled corticosteroid combined with a long-acting beta$_2$ agonist.

Not all patients with difficult-to-treat asthma have severe asthma. Difficult-to-treat asthma includes asthma that is uncontrolled due to

suboptimal adherence, inappropriate or incorrect use of medicines, environmental triggers or comorbidities. Patients whose asthma control improves rapidly after such problems are corrected are not considered to have severe asthma.[2]

Prevalence

Severe asthma is uncommon. Less than 4% of adults with asthma have severe asthma.[17]

Description

Severe asthma appears to be a distinct disease (or group of diseases) with different pathobiology from that of milder forms of asthma. It is rare for mild asthma to progress to severe asthma.[18]

Severe asthma imposes a high burden of disease due to symptoms, flare-ups, medication-related adverse effects and costs.[1, 19]

Bronchiectasis, granulomas and other auto-immune disease processes can coexist with severe asthma.[18, 20] Aspirin-exacerbated respiratory disease can present as severe asthma.

Patterns of airway inflammation vary among people with severe asthma,[4] which suggests that the underlying pathophysiology varies.

Inflammatory patterns identified in adults in research studies include eosinophilic (elevated sputum eosinophil count), neutrophilic (elevated sputum neutrophil count), mixed (elevated sputum eosinophil and neutrophil counts) and paucigranulocytic (sputum eosinophil and neutrophil counts within normal range).[21] However, these tests are not routinely available in practice to guide treatment.

Some patients with severe asthma show sustained eosinophilia on blood tests despite good adherence to treatment with high doses of inhaled corticosteroids[18, 22]

Current research aims to predict which treatments will be most effective in an individual according to the findings of a range clinical investigations (e.g. sputum cell counts, peripheral blood white cell counts, fraction of exhaled nitric oxide [FeNO]) and on other clinical features such as age of asthma onset, relationship of allergies to asthma symptoms or presence of nasal polyposis. Few studies have been conducted to identify severe asthma phenotypes among children with severe asthma.[4]

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Correct use of inhaler devices

Checking and correcting inhaler technique is essential to effective asthma management.

Most patients with asthma or COPD do not use their inhalers properly,[23, 24,25, 25, 26] and most have not had their technique checked or corrected by a health professional.

Incorrect inhaler technique when using maintenance treatments increases the risk of severe flare-ups and hospitalisation for people with asthma or COPD.[23, 24, 27, 28, 29, 30]

Poor asthma symptom control is often due to incorrect inhaler technique.[31, 32]

Incorrect inhaler technique when using inhaled corticosteroids increases the risk of local side effects like dysphonia and oral thrush.

The steps for using an inhaler device correctly differ between brands. Checklists of correct steps for each inhaler type and how-to videos are available from the National Asthma Council website.

▶ Go to: National Asthma Council Australia's *Using your inhaler* webpage for information, patient resources and videos on inhaler technique
Go to: National Asthma Council Australia's information paper for health professionals on *Inhaler technique for people with asthma or COPD*
Go to: NPS MedicineWise information on *Inhaler devices for respiratory medicines*

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Adherence to preventer treatment: adults and adolescents

Most patients do not take their preventer medication as often as prescribed, particularly when symptoms improve, or are mild or infrequent. Whenever asthma control is poor despite apparently adequate treatment, poor adherence, as well as poor inhaler technique, are probable reasons to consider.

Poor adherence may be intentional and/or unintentional. Intentional poor adherence may be due to the person's belief that the medicine is not necessary, or to perceived or actual adverse effects. Unintentional poor adherence may be due to forgetting or cost barriers.

Common barriers to the correct use of preventers include:

- being unable to afford the cost of medicines or consultations to adjust the regimen
- concerns about side effects

- interference of the regimen with the person's lifestyle
- forgetting to take medicines
- lack of understanding of the reason for taking the medicines
- inability to use the inhaler device correctly due to physical or cognitive factors
- health beliefs that are in conflict with the belief that the prescribed medicines are effective, necessary or safe (e.g. a belief that the prescribed preventer dose is 'too strong' or only for flare-ups, a belief that asthma can be overcome by psychological effort, a belief that complementary and alternative therapies are more effective or appropriate than prescribed medicines, mistrust of the health professional).

Adherence to preventers is significantly improved when patients are given the opportunity to negotiate the treatment regimen based on their goals and preferences.[33]

Assessment of adherence requires an open, non-judgemental approach.

Accredited pharmacists who undertake Home Medicines Reviews can assess adherence while conducting a review.

Table. Suggested questions to ask adults and older adolescents when assessing adherence to treatment

1. *Many people don't take their medication as prescribed. In the last four weeks:*
   - how many days a week would you have taken your preventer medication? None at all? One? Two? (etc).
   - how many times a day would you take it? Morning only? Evening only? Morning and evening? (or other)
   - each time, how many puffs would you take? One? Two? (etc).
2. *Do you find it easier to remember your medication in the morning, or the evening?*

Source: Foster JM, Smith L, Bosnic-Anticevich SZ et al. Identifying patient-specific beliefs and behaviours for conversations about adherence in asthma. *Intern Med J* 2012; 42: e136-e44. Available from: http://www.ncbi.nlm.nih.gov/pubmed/21627747

Asset ID: 38

▶ Go to: Medicare's *Home Medicines Review (HMR)*

Definition of variable expiratory airflow limitation

Most of the tests for variable expiratory airflow limitation are based on showing variability in FEV_1. While reduced FEV_1 may be seen with many other lung diseases (or due to poor spirometric technique), a reduced ratio of FEV_1 to FVC indicates airflow limitation.[34] Normal FEV_1/FVC values derived from population studies vary,[35, 36] but are usually greater than:[35]

- 0.85 in people aged up to 19 years
- 0.80 in people aged 20–39 years
- 0.75 in people aged 40–59 years
- 0.70 in people aged 60–80 years.

In children, it is less useful to define expiratory airflow limitation according to a specific cut-off for FEV_1/FVC ratio, because normal values in children change considerably with age.[36]

Some spirometers provide predicted normal values specific to age group. If these are available, a FEV_1/FVC ratio less than the lower limit of normal (i.e. less than the 5th percentile of normal population) indicates airflow limitation.

Variable expiratory airflow limitation (beyond the range seen in healthy populations) can be documented if any of the following are recorded:

- a clinically important increase in FEV_1 (change in FEV_1 of at least 200 mL and 12% from baseline for adults, or at least 12% from baseline for children) 10–15 minutes after administration of bronchodilator
- clinically important variation in lung function (at least 20% change in FEV_1) when measured repeatedly over time (e.g. spirometry on separate visits)
- a clinically important reduction in lung function (decrease in FEV_1 of at least 200 mL and 12% from baseline on spirometry, or decrease in peak expiratory flow rate by at least 20%) after exercise (formal laboratory-based exercise challenge testing uses different criteria for exercise-induced bronchoconstriction)
- a clinically important increase in lung function (at least 200 mL and 12% from baseline) after a trial of 4 or more weeks of treatment with an inhaled corticosteroid
- clinically important variation in peak expiratory flow (diurnal variability of more than 10%)
- a clinically important reduction in lung function (15–20%, depending on the test) during a test for airway hyperresponsiveness

(exercise challenge test or bronchial provocation test) measured by a respiratory function laboratory.

Notes

Patients referred to a respiratory function laboratory may be asked not to take certain medicines within a few hours to days before a spirometry visit.

A clinically important increase or decrease in lung function is defined as a change in FEV_1 of at least 200 mL and 12% from baseline for adults, or at least 12% from baseline for children, or a change in peak expiratory flow rate of at least 20% on the same meter.[37, 34] A clinically important increase in FVC after administering bronchodilator may also indicate reversible airflow limitation, but FVC is a less reliable measure in primary care because FVC may vary due to factors such as variation in inspiratory volume or expiratory time.

The finding of 'normal' lung function during symptoms reduces the probability that a patient has asthma, but a clinically important improvement in response to bronchodilator or inhaled corticosteroid can occur in patients whose baseline value is within the predicted normal range.

The greater the variation in lung function, the more certain is the diagnosis of asthma. However, people with longstanding asthma may develop fixed airflow limitation.

Reversibility in airflow limitation may not be detected if the person is already taking a long-acting $beta_2$ agonist or inhaled corticosteroid.

Airflow limitation can be transient and does not necessarily mean that the person has asthma (e.g. when recorded during a severe acute infection of the respiratory tract). Ideally, airflow limitation should be confirmed when the patient does not have a respiratory tract infection. Reduction in lung function during a respiratory tract infection with improvement in lung function after its resolution, commonly occurs in people with asthma, but can also be seen in patients with COPD or in healthy people without either asthma or COPD.[38,39]

▶ Go to: National Asthma Council Australia's *Spirometry Resources*
Go to: National Asthma Council Australia and Woolcock Institute *Peak Flow Chart*

Spirometry in diagnosis and monitoring

Spirometry is the best lung function test for diagnosing asthma and for measuring lung function when assessing asthma control. Spirometry can:

- detect airflow limitation
- measure the degree of airflow limitation compared with predicted normal airflow (or with personal best)
- demonstrate whether airflow limitation is reversible.

It should be performed by well-trained operators with well-maintained and calibrated equipment.[40, 37]

Before performing spirometry, check if the person has any contraindications (e.g. myocardial infarction, angina, aneurysm, recent surgery, suspected pulmonary embolism, suspected pneumothorax, fractured ribs). Advise them to stop if they become dizzy.

Clearly explain and physically demonstrate correct spirometry technique: [41]

- Sit upright with legs uncrossed and feet flat on the floor and do not lean forward.
- Breathe in rapidly until lungs feel absolutely full. (Coaching is essential to do this properly.)
- Do not pause for more than 1 second.
- Place mouthpiece in mouth and close lips to form a tight seal.
- Blast air out as hard and fast as possible and for as long as possible, until the lungs are completely empty or you are unable to blow out any longer.
- Remove mouthpiece.

▶ Go to: National Asthma Council Australia's spirometry technique video, *Performing spirometry in primary care*

Repeat the test until you obtain three acceptable tests and these meet repeatability criteria.

Acceptability of test

A test is acceptable if all the following apply:

- forced expiration started immediately after full inspiration
- expiration started rapidly
- maximal expiratory effort was maintained throughout the test, with no stops
- the patient did not cough during the test
- the patient did not stop early (before 6 seconds for adults and children over 10 years, or before 3 seconds for children under 10 years).

Record the highest FEV_1 and FVC result from the three acceptable tests, even if they come from separate blows.[41]

Repeatability criteria

Repeatability criteria for a set of acceptable tests are met if both of the following apply:[40]

- the difference between the highest and second-highest values for FEV_1 is less than 150 mL
- the difference between the highest and second-highest values for FVC is less than 150 mL.

For most people, it is not practical to make more than eight attempts to meet acceptability and repeatability criteria.[41]

Testing bronchodilator response (reversibility of airflow limitation)

Repeat spirometry 10-15 minutes after giving 4 separate puffs of salbutamol (100 microg/actuation) via a pressurised metered-dose inhaler and spacer.[41] (For patients who have reported unacceptable side-effects with 400 microg, 2 puffs can be used.)

For adults and adolescents, record a clinically important bronchodilator response if FEV_1 increases by ≥ 200 mL and ≥ 12%.[41]

For children, record a clinically important bronchodilator response if FEV_1 increases by ≥ 12%.[41]

▶ Go to: National Asthma Council Australia's *Spirometry Resources*

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Gastro-oesophageal reflux disease links with asthma

The majority of patients with asthma report symptoms of gastro-oesophageal reflux disease or an abnormal result on the 24-hour oesophageal pH test.[42] Among children treated in referral clinics, the prevalence of gastro-oesophageal reflux disease is higher among those with asthma than those without asthma,[43] but the causal link is unclear.[43]

Asthma may contribute to gastro-oesophageal reflux disease via changes in intrathoracic pressure or the effects of asthma medicines on the gastro-oesophageal sphincter.[42]

Gastro-oesophageal reflux disease may contribute to bronchoconstriction through various mechanisms (e.g. vagally mediated reflexes, increased airway hyperresponsiveness, chronic microaspiration of gastric fluid into the airways, or airway neurogenic inflammatory responses).[42]

Although the presence of gastro-oesophageal reflux disease is generally thought to worsen asthma control, the precise effect of gastro-oesophageal reflux disease on asthma is unclear.[42]

Effects of mental illness on asthma

Psychological factors may trigger asthma symptoms and affect patients' asthma symptom perception, but also may influence medication compliance.[42]

Anxiety, depression and personality disorders have been thought to be risk factors for near-fatal asthma, but the association is unclear.[44] Psychological factors may trigger asthma symptoms.[42] High levels of asthma-related fear and panic can exacerbate asthma symptoms.[45] However, anxiety and hyperventilation attacks can also be mistaken for asthma.[46]

Data from a cohort study of patients with asthma attending a specialist asthma clinic suggest that comorbid generalised anxiety disorder is associated with worse asthma morbidity (poorer overall asthma control, increased bronchodilator use, and worse asthma quality of life) than patients with asthma overall.[47] Several studies have reported an association between stress (socioeconomic status, interpersonal conflicts, emotional distress, terrorism) and asthma flare-ups.[48] The mechanism is not yet understood, but may involve circulating adrenaline levels, altered sensitivity to corticosteroids, or mast cell activation.[48]

Psychological factors may influence adherence to the treatment regimen.[42] The experience of euphoria or dysphoria during oral corticosteroid therapy[49] may influence a person's adherence to their written asthma action plan and could lead to delays in seeking medical care during flare-ups.

Asthma management in obese patients

Effects of obesity on asthma control

Among people with asthma, BMI predicts asthma control, independent of airway inflammation, lung function and airway hyperresponsiveness.[50]

Obese people may have a reduced response to inhaled corticosteroids, compared with non-obese people.[51, 52, 53] However, inhaled corticosteroids are still effective in obese people.[54] Compared to people with normal BMI, people with BMI > 40 may take longer to achieve peak FEV_1 after starting preventer treatment.[53]

There is also some evidence of a reduced response to montelukast among obese patients, but findings are not consistent.[52, 53]

Effects of weight loss interventions on asthma

The true effects of weight loss in people with asthma cannot be determined reliably, because many clinical trials assessing the effects of weight loss intervention on asthma have been poorly designed or reported, and have a high risk of bias.[55]

Systematic reviews of weight loss trials in people with asthma show that – regardless of the weight loss intervention – weight loss in people with asthma who are obese or overweight may improve asthma symptoms and reduce reliever requirement.[55, 56] However, weight loss has not been shown to achieve clinically important improvement in lung function.[55]

Some recent case series studies have found that adults who underwent bariatric surgery (various procedures) were able to reduce their inhaled corticosteroid dose.[57, 58]

In an Australian clinical trial comparing a dietary intervention, an exercise intervention, and a combination of these for obese adults with asthma, asthma control improved in the diet and combination groups.[59] Regardless of the method of weight loss, 5–10% weight loss was associated with a clinically important improvement in asthma control in 58% of patients, and improvement in quality of life in 83% of patients.[59]

In a small study in Australian children, a dietary weight loss intervention was associated with improvement in lung function, compared with baseline.[60]

▶ Go to: National Health and Medical Research Council *Clinical practice guidelines for the management of overweight and obesity in adults, adolescents and children in Australia*

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Upper airway dysfunction

Upper airway dysfunction is intermittent, abnormal adduction of the vocal cords during respiration, resulting in variable upper airway obstruction. It often mimics asthma[61, 62] and is commonly misdiagnosed as asthma.[46, 63] It can cause severe acute episodes of dyspnoea that occur either unpredictably or due to exercise.[46] Inspiratory stridor associated with vocal cord dysfunction is often described as 'wheezing',[46] but symptoms do not respond to asthma treatment.[62, 64]

Upper airway dysfunction can coexist with asthma.[61] People with asthma who also have upper airway dysfunction experience more symptoms than those with asthma alone and this can result in over-treatment if vocal cord dysfunction is not identified and managed appropriately.[61]

Upper airway dysfunction probably has multiple causes.[61] In some people it is probably due to hyperresponsiveness of the larynx in response to intrinsic and extrinsic triggers.[61, 65] Triggers can include exercise, psychological conditions, airborne irritants, rhinosinusitis, gastro-esophageal reflux disease, and medicines.[62, 63]

Upper airway dysfunction should be considered when spirometry shows normal FEV_1/FVC ratio in a patient with suspected asthma[63] or symptoms do not respond to short-acting $beta_2$ agonist reliever. The shape of the maximal respiratory flow loop obtained by spirometry may suggest the diagnosis.[46] Direct observation of the vocal cords is the best method to confirm the diagnosis of upper airway dysfunction.[61]

Links between allergic rhinitis and asthma

Prevalence, aetiology and symptoms

Asthma and allergic rhinitis frequently coexist. At least 75% of patients with asthma also have rhinitis, although estimates vary widely.[66] Patients with asthma may have both allergic and non-allergic rhinitis.

Allergic rhinitis that starts early in life is usually due to a classical IgE hypersensitivity. Adult-onset asthma or inflammatory airway conditions typically have more complex causes. Chronic rhinosinusitis with nasal polyps is not a simple allergic condition and generally needs specialist care.[67]

Symptoms and signs of allergic rhinitis can be local (e.g. nasal discharge, congestion or itch), regional (e.g. effects on ears, eyes, throat or voice), and systemic (e.g. sleep disturbance and lethargy). Most people with allergic rhinitis experience nasal congestion or obstruction as the predominant symptom. Ocular symptoms (e.g. tearing and itch) in people with allergic rhinitis are usually due to coexisting allergic conjunctivitis.[68]

Patients may mistake symptoms of allergic rhinitis for asthma and vice versa. Allergic rhinitis is sometimes more easily recognised only after asthma has been stabilised.

▶ Go to: National Asthma Council Australia's *Managing allergic rhinitis in people with asthma* information paper

Effects on asthma

Allergic rhinitis is an independent risk factor for developing asthma in children and adults.[69, 70, 71, 72, 73] However, the use of antihistamines in children has not been shown to prevent them developing asthma.[66]

The presence of allergic rhinitis is associated with worse asthma control in children and adults.[74, 75, 76, 77] The use of intranasal corticosteroids in patients with concommitant allergic rhinitis and asthma may improve asthma control in patients who are not already

taking regular inhaled corticosteroids.[78]

Both rhinitis and asthma can be triggered by the same factors, whether allergic (e.g. house dust mite, pet allergens, pollen, cockroach) or non-specific (e.g. cold air, strong odours, environmental tobacco smoke).

Food allergies do not cause allergic rhinitis. Most people with allergic rhinitis are sensitised to multiple allergens (e.g. both pollens and house dust mite), so symptoms may be present throughout the year.

Pollens (e.g. grasses, weeds, trees) and moulds are typically seasonal allergens in southern regions, but can be perennial in tropical northern regions.[79] However, ryegrass is not found in tropical regions (see Thunderstorm asthma).

Pollen calendars provide information on when airborne pollen levels are likely to be highest for particular plants.

Thunderstorm asthma

Seasonal allergic rhinitis, which in Australia is typically associated with sensitisation to perennial ryegrass (*Lolium perenne*), is an important risk factor for thunderstorm asthma.[80]

▶ Go to: ASCIA's *Pollen calendar*
Go to: National Asthma Council Australia's *Epidemic thunderstorm asthma* information paper

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Obstructive sleep apnoea and asthma

Links with asthma

The risk of obstructive sleep apnoea is higher among people with asthma than in the general population.[81]

Obstructive sleep apnoea is associated with upper and lower airway inflammation.[42] Pharyngeal inflammation in obstructive sleep apnoea may promote upper airway collapse.[42]

Obstructive sleep apnoea syndrome is an independent risk factor for asthma flare-ups.[81]

In adults, unrecognised obstructive sleep apnoea may contribute to persistent asthma daytime or night-time asthma symptoms, based on cohort study evidence.[82, 83]

In obese adults, obstructive sleep apnoea may contribute to poor asthma control.[84]

Obstructive sleep apnoea may also interact with gastro-oesophageal reflux disease to affect asthma control in adults.[84]

In children, sleep-disordered breathing in children appears to be a risk factor for severe asthma, independent of obesity.[85]

Effects of obstructive sleep apnoea treatment on asthma

Continuous positive airway pressure (CPAP) may improve asthma in adults with concomitant obstructive sleep apnoea syndrome.[86]

Among children with obstructive sleep apnoea, asthma control (measured by frequency of acute asthma flare-ups, reliever use, and asthma symptoms) may improve after adenotonsillectomy.[87] Tonsillectomy or adenotonsillectomy is indicated in the management of upper airway obstruction in children with obstructive sleep apnoea.[88]

Comorbidity in older adults

Many older people with asthma also have multiple comorbidities and complex healthcare needs.[89, 90] Common conditions in older people that may affect asthma control include:[89]

- obesity
- gastro-oesophageal reflux disease
- obstructive sleep apnoea syndrome and other sleep disorders
- osteoporosis (vertebral fractures can impair respiratory capacity)
- cardiovascular disease (some medicines may worsen asthma).

The presence of diabetes can affect decisions about the use of systemic corticosteroids, while heart disease or anaemia can mimic symptoms.

There is limited clinical trial evidence to guide asthma management in older people with common comorbid conditions, because most asthma treatment trials have excluded people with these conditions.[91, 89] Guidelines for one disease condition may have to be modified for older people with multiple chronic diseases to avoid potential adverse effects including drug–drug interactions.[89]

Common age-related problems such as cognitive impairment, poor eyesight, hearing loss, poor coordination or osteoarthritis can affect a person's ability to use inhaler devices correctly.

Medicare items for chronic disease management (e.g. GP Management Plans, Team Care Arrangements, Multidisciplinary Care Plans)

apply to patients with asthma.

▶ Go to: *Australian Government Department of Health*

Indoor air quality

Epidemiological studies suggest that asthma symptoms are worsened by exposure to range of indoor pollutants, especially environmental tobacco smoke, fuel combustion, damp and moulds.[92]

Environmental tobacco smoke

Among adults with asthma, exposure to cigarette smoke (smoking or regular exposure to environmental tobacco smoke within the previous 12 months) has been associated with a significantly increased risk of needing acute asthma care within the next 2–3 years.[93]

▶ See: *Smoking and asthma*

Fuel combustion

Indoor exposure to nitrogen dioxide (e.g. due to gas stoves or heaters in homes, schools or workplaces) increases the risk of asthma symptoms[94, 95, 96] and may reduce lung function.[95] Most evidence that nitrogen dioxide is an asthma trigger is from studies in children. Preventing exposure (e.g. replacing heaters with non-polluting heaters) improves symptoms of asthma and wheeze in children.[97, 98, 99, 96]

Woodfire smoke can reduce lung function and increase airway inflammation in children with asthma.[100] Inhaled corticosteroids may reduce the effects of wood smoke.

Damp and moulds

Several mould species have been associated with asthma, including *Alternaria* (e.g. *Alternaria alternate*), *Cladosporium*, *Aspergillus* and *Penicillium*.[101] Two mechanisms have been reported for airway disease due to moulds: allergic sensitisation and reaction to mould aeroirritants.[102]

Sensitisation to *Alternaria* has been associated with an increased risk of hospitalisation in children with asthma.[101] Epidemiological studies suggest that exposure to damp, mouldy buildings can worsen symptoms in adults and children with asthma[101, 103, 104] and is associated with increased risk of asthma flare-ups.

Building repairs to reduce dampness in homes (e.g. leak repair, improvement of ventilation, removal of water-damaged materials) may reduce asthma symptoms and the use of asthma medicines.[105] A systematic review and meta-analysis found that damp remediation of houses reduced asthma-related symptoms including wheezing in adults, and reduced acute care visits in children.[105] In children living in mouldy houses, reducing damp in the home may reduce symptoms and flare-ups, compared with cleaning advice about moulds.[106]

There are too few good-quality studies to conclude whether remediation of workplace buildings or schools reduces asthma symptoms.[105]

Antifungal medication (oral itraconazole) may improve quality of life in people with severe asthma (requiring high-dose inhaled corticosteroid treatment or frequent/continuous courses of oral corticosteroids) who are sensitised to moulds.[107] However, antifungal treatment is associated with adverse effects.[107]

Perfumes

Asthma symptoms can be triggered by strong scents including:

- incense[108]
- perfumes.[109, 110]

There have been anecdotal reports of asthma triggered by spray deodorants.

Work-exacerbated asthma due to perfumes has also been documented.[111]

▶ See: *Work-related asthma*

Outdoor air quality

Industrial and traffic pollutants

Overall, epidemiological studies suggest that there is a strong relationship between air pollution and asthma symptoms or flare-ups, including severe acute asthma requiring hospital admission.[112] Airborne pollutants associated with worsening of asthma symptoms include:[113, 114, 115, 116, 117, 118, 119, 120, 121, 122, 123]

- coarse particulate matter (diameter ≤10 micrometre)

- fine particulate matter (diameter ≤2.5 micrometre)
- carbon monoxide
- ozone
- nitrogen dioxide
- sulphur dioxide
- diesel exhaust (multiple chemicals).

The mechanisms appear to involve airway inflammation and reduction in lung function.

Evidence from regional studies correlating recorded air pollution levels with hospital records show that pollutants from traffic sources are positively associated with emergency department visits for asthma or wheeze. Even low concentrations of ozone and traffic-related air pollutants may increase the risk of serious asthma flare-ups in children.

As little as 2 hours' exposure to air alongside busy city roads or freeways increases airway inflammation, reduces lung function, and can cause symptoms in people with asthma.[124, 125]

Harmful effects of exposure to particulate matter are worse during warm weather.[117] There may be a delay of 3–5 days between exposure to pollution and asthma flare-ups, particularly in children.[116]

Simultaneous exposure to pollutants (e.g. diesel exhaust, ozone) and allergens may have synergistic effects.[112, 126] Diesel may interact with proteins to cause deposition of allergens deep in respiratory tract.[112]

Airborne fungi

High levels of airborne fungi (e.g. *Basidiomycetes*, *Ascomycetes*, *Deuteromycetes*) in urban environments were associated with increased rates of hospitalisation for asthma in a population study.[126]

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Allergens as asthma triggers

Allergens can trigger asthma if the person is sensitised.

Pet allergens

Contact with pets (e.g. cats, dogs and horses) can trigger asthma, mainly due to sensitisation to allergens in sebum or saliva. Exposure can trigger flare-ups or worsen symptoms.[127]

The amount of allergen excreted differs between breeds.[127] Although some breeders claim that certain breeds of dogs that are less likely to trigger asthma ('hypoallergenic' breeds), allergen levels have not been shown to be lower in the animal's hair or coat,[128] or in owner's homes[129] with these breeds than other breeds.

Cat allergens easily spread on clothing and are found in places where cats have never been.[127]

Work-related asthma, triggered by animal urine or dander, is seen in animal workers such as breeders, jockeys, laboratory workers, pet shop workers, and people who work in veterinary surgeries.

House dust mite

Exposure to house dust mite antigens is a major asthma trigger in Australia.[127]

Pollens

Exposure to pollen can worsen asthma symptoms during the pollen seasons. Pollen counts are generally highest on calm, hot, sunny days in spring, early summer or during the dry season in tropical regions.

Thunderstorms are also associated with asthma flare-ups due to pollen in sensitised individuals (see: Weather events).

▶ See: *Allergies and asthma*
See: *Work-related asthma*
Go to: National Asthma Council Australia's *Asthma and Allergy* information paper

Home renovation materials

Home renovation materials can trigger asthma either as sensitisers (in patients allergic to the airborne substance) or as irritants.

Home renovators may be exposed to allergens commonly responsible for work-related asthma such as wood dust (e.g. western red cedar, redwood, oak) or isocyanates in adhesives.

▶ See: *Work-related asthma*

Triggers in the workplace

A wide range of occupational allergens has been associated with work-related asthma. Investigation of work-related asthma is complex and typically requires specialist referral.

Table. Examples of common sensitising agents and occupations associated with exposure

Agent	Occupations
Low molecular weight agents	
Wood dust (e.g. western red cedar, redwood, oak)	• Carpenters • Builders • Model builders • Sawmill workers • Sanders
Isocyanates	• Automotive industry workers • Adhesive workers • Chemical industry • Mechanics • Painters • Polyurethane foam production workers
Formaldehyde	• Cosmetics industry • Embalmers • Foundry workers • Hairdressers • Healthcare workers • Laboratory workers • Tanners • Paper, plastics and rubber industry workers
Platinum salts	• Chemists • Dentists • Electronics industry workers • Metallurgists • Photographers
High molecular weight agents	
Latex	• Food handlers • Healthcare workers • Textile industry workers • Toy manufacturers

Agent	Occupations
Low molecular weight agents	
Flour and grain dust	• Bakers • Combine harvester drivers • Cooks • Farmers • Grocers • Pizza makers
Animal allergens (e.g. urine, dander)	• Animal breeders • Animal care workers • Jockeys • Laboratory workers • Pet shop workers • Veterinary surgery workers

Source: Adapted from Hoy R, Abramson MJ, Sim MR. Work related asthma. *Aust Fam Physician* 2010; 39: 39-42. Available from: http://www.racgp.org.au/afp/201001/35841

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▶ See: *Work-related asthma*

Dietary triggers

Foods are rarely a trigger for asthma.[127]

Food chemicals and additives

Sulphite additives (widely used as preservative and antioxidants in the food and pharmaceutical industries) have been associated with acute asthma.[130]

An estimated 3–10% of people with asthma are sensitised to sulphites.[130]

See also: Dietary salicylates

Wine

Wine has been documented to trigger asthma symptoms.[131] The mechanism appears to be complex and varies between individuals.[131, 132] Components of wine implicated in asthma reactions include sulphite additives and histamines.[131]

Although sensitivity to sulphites in wine has been demonstrated in individuals in clinical studies, this mechanism does not explain all asthmatic reactions to wine.[131, 132, 133] The amount of sulphite in wine varies between brands. In general, there is more preservative in white wine than red wine, and more in cask wine than bottled wine.[134]

Some challenge studies suggest that antihistamines may reduce the severity of asthma symptoms due to wine.[134] In general there is more histamine in red than white wines and more in Shiraz than Cabernet.[134]

▶ Go to: Australasian Society of Clinical Immunology and Allergy's patient information: *Alcohol allergy* (2010)

Thermal effects

Asthma symptoms provoked by cold drinks are commonly reported anecdotally. Asthma symptoms and a reduction in FEV_1 after drinking icy water have been observed in children with asthma.[135] Increased bronchial hyperresponsiveness has been observed approximately 90 minutes after ingestion of ice.[135]

Dairy foods

Milk and other dairy foods do not increase mucus.[136]

Table. Association between food chemicals and asthma

Food chemical	Sources	Association with asthma
Benzoates (food additives 211, 213, 213, 216, 218)	Common preservative in soft drinks and foods	Probably minimal
Monosodium glutamate (food additive 621) and naturally occurring	Natural sources in fresh foods include tomatoes, various vegetables, mushrooms, fish, cheese, milk Added as flavour enhancer	Probably minimal
Sulphites (food additives 221, 222, 223, 224, 225, 228)	Common preservative used in processed foods, dried fruits, medicines, beer, wine	May trigger acute asthma (uncommon)
Tartrazine (food additive 102)	Colouring	Probably minimal
Salicylates (naturally occurring)	Stone fruits, berries, dried fruits, gherkins, concentrated tomato products, curry powder, paprika, thyme, garam masala, rosemary, tea	Probably minimal risk for people with aspirin-exacerbated respiratory disease

Sources

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Aspirin-exacerbated respiratory disease

Aspirin-exacerbated respiratory disease is a syndrome of chronic and treatment-resistant airway disease characterised by the presence of nasal polyposis, asthma, and hypersensitivity to NSAIDs, often also with eosinophilia and chronic rhinosinusitis.[137]

It is rare in the general population and the general asthma population, but is diagnosed in approximately 15% of patients with severe asthma and in approximately 9% of patients with chronic rhinosinusitis with nasal polyps.[138]

Aspirin-exacerbated respiratory disease usually develops in a person's thirties or forties.[138] If asthma develops, symptoms typically start 1–3 years after the development of rhinitis and are severe and resistant to treatment.[138]

The diagnosis is usually made clinically.[138] A positive aspirin challenge test provides a definitive diagnosis, but the test must be conducted with extreme caution because it can provoke severe bronchospasm.[138]

People with aspirin-exacerbated respiratory disease may react to one or more NSAIDs.[139]

Montelukast may improve lung function, reduce short-acting beta$_2$ bronchodilator use, reduce symptoms, and improve quality of life in patients with aspirin-exacerbated respiratory disease.[138]

People with aspirin-exacerbated respiratory disease must avoid all aspirin, including low-dose aspirin as anti-platelet therapy. They could be at risk if they use complementary medicines that contain salicylates (e.g. willowbark) or salicin (e.g. meadowsweet). COX-2 inhibitors may be a well-tolerated alternative to NSAIDs for most patients.[140]

Aspirin desensitisation is effective in improving asthma symptoms when provided within multidisciplinary care,[141] but it must only be considered in a centre with expertise in this procedure.

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Other medicines that can trigger asthma

Beta blockers

Beta-adrenergic blocking agents (beta blockers) may cause bronchoconstriction and reduce lung function and should be used with caution in people with asthma.

Risk may be reduced with cardioselective systemic beta blockers (i.e. those that primarily block $beta_1$-adrenergic receptors in the heart rather than $beta_2$-receptors in the airways), such as atenolol, bisoprolol, metoprolol and nebivolol. However, selective beta blockers are not risk-free. A meta-analysis of randomised, blinded, placebo-controlled clinical trials evaluating acute beta blocker exposure in patients with asthma found hat selective beta blockers caused a fall in FEV_1 of >20% in one in eight patients, and respiratory symptoms in one in 33 patients.[142]

Nonselective systemic beta blockers (including carvedilol, labetolol, oxprenolol, pindolol and propranolol) should not be used in people with asthma.

Ocular beta blocker preparations (e.g. timolol) may also impair respiratory function,[143, 144] and asthma deaths have been reported.[145, 146] Changing from timolol (nonselective) to betaxolol (selective) might improve respiratory function.[144] Blocking the tear duct for 2–3 minutes after administering drops (punctual occlusion) may reduce risk of respiratory effects by minimising systemic absorption.[147]

Prostaglandin analogues (e.g. bimatoprost, latanoprost, travoprost), $alpha_2$-agonists, carbonic acid inhibitors and cholinergic agents are alternative agents for managing intraocular pressure and have minimal effect on airways.[143] Note that some preparations are combined with a beta blocker.

Anticholinesterases and cholinergic agents

Cholinesterase inhibitors (e.g. pyridostygmine, neostigmine, donepezil, rivastigmine, galantamine) should be used with caution in people with asthma: they may reduce lung function and theoretically could cause bronchoconstriction.

Cholinergic agents (e.g. carbachol, pilocarpine) might also cause bronchoconstriction.

Complementary medicines

Some complementary and alternative medicines may trigger asthma:

- Echinacea[148]
- bee products (pollen, propolis, royal jelly).[149, 150, 151]
- complementary medicines that contain salicylates (e.g. willowbark) or salicin (e.g. meadowsweet) – could present a risk to people with aspirin-exacerbated respiratory disease

Combination budesonide/formoterol maintenance-and-reliever regimen in adults and adolescents: overview of efficacy

Low-dose budesonide/formoterol combination can be used as reliever for asthma symptoms (instead of using a short-acting $beta_2$ agonist reliever), in addition to its use as regular long-term preventer treatment.[152, 153, 154, 155, 156, 157] The following formulations can be used in maintenance-and-reliever regimens:

- dry-powder inhaler (*Symbicort Turbuhaler*) 100/6 microg or 200/6 microg
- pressurised metered-dose inhaler (*Symbicort Rapihaler*) 50/3 microg or 100/3 microg.

Neither the 400/12 microg dry-powder inhaler nor the 200/6 microg pressurised metered-dose inhaler should be used in this way.

Overall, clinical trials show that budesonide/formoterol combination as maintenance and reliever reduces the risk of flare-ups that require oral corticosteroids, compared with other current preventer regimens and compared with a fixed higher dose of inhaled corticosteroids.[158]

Pooled data from five randomised controlled trials assessing budesonide/formoterol maintenance-and-reliever regimens showed that similar or better levels of asthma control were achieved with budesonide/formoterol maintenance-and-reliever compared with the conventional maintenance regimen comparators:[154]

- higher-dose budesonide
- same dose budesonide/formoterol
- higher-dose inhaled corticosteroid/long-acting beta$_2$ agonist (budesonide/formoterol or fluticasone propionate/salmeterol).

In randomised clinical trials in patients with a history of asthma flare-up within the previous 12 months (and therefore at greater risk of flare-up in the next 12 months), the use of formoterol/budesonide as maintenance-and-reliever regimen reduced the risk of asthma flare-ups that required treatment with oral corticosteroids, compared with the use of any of the following (plus a short-acting beta$_2$ agonist reliever as needed):[154, 159, 160]

- the same combination as maintenance treatment only
- higher-dose combination as maintenance treatment only
- higher-dose inhaled corticosteroids.

Meta-analysis of six randomised controlled trials found that maintenance-and-reliever treatment with budesonide/formoterol reduced the risk of severe asthma flare-ups (use of oral corticosteroids for 3 days or more, hospitalisation or emergency department visits), compared with higher-dose inhaled corticosteroid alone, or in combination with a long-acting beta$_2$ agonist.[161]

In open-label studies in which patients were not selected for a previous history of flare-ups, there was no overall difference in time to first flare-up between budesonide/formoterol as maintenance-and-reliever regimen and conventional maintenance regimens (including inhaled corticosteroid or inhaled corticosteroid/long-acting beta$_2$ agonist combinations, leukotriene receptor antagonists, xanthines or any other asthma medicines) with rapid-onset beta$_2$ agonist reliever (selected according to clinician's choice).[162] However, the inhaled corticosteroid dose was higher with conventional maintenance regimens.

Note: The fluticasone propionate/formoterol combination is approved by the Therapeutic Goods Administration only for regular maintenance therapy.

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Inhaled corticosteroids for adults and adolescents: particle size

Medicines with small particle size CFC-free beclometasone [*Qvar*] and ciclesonide) achieve a greater proportion of medicine deposited in the lungs,[163] and are potentially distributed more widely in the large, intermediate, and small airways.[163] Although there are theoretical advantages with fine-particle formulations, including in severe asthma, the clinical implications have not been established.[4]

Randomised controlled trials comparing ciclesonide with fluticasone propionate in adults and adolescents have observed lower rates of patient-reported side-effects,[164] and confirmed dysphonia and oral candidiasis,[165] among patients using ciclesonide than among those using fluticasone propionate.

A small randomised controlled trial reported that ciclesonide treatment reduced sputum eosinophil counts in patients with refractory asthma who has previously shown persistent airway eosinophilia despite high-dose inhaled corticosteroids.[166] However, this study did not provide any comparison with a higher dose of the patient's existing inhaled corticosteroid.

Evidence from clinical trials of ciclesonide is limited. There have been no high quality double-blind studies to date, and observational studies have not been properly designed to avoid confounding factors such as prescriber bias.[4]

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Montelukast for adults: efficacy

In adults and adolescents with asthma that is not controlled by low-dose inhaled corticosteroid, the addition of a leukotriene receptor antagonist is less effective than the addition of a long-acting beta$_2$ agonist in reducing the rate of asthma flare-ups that require treatment with oral corticosteroids.[167] The addition of a leukotriene receptor antagonist is also associated with lesser improvement in lung function and quality of life than the addition of a long-acting beta$_2$ agonist.[167]

Montelukast taken 1 hour before exercise can be used to manage exercise-induced bronchoconstriction, but it is less effective than short-acting beta$_2$ agonists.[168]

Montelukast may improve lung function, reduce short-acting beta2 bronchodilator use, reduce symptoms, and improve quality of life in patients with aspirin-exacerbated respiratory disease.[138]

Montelukast is sometimes prescribed as add-on treatment for adults with severe asthma. Current evidence does not support its long-term use unless the patient shows a clear improvement in symptoms during a treatment trial.[21]

▶ Go to: *Investigation and management of exercise-induced bronchoconstriction*

Note: PBS status as at March 2019: Montelukast treatment is not subsidised by the PBS for people aged 15 years or over. Special Authority is available for DVA gold card holders or white card holders with approval for asthma treatments.

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Tiotropium for adults and adolescents

Tiotropium via mist inhaler (not dry-powder inhaler) is approved by the TGA for add-on maintenance treatment in patients with moderate-to-severe asthma.[169]

Tiotropium is well tolerated.[5, 170]

Note: PBS status as at March 2019:

Adults: Tiotropium is subsidised by the PBS for use in combination with a maintenance combination of an inhaled corticosteroid and a long acting beta$_2$ agonist for patients with severe asthma who have had at least one severe flare-up in the previous 12 months that required documented systemic corticosteroids, while receiving optimised asthma therapy with a combination of at least 800 mg budesonide per day or equivalent and a long acting beta$_2$ agonist, and correct inhaler technique has been assessed, demonstrated and documented.

Children and adolescents aged 6–17 years: Tiotropium is subsidised by the PBS for use in combination with a maintenance combination of an inhaled corticosteroid and a long acting beta2 agonist for patients with severe asthma who have had at least one severe flare-up in the previous 12 months that required documented systemic corticosteroids, while receiving optimised asthma therapy with a combination of a medium-to-high dose of an inhaled corticosteroid and a long acting beta2 agonist, and correct inhaler technique has been assessed, demonstrated and documented.

▶ Go to: *PBS listings*

Adults

Tiotropium added to inhaled corticosteroid therapy

A Cochrane review and meta-analysis that included five double-blind, double-dummy trials found that the addition of tiotropium to inhaled corticosteroid therapy reduced the risk of flare-ups requiring systemic corticosteroids and improved lung function, compared with the same dose of inhaled corticosteroid, in adults not taking a long-acting beta$_2$ agonist.[171]

Another systematic review and meta-analysis of long-acting muscarinic antagonists (tiotropium or umeclidinium) in patients with poorly controlled asthma despite taking inhaled corticosteroids reported that the addition of a long-acting muscarinic antagonist significantly reduced the risk of an asthma flare-up requiring systemic corticosteroids, or of asthma worsening, compared with placebo.[172] There were no significant effects on asthma control, reliever use or quality of life.[172] In most included studies participants were adults with a mean age between 30 and 40 years.[172]

However, there is insufficient evidence overall to support the use of tiotropium as an alternative to a long-acting beta$_2$ agonist as add-on therapy. In contrast, there is a large evidence base supporting the combination of inhaled corticosteroid and long-acting beta$_2$ agonist in adults.

Tiotropium versus long-acting beta$_2$ agonist added to inhaled corticosteroids

Few studies have compared tiotropium with long-acting beta$_2$ agonists as add-on therapy in patients taking inhaled corticosteroids. Direct evidence is mainly limited to studies of less than 6 months' duration comparing tiotropium with salmeterol. Meta-analysis of these studies showed no significant difference between treatment groups in flare-ups requiring oral corticosteroids, lung function, symptom control or asthma-related quality of life.[172]

While there is insufficient evidence to support the use of tiotropium as an alternative to a long-acting beta$_2$ agonist as add-on therapy in patients taking an inhaled corticosteroid, it may be a suitable alternative for patients who have experienced adverse effects of long-acting beta$_2$ agonist therapy.

Tiotropium added to the combination of inhaled corticosteroid and long-acting beta$_2$ agonist

The addition of tiotropium bromide via mist inhaler therapy is effective in improving lung function and reducing worsening asthma in adults and adolescents with asthma that is uncontrolled despite taking a combination of inhaled corticosteroid and long-acting beta$_2$ agonist, but does not reduce the rate of severe flare-ups requiring oral corticosteroid.[172]

A Cochrane review[173] concluded that tiotropium in addition to the combination of an inhaled corticosteroid and a long-acting beta$_2$ agonist may have additional benefits over inhaled corticosteroid/long-acting beta$_2$ agonist alone in reducing the need for oral corticosteroids in adults with severe asthma.

Another systematic review and meta-analysis found that the addition of a long-acting muscarinic antagonist (tiotropium or umeclidinium) to the combination an inhaled corticosteroid and a long-acting beta$_2$ agonist in adults significantly reduced the rate of worsening asthma, but not the rate of severe flare-ups requiring oral corticosteroids, and had no significant effect on other outcomes including lung function or symptom control.[172]

Adolescents

Tiotropium added to inhaled corticosteroid therapy

A meta-analysis of randomised placebo-controlled clinical trials in adolescents with asthma found that tiotropium as an add-on in patients taking inhaled corticosteroids improved lung function, reduced the rate of flare-ups, and improved asthma symptom control.[170] In those with poorly controlled asthma despite treatment with medium-to-high doses of inhaled corticosteroids, tiotropium was not inferior to salmeterol.[170]

Another systematic review and meta-analysis of clinical trials of long-acting muscarinic antagonists in patients with poorly controlled asthma included only two trials evaluating tiotropium in adolescents aged 12–17 years. Tiotropium added to inhaled corticosteroid treatment was associated with numerical improvements in lung function, but this reached significance in comparison with placebo in only one study. Both studies in adolescents reported large placebo effects, which may have been due to improved adherence to inhaled corticosteroids during the trial.[172]

Tiotropium added to the combination of inhaled corticosteroid and long-acting beta$_2$ agonist

A meta-analysis of randomised placebo-controlled clinical trials in adolescents with asthma reported that, among patients taking a combination of an inhaled corticosteroid and salmeterol, the addition of tiotropium increased lung function, reduced the rate of flare-ups, and improved asthma symptom control.[170]

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Written asthma action plans for adults

Every person with asthma should have their own written asthma action plan.

When provided with appropriate self-management education, self-monitoring and medical review, individualised written action plans consistently improve asthma health outcomes if they include two to four action points, and provide instructions for use of both inhaled corticosteroid and oral corticosteroids for treatment of flare-ups.[174] Written asthma action plans are effective if based on symptoms[175] or personal best peak expiratory flow (not on percentage predicted).[174]

How to develop and review a written asthma action plan

A written asthma action plan should include all the following:

- a list of the person's usual medicines (names of medicines, doses, when to take each dose) – including treatment for related conditions such as allergic rhinitis
- clear instructions on how to change medication (including when and how to start a course of oral corticosteroids) in all the following situations:
  - when asthma is getting worse (e.g. when needing more reliever than usual, waking up with asthma, more symptoms than usual, asthma is interfering with usual activities)
  - when asthma symptoms get substantially worse (e.g. when needing reliever again within 3 hours, experiencing increasing difficulty breathing, waking often at night with asthma symptoms)
  - when peak flow falls below an agreed rate (for those monitoring peak flow each day)
  - during an asthma emergency.
- instructions on when and how to get medical care (including contact telephone numbers)
- the name of the person writing the action plan, and the date it was issued.

Table. Options for adjusting medicines in a written asthma action plan for adults

Please view and print this figure separately: http://www.asthmahandbook.org.au/table/show/42

Table. Checklist for reviewing a written asthma action plan

- Ask if the person (or parent) knows where their written asthma action plan is.
- Ask if they have used their written asthma action plan because of worsening asthma.
- Ask if the person (or parent) has had any problems using their written asthma action plan, or has any comments about whether they find it suitable and effective.
- Check that the medication recommendations are appropriate to the person's current treatment.
- Check that all action points are appropriate to the person's level of recent asthma symptom control.
- Check that the person (or parent) understands and is satisfied with the action points.
- If the written asthma action plan has been used because of worsening asthma more than once in the past 12 months: review the person's usual asthma treatment, adherence, inhaler technique, and exposure to avoidable trigger factors.
- Check that the contact details for medical care and acute care are up to date.

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Templates for written asthma action plans

Templates are available from National Asthma Council Australia:

- National Asthma Council Australia colour-coded plan, available as a printed handout that folds to wallet size and as the *Asthma Buddy* mobile site
- Asthma Cycle of Care asthma action plan
- A plan designed for patients using budesonide/formoterol combination as maintenance and reliever therapy
- Remote Indigenous Australian Asthma Action Plan
- Every Day Asthma Action Plan (designed for remote Indigenous Australians who do not use written English – may also be useful for others for whom written English is inappropriate).

Some written asthma action plans are available in community languages.

Software for developing electronic pictorial asthma action plans[176, 177] is available online.

▶ Go to: National Asthma Council Australia's *Asthma Action Plan Library*
Download: Imperial College London's *Electronic Asthma Action Plan*

Monoclonal antibody therapy for severe asthma

Three monoclonal antibody therapies (omalizumab, mepolizumab and benralizumab) are available in Australia for the treatment of patients with severe asthma whose asthma is uncontrolled despite optimised standard treatment including high-dose inhaled corticosteroids and long-acting beta$_2$ agonists.

Table. Monoclonal antibody therapies currently available in Australia for severe asthma

Name	Description	Indication*	Dosage & route of administration
Benralizumab (Fasenra)	**Anti-IL-5 receptor** Humanised monoclonal antibody directed against IL-5 receptor Rα on surface of eosinophils and basophils	Add-on treatment for uncontrolled severe eosinophilic asthma in adults and adolescents aged ≥ 12 years	Prefilled syringe for SC injection 30 mg SC every 4 weeks for three injections then every 8 weeks
Mepolizumab (Nucala)	**Anti-IL-5** Humanised monoclonal antibody directed against IL-5	Add-on treatment for uncontrolled severe eosinophilic asthma in adults and adolescents ≥12 years	Powder for SC injection in a single-use vial 100 mg SC every 4 weeks
Omalizumab (Xolair)	**Anti-IgE** Humanised monoclonal antibody directed against IgE	Add-on treatment for uncontrolled severe allergic asthma in adults, adolescents and children aged ≥6 years	Prefilled syringe for SC injection Dose calculated according to baseline IgE and body weight. Usual dose every 2–4 weeks (larger doses divided in 2 and administered every 2 weeks)

SC: subcutaneous

**Refer to TGA-approved indications and PBS criteria*

▶ Go to: *TGA product information*

▶ Go to: *PBS medicine listing*

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Monoclonal antibody therapy reduces the rate of severe flare-ups requiring systemic corticosteroids.[8, 10, 178, 6, 7, 15, 9, 11, 14, 13, 179] Many patients also experience improvement in asthma symptoms[8, 10, 6, 7, 15, 11, 179, 180, 16] and quality of life.[8, 15, 9, 12] Some studies have also shown a reduction in oral corticosteroid in patients with severe asthma.[8, 10, 181, 15, 13, 179]

These therapies are generally well tolerated.[8, 6, 7, 14, 182] Injection site reactions are among the most common adverse events. Systemic reactions, including anaphylaxis, are rare but can occur.[183]

Monoclonal antibody therapies are funded by PBS only when prescribed by specialists (respiratory physician, clinical immunologist, allergist or general physician or paediatrician experienced in severe asthma management), for patients attending a public or private hospital, and when patients meet certain general and product-specific criteria. After treatment is initiated by a specialist, ongoing maintenance doses can be administered in primary care, but regular review for continuing PBS-funded treatment must be carried out by the specialist.

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Home Medicines Review and MedsCheck

Home Medicines Review

A Home Medicines Review involves the patient, their GP, an accredited pharmacist and a community pharmacy. Referral (Medicare Item 900) may be either direct to an accredited pharmacist, or to a community pharmacy that uses the services of an accredited pharmacist.

The accredited pharmacist visits the patient at their home, reviews their medicine regimen and provides a report to the person's GP and usual community pharmacy. The GP and patient then agree on a medication management plan.

The aims of Home Medicines Review include detecting and overcoming any problems with the person's medicines regimen, and improving the patient's knowledge and understanding of their medicines.

Patients could be eligible for a Home Medicines Review if they (any of):

- take more than 12 doses of medicine per day
- have difficulty managing their own medicines because of literacy or language difficulties, or impaired eyesight
- visit multiple specialists
- have been discharged from hospital in the previous four weeks
- have changed their medicines regimen during the past 3 months
- have experienced a change in their medical condition or abilities
- are not showing improvement in their condition despite treatment
- have problems managing their delivery device
- have problems taking medicines because of confusion, limited dexterity or poor eyesight.

▶ Go to: Medicare's *Home Medicines Review (HMR)*

MedsCheck

MedsCheck involves review of a patient's medicines by a registered pharmacist within the pharmacy.

Patients are eligible if they take multiple medicines, and they do not need a referral from a GP.

The pharmacist makes a list of all the person's medicines and medication or monitoring devices, and discusses them with the patient to identify any problems. If necessary, the pharmacist refers any issues back to the person's GP or other health professional.

▶ Go to: Australian Department of Health's *Medication Use Review (MedsCheck)*

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Managing severe asthma in adults and adolescents: non-pharmacological strategies and general care

Recommendations

If the person smokes, strongly advise them quit and support them to quit.

▶ **Go to:** *The Royal Australian College of General Practitioners' Supporting smoking cessation: a guide for health professionals*

How this recommendation was developed

Consensus

Based on clinical experience and expert opinion (informed by evidence, where available).

Last reviewed version 2.0

Provide training, information and encouragement to help patients improve their self-management skills, including:

- **inhaler technique**
- **understanding the importance of good adherence to maintenance treatments**
- **self-monitoring asthma symptoms**
- **understanding of asthma**
- **how to use their written action plan.**

How this recommendation was developed

Consensus

Based on clinical experience and expert opinion (informed by evidence, where available).

Last reviewed version 2.0

Provide every patient with an individualised written asthma action plan and update it regularly (at least yearly, and whenever treatment is changed).

▶ **See:** *Preparing written asthma action plans for adults*

How this recommendation was developed

Consensus

Based on clinical experience and expert opinion (informed by evidence, where available).

Last reviewed version 2.0

For patients with mucus production, consider referral to a physiotherapist or online video to learn Active Cycle of Breathing technique.

▶ **Go to:** *Bronchiectasis Toolbox's video on Active Cycle of Breathing technique*

How this recommendation was developed

Consensus

Based on clinical experience and expert opinion (informed by evidence, where available), with particular reference to named source(s):

- Lewis et al. 2012[1]

Last reviewed version 2.0

Assess and manage exposure to asthma triggers at home or work (e.g. cigarette smoke, allergens, irritants, infections, moulds/dampness, indoor or outdoor air pollution).

Table. Summary of asthma triggers

Please view and print this figure separately: http://www.asthmahandbook.org.au/table/show/52

How this recommendation was developed

Consensus

Based on clinical experience and expert opinion (informed by evidence, where available).

Last reviewed version 2.0

Advise patients with severe asthma to keep influenza vaccination up to date.

Note: Influenza vaccines are free of charge for people with severe asthma (defined as patients requiring frequent medical consultations or the use of multiple medications)

Vaccination reduces the risk of acquiring influenza, but may not reduce the risk or severity of asthma flare-ups during the influenza season.

For patients with allergies (e.g. egg, latex), refer to national immunisation guidelines and Australasian Society of Allergy and Clinical Immunology guidance.

There is no significant increase in asthma flare-ups following vaccination with inactivated trivalent influenza vaccine.

▶ **Go to:** *The Australian Immunisation Handbook*
Go to: *ASCIA guidelines on Influenza vaccination of the egg-allergic Individual*
Go to: *TGA safety advice on latex allergy with Fluad trivalent influenza vaccine*

How this recommendation was developed

Adapted from existing guidance

Based on reliable clinical practice guideline(s) or position statement(s):

- Australian Technical Advisory Group on Immunisation (ATAGI)[2]

Last reviewed version 2.0

Counsel adults and adolescents about maintaining a healthy lifestyle including healthy eating (e.g. eating plenty of fruit and vegetables, minimising intake of processed and take-away foods that are high in saturated fats), adequate physical activity, and achieving and maintaining a healthy weight.

How this recommendation was developed

Consensus

Based on clinical experience and expert opinion (informed by evidence, where available), with particular reference to named source(s):

- Wood et al. 2011[3]
- Wood et al. 2012[4]
- Adeniyi and Young. 2012[5]

Last reviewed version 2.0

For patients taking oral corticosteroids (maintenance treatment or frequent courses) or high-dose inhaled corticosteroids, monitor and manage potential adverse effects, including:

- **check for oral candidiasis (thrush)**
- **check blood pressure and blood glucose**
- **DEXA scan at baseline and repeated every 1–5 years (depending on age, sex and result)**
- **regular eye examination to check for cataracts and glaucoma, arranging assessment by ophthalmologist as necessary**
- **consider screening for adrenal suppression (or referring for screening)**
- **provide advice about the potential need for additional corticosteroids in the case of surgery or injury.**

- **Risk of reduced bone density should be managed in in patients taking oral corticosteroids (e.g. falls prevention, regular weight-bearing exercise and resistance training, adequate calcium and vitamin D intake, anti-osteoporosis treatment where indicated)**

Note: bisphosphonates are recommended (and subsided by the PBS) for primary fracture prevention in:

- **patients with glucocorticoid-induced osteoporosis when the T-score is ≤ −1.5**
- **patients with osteopenia (T score ≤1.0) treated with ≥7.5 mg prednisolone/day (or equivalent) for 3 months or more.**

How this recommendation was developed

Consensus

Based on clinical experience and expert opinion (informed by evidence, where available), with particular reference to named source(s):

- RACGP 2017[6]

Last reviewed version 2.0

More information

What is severe asthma?

Definitions

Severe asthma is asthma that remains uncontrolled despite high-dose inhaled corticosteroids plus long-acting beta$_2$ agonist (with correct inhaler technique and good adherence) or maintenance oral corticosteroids, or that requires such treatment to prevent it becoming uncontrolled.[7]

Severe asthma is sometimes also called ‘severe refractory asthma' or 'severe treatment-resistant asthma'. However, the introduction of monoclonal antibody therapies has demonstrated that significant improvements can be seen in asthma that was previously termed ‘refractory’.

Asthma is considered to be uncontrolled if any of the following are identified:

- poor symptom control, e.g. during previous 4 weeks any of:
  - symptoms during night or on waking
  - limitation of activities due to asthma
  - daytime symptoms on more than 2 days per week
  - need for short-acting beta$_2$ agonist reliever on more than 2 days per week (not including doses taken prophylactically before exercise).
- frequent severe flare-ups (e.g. more than one flare-up requiring treatment with oral corticosteroids in the previous year)
- serious flare-ups (e.g. hospital admission, intensive care unit admission, or mechanical ventilation in the previous year)
- persistent airflow limitation (e.g. detected by spirometry).

Patients with severe asthma are a subgroup of those with difficult-to-treat asthma. Difficult-to-treat asthma is defined as asthma that remains uncontrolled despite treatment with a high dose of an inhaled corticosteroid combined with a long-acting beta$_2$ agonist.

Not all patients with difficult-to-treat asthma have severe asthma. Difficult-to-treat asthma includes asthma that is uncontrolled due to suboptimal adherence, inappropriate or incorrect use of medicines, environmental triggers or comorbidities. Patients whose asthma control improves rapidly after such problems are corrected are not considered to have severe asthma.[7]

Prevalence

Severe asthma is uncommon. Less than 4% of adults with asthma have severe asthma.[8]

Description

Severe asthma appears to be a distinct disease (or group of diseases) with different pathobiology from that of milder forms of asthma. It is rare for mild asthma to progress to severe asthma.[9]

Severe asthma imposes a high burden of disease due to symptoms, flare-ups, medication-related adverse effects and costs.[10, 11]

Bronchiectasis, granulomas and other auto-immune disease processes can coexist with severe asthma.[9, 12] Aspirin-exacerbated respiratory disease can present as severe asthma.

Patterns of airway inflammation vary among people with severe asthma,[13] which suggests that the underlying pathophysiology varies.

Inflammatory patterns identified in adults in research studies include eosinophilic (elevated sputum eosinophil count), neutrophilic (elevated sputum neutrophil count), mixed (elevated sputum eosinophil and neutrophil counts) and paucigranulocytic (sputum eosinophil and neutrophil counts within normal range).[14] However, these tests are not routinely available in practice to guide treatment.

Some patients with severe asthma show sustained eosinophilia on blood tests despite good adherence to treatment with high doses of inhaled corticosteroids[9, 15]

Current research aims to predict which treatments will be most effective in an individual according to the findings of a range clinical investigations (e.g. sputum cell counts, peripheral blood white cell counts, fraction of exhaled nitric oxide [FeNO]) and on other clinical features such as age of asthma onset, relationship of allergies to asthma symptoms or presence of nasal polyposis. Few studies have been conducted to identify severe asthma phenotypes among children with severe asthma.[13]

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Living with asthma

People's experiences of asthma

More than three-quarters of Australians with asthma describe their general health as 'good' to 'excellent'.[16] However, the experience of living with asthma differs between individuals.

Experiences of asthma reported in research studies are diverse. They include:[17]

- frightening physical symptoms experience as 'panicky', a sensation of 'choking', 'breathing through a straw', 'suffocating' or 'drowning'
- feeling judged by others (family, employers/colleagues)
- self-judgement (e.g. believing that asthma is not a legitimate reason for absence from work)
- fearing dependency on medications
- fearing or experiencing side effects from medication
- fearing unpredictability of asthma symptoms that could occur while out
- wishing to be 'normal'.

Living with severe asthma

Studies of adults with severe asthma have identified frequently reported needs and goals, including:[18]

- achieving greater personal control over their conditions by gaining knowledge about symptoms and treatment. This included receiving more information about asthma from health professionals.
- being able to ask questions without feeling rushed during consultations
- being involved in making decisions about their treatment
- striving for a normal life.

People with severe asthma report a range of problems, including:[18, 11]

- troublesome adverse effects of oral corticosteroids (e.g. weight gain, 'puffy face', anxiety, irritability and depression) – these can affect social relationships and cause some people reduce or stop their use
- feelings of panic and fear of asthma symptoms – some people avoid activities and situations due to severe asthma
- emotional distress
- stigma
- restrictions on social life or ability to play with children
- restrictions on everyday activities including chores or leisure activities
- effects on working life, including absences or the need to change occupation or give up work
- being misunderstood by other people, who expect the person's asthma to be readily controlled as for milder asthma
- a sense of lack of support from their healthcare providers, including the perception that doctors did not have time to discuss asthma.

Last reviewed version 2.0

Effects of smoking on asthma control and medicines

Smoking reduces the probability of achieving good asthma control.[19] Among adults with asthma, exposure to cigarette smoke (smoking or regular exposure to environmental tobacco smoke within the previous 12 months) has been associated with a significantly increased risk of needing acute asthma care within the next 2–3 years.[20]

Smoking reduces response to inhaled corticosteroids and oral corticosteroids in people with asthma.[21, 22, 23, 24, 25] People who smoke may need higher doses of inhaled corticosteroids to receive the same benefits (improvement in lung function and reduction in flare-ups) as non-smokers.[25]

Therapeutic response to montelukast appears to be unchanged by smoking.[23] Therefore, montelukast may be useful in smokers with mild asthma.[26, 27]

Note: PBS status as at March 2019: Montelukast treatment is not subsidised by the PBS for people aged 15 years or over. Special Authority is available for DVA gold card holders, or white card holders with approval for asthma treatments.

Correct use of inhaler devices

Checking and correcting inhaler technique is essential to effective asthma management.

Most patients with asthma or COPD do not use their inhalers properly,[28, 29,30, 30, 31] and most have not had their technique checked or corrected by a health professional.

Incorrect inhaler technique when using maintenance treatments increases the risk of severe flare-ups and hospitalisation for people with asthma or COPD.[28, 29, 32, 33, 34, 35]

Poor asthma symptom control is often due to incorrect inhaler technique.[36, 37]

Incorrect inhaler technique when using inhaled corticosteroids increases the risk of local side effects like dysphonia and oral thrush.

The steps for using an inhaler device correctly differ between brands. Checklists of correct steps for each inhaler type and how-to videos are available from the National Asthma Council website.

▶ Go to: National Asthma Council Australia's *Using your inhaler* webpage for information, patient resources and videos on inhaler technique
Go to: National Asthma Council Australia's information paper for health professionals on *Inhaler technique for people with asthma or COPD*
Go to: NPS MedicineWise information on *Inhaler devices for respiratory medicines*

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Written asthma action plans for adults

Every person with asthma should have their own written asthma action plan.

When provided with appropriate self-management education, self-monitoring and medical review, individualised written action plans consistently improve asthma health outcomes if they include two to four action points, and provide instructions for use of both inhaled corticosteroid and oral corticosteroids for treatment of flare-ups.[38] Written asthma action plans are effective if based on symptoms[39] or personal best peak expiratory flow (not on percentage predicted).[38]

How to develop and review a written asthma action plan

A written asthma action plan should include all the following:

- a list of the person's usual medicines (names of medicines, doses, when to take each dose) – including treatment for related conditions such as allergic rhinitis
- clear instructions on how to change medication (including when and how to start a course of oral corticosteroids) in all the following situations:
  - when asthma is getting worse (e.g. when needing more reliever than usual, waking up with asthma, more symptoms than usual, asthma is interfering with usual activities)
  - when asthma symptoms get substantially worse (e.g. when needing reliever again within 3 hours, experiencing increasing difficulty breathing, waking often at night with asthma symptoms)
  - when peak flow falls below an agreed rate (for those monitoring peak flow each day)
  - during an asthma emergency.
- instructions on when and how to get medical care (including contact telephone numbers)
- the name of the person writing the action plan, and the date it was issued.

Table. Options for adjusting medicines in a written asthma action plan for adults

Please view and print this figure separately: http://www.asthmahandbook.org.au/table/show/42

Table. Checklist for reviewing a written asthma action plan

- Ask if the person (or parent) knows where their written asthma action plan is.

- Ask if they have used their written asthma action plan because of worsening asthma.
- Ask if the person (or parent) has had any problems using their written asthma action plan, or has any comments about whether they find it suitable and effective.
- Check that the medication recommendations are appropriate to the person's current treatment.
- Check that all action points are appropriate to the person's level of recent asthma symptom control.
- Check that the person (or parent) understands and is satisfied with the action points.
- If the written asthma action plan has been used because of worsening asthma more than once in the past 12 months: review the person's usual asthma treatment, adherence, inhaler technique, and exposure to avoidable trigger factors.
- Check that the contact details for medical care and acute care are up to date.

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Templates for written asthma action plans

Templates are available from National Asthma Council Australia:

- National Asthma Council Australia colour-coded plan, available as a printed handout that folds to wallet size and as the *Asthma Buddy* mobile site
- Asthma Cycle of Care asthma action plan
- A plan designed for patients using budesonide/formoterol combination as maintenance and reliever therapy
- Remote Indigenous Australian Asthma Action Plan
- Every Day Asthma Action Plan (designed for remote Indigenous Australians who do not use written English – may also be useful for others for whom written English is inappropriate).

Some written asthma action plans are available in community languages.

Software for developing electronic pictorial asthma action plans[40, 41] is available online.

▶ Go to: National Asthma Council Australia's *Asthma Action Plan Library*
Download: Imperial College London's *Electronic Asthma Action Plan*

Asthma self-management for adults

Effective self-management requires:

- adherence to the agreed treatment regimen
- correct use of inhaler devices for asthma medicines
- monitoring asthma control (symptoms, with addition of peak expiratory flow for some patients)
- having an up-to-date written asthma action plan and following it when asthma worsens
- management of triggers or avoidance (if appropriate)
- regular medical review.

Self-monitoring of asthma

Self-monitoring by the patient, based on symptoms and/or peak expiratory flow, is an important component of effective asthma self-management.[42]

For most patients, a daily diary is not necessary. Patients should be trained to take note if their symptoms worsen or their reliever use increases, so they can implement their written asthma action plan and/or get medical care as appropriate.

Internet-based self-management algorithms in which patients adjust their treatment monthly on the basis of control scores have been reported to be more effective than usual care.[43] In patients with partly and uncontrolled asthma, weekly self-monitoring and monthly treatment adjustment may improve asthma control.[44]

Asthma self-management education

Patients need careful asthma education to enable them to manage their asthma effectively.

Education in asthma self-management that involves self-monitoring (by either peak expiratory flow or symptoms), regular medical review and a written action plan improves health outcomes for adults with asthma.[42] Training programs that enable people to adjust their medication using a written action plan appear to be more effective than other forms of asthma self-management.[42]

Information alone does not appear to improve health outcomes in adults with asthma, although perceived symptoms may improve.[45]

Structured group asthma education programs are available in some regions. Contact Asthma Australia in your state or territory for information about available asthma education programs.

▶ Go to: *Asthma Australia*

See: *Asthma triggers*
See: *Inhaler devices and technique*

Asthma self-management for adolescents

Children's knowledge of asthma improves during adolescence.[46] However, the latest available data show that less than one in five (18%) Australian adolescents has a written asthma action plan, and only 28% have discussed their asthma management plan with their GP within the previous 12 months.[47]

During adolescence, young people get their asthma knowledge mainly from parents.[46] Adolescents whose parents were born overseas in countries with a lower asthma prevalence may have less knowledge of asthma. Chronic disease carries stigma in some communities, particularly Asian cultures. Children and adolescents from culturally and linguistically diverse communities may be expected to self-manage at a younger age and with less monitoring by parents, and so may need more support and education.

Specialised asthma nurses and asthma and respiratory educators are an invaluable resource for instruction, training and providing support for adolescents with asthma and their families.

Self-management programs

Asthma self-management education programs designed for adolescents can improve asthma-related quality of life,[48, 49, 50, 51] improve asthma knowledge,[48, 49, 52] improve ability to use a spacer correctly,[48] improve adolescents' confidence or belief in their ability (self-efficacy) to manage their asthma,[48, 51] increase behaviour to prevent asthma symptoms,[51] increase use of preventer medicines,[51] increase use of written asthma action plans,[51] reduce symptoms[48, 51] reduce limitation of activity due to asthma,[51] reduce school absences due to asthma,[48, 51] and reduce rates of acute care visits, emergency department visits, and hospitalisations.[51]

However, there is not enough evidence to determine which types of self-management programs for adolescents are most effective or the most important components of programs. (Few RCTs directly compared different programs.)

Most of the asthma programs designed for adolescents have been run in schools.

Peer-led asthma programs

Several studies have shown that adolescents can be trained to teach their peers about asthma self-management and motivate them to avoid smoking.[49, 50, 53] Asthma self-management programs for adolescents that use peer leaders can:

- significantly influence self-management behaviour, compared with adult-led programs[53]
- achieve clinically important improvements in health-related quality of life,[49, 50] increase adolescents' belief in their ability (self-efficacy) to resist smoking,[49] and increase asthma self-management knowledge[49] (compared with adolescents at schools not involved in this type of program[49] or with baseline[50])
- may be particularly beneficial for boys from low socioeconomic status background.[50]

The Triple A (Adolescent Asthma Action) program is a school-based peer-led adolescent asthma self-management education program developed in Australia.[54]

▶ Go to: *The Triple A (Adolescent Asthma Action) program*

Use of technology to support self-care

Providing asthma education messages through technologies that adolescents use every day (e.g. internet, phones, interactive video)[55, 56, 57] may be an effective way to deliver asthma health messages, compared with traditional media or with strategies that are not tailored for adolescents.

Active cycle of breathing technique for mucus clearance

The active cycle of breathing technique is a physiotherapy technique commonly used to promote airway clearance for people with chronic lung disease (e.g. cystic fibrosis, bronchiectasis, chronic bronchitis, COPD) who have copious airway secretions.[1] It is sometimes used for people with severe asthma who also have bronchiectasis.[12] It can also be used for short-term management of lower respiratory tract infections.

The technique designed to clear secretions, with the aim of reducing the frequency of infections and so preventing further airway damage and deterioration of lung function.[1] It may also reduce the potential for laryngeal irritation by reducing the number of coughs required to clear sputum.

One component of the active cycle of breathing is the forced expiratory technique (huffing), which consists of one or two forced expirations or huffs, followed by relaxed breathing (termed breathing control). [1]

A typical active cycle of breathing consists of breathing control, 3–4 thoracic expansion exercises, breathing control, and the forced expiratory technique.[1]

▶ Go to: *Bronchiectasis Toolbox's video on active cycle of breathing technique*

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Bronchial thermoplasty

The bronchial thermoplasty procedure applies heat directly to the airway walls to ablate smooth muscle within the bronchus, with the purpose of reducing the potential for constriction. It may also affect nerves and inflammatory cells in the airway.[14]

The procedure requires three bronchoscopy procedures.[14]

Bronchial thermoplasty is currently being investigated as a treatment for patients with asthma that is not well controlled with medical management, and has been reported to reduce rates of severe flare-ups and emergency department visits.[58, 44, 59, 60, 61, 62] However, it has been evaluated in only one good-quality double-blind sham-controlled trial.[60] This study showed a very large placebo effect for the primary outcome measure of quality of life, possibly due to multiple factors including frequent contact with health professionals, and high-dose treatment with oral corticosteroids during the 12-week treatment period. Long-term follow-up has been limited, with no comparison of sham- and active-treated patients.

The device used in the bronchial thermoplasty procedure has been registered in Australia since 2013. A retrospective analysis[63] reported data from 20 patients with severe asthma treated in 2014 and 2015 at three university teaching hospitals in NSW, Queensland and Victoria. All patients were receiving high-dose inhaled corticosteroids, long-acting beta$_2$ agonists and long-acting muscarinic antagonists. Half the patients were also taking maintenance oral prednisolone. After bronchial thermoplasty, short-acting reliever use and the rate of flare-ups requiring oral corticosteroids were significantly reduced. Five of 10 patients completely discontinued maintenance oral corticosteroids.[63]

An ongoing real-world US study[64] followed patients who had undergone bronchial thermoplasty due to poor asthma symptom control despite treatment with high doses of inhaled corticosteroid and long-acting beta$_2$ agonists. At 3 years after the procedure, substantial reductions in severe flare-ups, emergency department visits and hospitalisation due to asthma were reported, compared with baseline.[64] However, baseline adherence and inhaler technique were not reported.

Potential short-term adverse effects include worsening asthma, atelectasis, and pneumonia.[65] Long-term safety data are limited.[14]

Bronchial thermoplasty should only be considered after the patient has been evaluated at a highly specialised severe asthma clinic, and in conjunction with an interventional pulmonology multidisciplinary meeting. Adherence and inhaler technique should be assessed before considering the procedure. All patients should be included in a registry.

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Immunisation

Influenza and pneumococcal infections contribute to some acute flare-ups of asthma in people with asthma.[2, 66] People with obstructive airways disease, including asthma and COPD have a higher risk of invasive pneumococcal disease.[66]

Influenza vaccination reduces the risk of influenza and pneumococcal vaccination reduces the risk of pneumococcal pneumonia. However, the extent to which influenza vaccination and pneumococcal vaccination protect against asthma flare-ups due to respiratory tract infections is uncertain.[66, 67, [REFERENCE927], 68]

A 2017 systematic review[68] reported that no randomised controlled trials assessing the effect of vaccination on asthma flare-ups had been performed since 2001. Meta-analysis of randomised controlled trials and observational studies found that influenza vaccination protected against 59–78% of asthma flare-ups.[68] However, the quality of the included studies was low and were at high or unclear risk of bias.[68]

The use of inactivated trivalent influenza vaccine has not been associated with an increase in the risk of asthma flare-ups.

The *Australian Immunisation Handbook*[2] recommends annual influenza vaccination for these groups (in addition to other risk groups and health workers):

- patients with severe asthma, defined as those who need frequent hospital visits and multiple medicines for asthma
- all Aboriginal and Torres Strait Islander people aged 15 years and over
- all adults ≥65 years
- patients with COPD
- pregnant women
- for any adult who wishes to avoid influenza.

Influenza vaccines are free of charge for people with severe asthma (defined as patients requiring frequent medical consultations or the use of multiple medications).

Asthma, atopic dermatitis (eczema) and allergic rhinitis (hay fever) are not contraindications to any vaccine, unless the person is receiving high-dose oral steroid therapy.[2] There is no significant increase in asthma flare-ups immediately after vaccination with

inactivated influenza vaccination.[67]

To be effective, influenza vaccination must be given every year before the influenza season.

People at increased risk of invasive pneumococcal disease include:

- people with severe asthma (defined as those who need frequent hospital visits and multiple medicines for asthma)
- people using corticosteroid therapy equivalent to ≥2 mg/kg per day of prednisolone for more than 1 week.

For information about immunisation (including recommended dose schedules for influenza and pneumococcal vaccination, and eligibility for free vaccines), refer to the current version of the *Australian Immunisation Handbook*.[2]

▶ Go to: *The Australian Immunisation Handbook*

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Healthy living and asthma

▶ Go to: National Asthma Council Australia's *Asthma and healthy living. An information paper for health professionals*

Inhaled corticosteroids for adults: adverse effects

Local adverse effects

Hoarseness (dysphonia) and candidiasis are the most common local adverse effects of inhaled corticosteroids with both pressurised metered-dose inhalers and dry-powder inhalers:[69]

- The rate of of dysphonia among patients taking inhaled corticosteroids has been estimated at 5–20%.[70] However, higher rates of up to 58% have been reported in some studies.[71] The risk varies with the device used.
- The rate of oropharyngeal candidiasis among adults using inhaled corticosteroids has been estimated at 5–7%, with positive mouth culture for *Candida albicans* in approximately 25% of patients. However, higher rates of up to 70% have been reported in some studies. The risk depends on the formulation, dose and dose frequency.[70]

When taking inhaled corticosteroids via pressurised metered-dose inhalers, the use of a spacer reduces the risk of dysphonia and candidiasis.[72] Spacers improve delivery of the medicine to the airways.

Quick mouth rinsing immediately after inhaling effectively removes a high proportion of remaining medicine.[73] This may reduce the risk of oropharyngeal candidiasis ('thrush').

The incidence of dysphonia and candidiasis is significantly lower with ciclesonide than with equivalent doses of fluticasone propionate.[74] This may an important consideration for patients who experience dysphonia, particularly for those for whom voice quality is important (e.g. singers, actors, teachers). With ciclesonide, the rate of adverse effects may not differ when taken with or without a spacer.[75]

▶ Go to: National Asthma Council Australia's *Inhaler technique in adults with asthma or COPD* information paper

Systemic adverse effects

Cross-sectional population studies have reported lower bone mineral density with long-term use of high doses of inhaled corticosteroid,[76] but the effect on fracture risk in patients with asthma is unclear.

A meta-analysis of randomised controlled trials in adults older than 40 years with COPD (in which osteoporosis is more common) or asthma found no association between the use of inhaled corticosteroid and fracture risk overall, but found a slight increase in fracture risk among those using high doses.[77]

Cross-sectional studies show a dose–response relationship between inhaled corticosteroid use for asthma or COPD, and risk of cataracts in adults.[78]

Long-term inhaled corticosteroid use for asthma or COPD is associated with a small increase in the risk of developing diabetes, and in the risk of diabetes progression. These risks are greatest at higher doses (equivalent to fluticasone propionate 1000 microg/day or higher).[79]

The incidence of osteoporosis, cataracts and diabetes increases with age, and these conditions are also more common in smokers and in patients with COPD. Few studies have assessed risk specifically in patients with asthma.

Patients at risk of osteoporosis should be referred for bone density screening, screened for vitamin D and/or calcium deficiency, and provided with advice about maintaining bone health.

▶ Go to: Australian and New Zealand Bone and Mineral Society's *Vitamin D and health in adults in Australia and New Zealand: a position statement*
Go to: Osteoporosis Australia's *Building healthy bones throughout life: an evidence-informed strategy to prevent osteoporosis in Australia*

Patient concerns about adverse effects

The prevalence of side effects that patients consider troubling increases with increasing dose of inhaled corticosteroids.[80] Mid and high doses are consistently associated with a higher intensity and a higher prevalence of reported adverse effects, after controlling for other factors.[80]

A high proportion of people with asthma may have misunderstandings and fears about using inhaled corticosteroids,[81, 82] such as fears about weight gain, unwanted muscle development, bone fractures, susceptibility to infections and reduction of efficacy of the medicine over time.[81] Most people do not discuss their concerns about inhaled corticosteroid treatment with health professionals.[81] Safety concerns are a major reason for poor adherence, particularly general concerns about corticosteroids rather than concerns about specific adverse effects.[83]

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Managing severe asthma in adults and adolescents: add-on treatments

Recommendations

If an adult with confirmed severe asthma continues to experience frequent symptoms or flare-ups despite optimisation of inhaler technique and adherence, and treatment of comorbidities, a trial of add-on treatment with tiotropium or montelukast can be considered in primary care before referring for specialist assessment for monoclonal antibody therapy.

- **It is preferable to offer specialist referral without delay, because 6 months' treatment by a specialist (or asthma diagnosis by a multidisciplinary severe asthma clinic team) is required before the patient can become eligible for monoclonal antibody therapy.**

Note: The addition of tiotropium to inhaled corticosteroid and long-acting beta$_2$ agonist may benefit some individuals with severe asthma.

There is very little evidence supporting the use of add-on montelukast for severe asthma. Limited evidence supports its use in the management of aspirin-exacerbated respiratory disease.

- **Warn patients about potential neuropsychiatric effects of montelukast.**

Refer to PBS listings for adults and adolescents.

▶ **Go to:** *PBS listings*

How this recommendation was developed

Consensus

Based on clinical experience and expert opinion (informed by evidence, where available), with particular reference to named source(s):

- Sobieraj et al. 2018[1]

Last reviewed version 2.0

For a patient already using regular treatment with a high dose of an inhaled corticosteroid plus a long-acting beta$_2$ agonist in a fixed-dose combination, consider changing to low-dose budesonide plus formoterol as single maintenance-and-reliever therapy.

Note: Review inhaler technique and adherence before trialling changes to the treatment regimen.

How this recommendation was developed

Consensus

Based on clinical experience and expert opinion (informed by evidence, where available), with particular reference to named source(s):

- Bousquet et al. 2007[2]
- Cates et al. 2013[3]
- Patel et al. 2013[4]
- Sobieraj et al. 2010[5]

Last reviewed version 2.0

When add-on treatments are indicated, initiate each add-on therapy as a treatment trial. If no improvement in an individual's asthma after an adequate trial, stop the treatment.

Notes: Adequate duration of a treatment trial depends on the agent. and the relevant clinical outcome. For treatment aimed at improving symptoms and/or lung function, a 3-month trial may be sufficient. For treatment aimed at reducing exacerbations, a trial of 6–12 months may be necessary.

Review inhaler technique and adherence before trialling changes to the treatment regimen.

Table. Steps for conducting a treatment trial

1. **Document baseline lung function.**
2. **Document baseline asthma control using a validated standardised tool such as the Asthma Score.**
3. **Discuss treatment goals and potential adverse effects with the person.**
4. **Run treatment trial for agreed period (e.g. 4–8 weeks, depending on the treatment and clinical circumstances, including urgency).**
5. **At an agreed interval, measure asthma control and lung function again and document any adverse effects.**
6. **If asthma control has not improved despite correct inhaler technique and good adherence, resume previous treatment and consider referral for specialist consultation.**

▶ **See:** *Asthma Score (Asthma Control Test)*

Asset ID: 36

How this recommendation was developed

Consensus

Based on clinical experience and expert opinion (informed by evidence, where available).

Last reviewed version 2.0

For a patient already using budesonide plus formoterol as single maintenance-and-reliever therapy, consider add-on options:

- **tiotropium via mist inhaler**
- **monoclonal antibody therapy (specialist-only treatment)**
- **montelukast.**

- **Warn patients about potential neuropsychiatric effects of montelukast**

Note: PBS status as at March 2019:

Adults: Tiotropium is subsidised by the PBS when used in combination with maintenance ICS+LABA treatment, for people with ≥ one documented severe exacerbation that required systemic corticosteroids in the previous 12 months despite maintenance treatment with inhaled corticosteroid (equivalent to 800 microg budesonide/day or higher) in combination with a long-acting beta2 agonist, and correct inhaler technique has been assessed, demonstrated and documented.

Adolescents aged up to 17 years: Tiotropium is subsidised by the PBS when used in combination with maintenance ICS+LABA treatment, for patients with severe asthma treated by (or in consultation with) a specialist, with frequent moderate exacerbations or ≥ one documented severe exacerbation that required systemic corticosteroids in the previous 12 months despite maintenance treatment with a medium-to-high dose of inhaled corticosteroid in combination with a long-acting beta2 agonist, and correct inhaler technique has been assessed, demonstrated and documented (see PBS for details).

PBS status as at March 2019: Montelukast treatment is not subsidised by the PBS for people aged 15 years or over. However, generic formulations are available as non-PBS prescriptions at lower cost to patients than in the past.

Note: There is very little evidence supporting the use of add-on montelukast for severe asthma. Limited evidence supports its use in the management of aspirin-exacerbated respiratory disease.

To date, studies of add-on therapies in patients with severe asthma have excluded those taking budesonide-and-formoterol maintenance and reliever therapy.

Review inhaler technique and adherence before trialling changes to the treatment regimen.

▶ **Go to:** *PBS listings*

How this recommendation was developed

Consensus

Based on clinical experience and expert opinion (informed by evidence, where available), with particular reference to named source(s):

- Sobieraj et al. 2018[1]

- Anderson et al. 2015[6]
- Kew et al. 2016[7]
- Rodrigo et al. 2015[8]
- Bleecker et al. 2016[9]
- FitzGerald et al. 2016[10]
- Nair et al. 2017[11]
- Wang et al, 2016[12]
- Bel et al. 2014[13]
- Ortega et al. 2014[14]
- Lai et al. 2015[15]
- Norman et al. 2013[16]
- Normansell et al. 2014[17]
- Abraham et al. 2016[18]
- Gibson et al. 2016[19]

Last reviewed version 2.0

In specialist referral clinics, 6–12 months' treatment with low-dose azithromycin or clarithromycin may be considered for an adult with confirmed moderate or severe asthma that remains poorly controlled despite treatment with a moderate-to-high dose of an inhaled corticosteroid plus a long-acting beta$_2$ agonist.

Note: Macrolides should only be prescribed by specialists with expertise in severe asthma. Consultation with a local infectious diseases expert may be necessary.

Clinical response to macrolides is more likely in patients with a positive bacterial culture on sputum test.

Compared with standard doses for infections, macrolide doses evaluated in studies of long-term asthma treatment are generally lower.

Azithromycin and clarithromycin are not registered by the TGA for the long-term treatment of asthma.

Check PBS listings before prescribing.

- **Before prescribing, rule out atypical mycobacterial infection, refer for hearing test and check ECG for prolonged QT interval**
- **Assess risk of toxicity (e.g. ototoxicity, hepatic toxicity, diarrhoea, QTc prolongation), assess potential for drug interactions, counsel patient about potential adverse effects.**
- **Monitor treatment-related adverse effects during treatment, including ECG, audiology, liver function tests.**

How this recommendation was developed

Consensus

Based on clinical experience and expert opinion (informed by evidence, where available), with particular reference to named source(s):

- Kew et al. 2015[20]
- Gibson et al. 2017[21]
- Brusselle et al. 2013[22]

Last reviewed version 2.0

A trial of maintenance treatment with oral corticosteroids can be considered for an adult or adolescent if asthma remains poorly controlled despite treatment with a high dose of an inhaled corticosteroid plus a long-acting beta$_2$ agonist if both the following apply:

- **Other add-on therapies have been considered and found to be unsuitable, or have been trialled without success.**
- **The person is not eligible for monoclonal antibody therapy.**

Avoid daily treatment with oral corticosteroids, if possible (e.g. use every second day). Use the lowest effective dose.

- **Risk of reduced bone density should be managed in in patients taking oral corticosteroids (e.g. falls prevention, regular weight-bearing exercise and resistance training, adequate calcium and vitamin D intake, anti-osteoporosis treatment where indicated). Consider yearly DXA.**
- **Monitor blood pressure and blood glucose in patients taking systemic corticosteroids**
- **Monitor mental health and manage treatment-related adverse effects**

Note: Arrange specialist referral for any patient for whom long-term maintenance oral corticosteroids for asthma have been prescribed or are being considered, or who requires frequent short courses of oral corticosteroids for acute asthma.

Bisphosphonates are recommended (and subsided by the PBS) for primary fracture prevention in:

- **patients with glucocorticoid-induced osteoporosis when the T-score is ≤ −1.5**
- **patients with osteopenia (T score ≤ −1.0) treated with ≥7.5 mg prednisolone/day (or equivalent) for 3 months or more.**

▶ **Go to:** *Royal Australian College of General Practitioners and Osteoporosis Australia's osteoporosis guidelines*

How this recommendation was developed

Consensus

Based on clinical experience and expert opinion (informed by evidence, where available), with particular reference to named source(s):

- Buckley et al. 2017[23]
- RACGP 2017[24]
- Bell et al. 2012[25]

Last reviewed version 2.0

More information

What is severe asthma?

Definitions

Severe asthma is asthma that remains uncontrolled despite high-dose inhaled corticosteroids plus long-acting beta$_2$ agonist (with correct inhaler technique and good adherence) or maintenance oral corticosteroids, or that requires such treatment to prevent it becoming uncontrolled.[26]

Severe asthma is sometimes also called 'severe refractory asthma' or 'severe treatment-resistant asthma'. However, the introduction of monoclonal antibody therapies has demonstrated that significant improvements can be seen in asthma that was previously termed 'refractory'.

Asthma is considered to be uncontrolled if any of the following are identified:

- poor symptom control, e.g. during previous 4 weeks any of:
  - symptoms during night or on waking
  - limitation of activities due to asthma
  - daytime symptoms on more than 2 days per week
  - need for short-acting beta$_2$ agonist reliever on more than 2 days per week (not including doses taken prophylactically before exercise).
- frequent severe flare-ups (e.g. more than one flare-up requiring treatment with oral corticosteroids in the previous year)
- serious flare-ups (e.g. hospital admission, intensive care unit admission, or mechanical ventilation in the previous year)
- persistent airflow limitation (e.g. detected by spirometry).

Patients with severe asthma are a subgroup of those with difficult-to-treat asthma. Difficult-to-treat asthma is defined as asthma that remains uncontrolled despite treatment with a high dose of an inhaled corticosteroid combined with a long-acting beta$_2$ agonist.

Not all patients with difficult-to-treat asthma have severe asthma. Difficult-to-treat asthma includes asthma that is uncontrolled due to suboptimal adherence, inappropriate or incorrect use of medicines, environmental triggers or comorbidities. Patients whose asthma control improves rapidly after such problems are corrected are not considered to have severe asthma.[26]

Prevalence

Severe asthma is uncommon. Less than 4% of adults with asthma have severe asthma.[27]

Description

Severe asthma appears to be a distinct disease (or group of diseases) with different pathobiology from that of milder forms of asthma. It is rare for mild asthma to progress to severe asthma.[28]

Severe asthma imposes a high burden of disease due to symptoms, flare-ups, medication-related adverse effects and costs.[29, 30]

Bronchiectasis, granulomas and other auto-immune disease processes can coexist with severe asthma.[28, 31] Aspirin-exacerbated

respiratory disease can present as severe asthma.

Patterns of airway inflammation vary among people with severe asthma,[32] which suggests that the underlying pathophysiology varies.

Inflammatory patterns identified in adults in research studies include eosinophilic (elevated sputum eosinophil count), neutrophilic (elevated sputum neutrophil count), mixed (elevated sputum eosinophil and neutrophil counts) and paucigranulocytic (sputum eosinophil and neutrophil counts within normal range).[33] However, these tests are not routinely available in practice to guide treatment.

Some patients with severe asthma show sustained eosinophilia on blood tests despite good adherence to treatment with high doses of inhaled corticosteroids[28, 34]

Current research aims to predict which treatments will be most effective in an individual according to the findings of a range clinical investigations (e.g. sputum cell counts, peripheral blood white cell counts, fraction of exhaled nitric oxide [FeNO]) and on other clinical features such as age of asthma onset, relationship of allergies to asthma symptoms or presence of nasal polyposis. Few studies have been conducted to identify severe asthma phenotypes among children with severe asthma.[32]

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Investigations for severe asthma

Allergy tests

Allergy tests (skin prick testing or specific IgE test) are used to identify sensitisation to potentially avoidable allergens that may be contributing to symptoms. Allergy tests should always be interpreted with consideration of the clinical history.

▶ Go to: *Allergies and asthma*

Specialist investigations before starting monoclonal antibody therapies

The following are required for PBS subsidy for monoclonal antibody therapies:

- blood eosinophil count within the previous 12 months – required for benralizumab and mepolizumab
- total serum IgE level within the previous 12 months – required for omalizumab
- allergy tests skin prick testing or specific IgE test – required for omalizumab.

Eosinophil count and serum IgE level are arranged by the prescribing specialist. Eosinophil counts may be normal in patients taking oral corticosteroids. The dose is sometimes reduced before repeating the test.[35]

▶ Go to: National Asthma Council Australia's *Monoclonal antibody therapy for severe asthma* information paper

Other specialist investigations to identify severe asthma phenotype

Sputum eosinophil count may help predict response to benralizumab and mepolizumab therapy, but the optimal cut-off value for this purpose has not been identified.[35]

Fractional FeNO may help predict response to monoclonal antibody therapies, but the evidence is inconclusive.[35]

Specialist investigations to investigate severe asthma or rule out other conditions

High-resolution computed tomography of the chest is the most common imaging modality used in the investigation of severe asthma.[33] Its main purpose is to exclude alternative diagnoses or comorbid conditions (e.g. bronchiectasis, emphysema, mucus plugging, fibrosis, paralysed hemidiaphragm, idiopathic interstitial pneumonia including eosinophilic pneumonia, allergic bronchopulmonary aspergillosis).

Bronchoscopy may be used to evaluate tissue inflammation and structural abnormalities.[29] Its main purpose is to rule out other causes of symptoms.[33]

Transbronchial biopsy of peripheral airways might help identify specific lesions or diseases (e.g. malignancy, sarcoidosis).[33]

▶ Go to: *Centre of Excellence in Severe Asthma's Severe asthma toolkit*

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Peripheral blood eosinophil count in adults and adolescents

White cell differential count on a peripheral blood sample is not currently recommended routinely in the investigation and management of asthma.

Two studies in severe asthma found that blood eosinophils correlated modestly with sputum eosinophil counts.[36, 37] In severe asthma, higher blood eosinophil counts are associated with greater risk of poor symptom control and more frequent exacerbations.[38] In patients with severe asthma, peripheral blood eosinophil count is important for predicting response to monoclonal antibody therapy and is a requirement for eligibility for some therapies.

▶ See: *Monoclonal antibody therapy*

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Combination budesonide/formoterol maintenance-and-reliever regimen in adults and adolescents: overview of efficacy

Low-dose budesonide/formoterol combination can be used as reliever for asthma symptoms (instead of using a short-acting beta$_2$ agonist reliever), in addition to its use as regular long-term preventer treatment.[39, 40, 41, 42, 43, 44] The following formulations can be used in maintenance-and-reliever regimens:

- dry-powder inhaler (*Symbicort Turbuhaler*) 100/6 microg or 200/6 microg
- pressurised metered-dose inhaler (*Symbicort Rapihaler*) 50/3 microg or 100/3 microg.

Neither the 400/12 microg dry-powder inhaler nor the 200/6 microg pressurised metered-dose inhaler should be used in this way.

Overall, clinical trials show that budesonide/formoterol combination as maintenance and reliever reduces the risk of flare-ups that require oral corticosteroids, compared with other current preventer regimens and compared with a fixed higher dose of inhaled corticosteroids.[45]

Pooled data from five randomised controlled trials assessing budesonide/formoterol maintenance-and-reliever regimens showed that similar or better levels of asthma control were achieved with budesonide/formoterol maintenance-and-reliever compared with the conventional maintenance regimen comparators:[41]

- higher-dose budesonide
- same dose budesonide/formoterol
- higher-dose inhaled corticosteroid/long-acting beta$_2$ agonist (budesonide/formoterol or fluticasone propionate/salmeterol).

In randomised clinical trials in patients with a history of asthma flare-up within the previous 12 months (and therefore at greater risk of flare-up in the next 12 months), the use of formoterol/budesonide as maintenance-and-reliever regimen reduced the risk of asthma flare-ups that required treatment with oral corticosteroids, compared with the use of any of the following (plus a short-acting beta$_2$ agonist reliever as needed):[41, 46, 47]

- the same combination as maintenance treatment only
- higher-dose combination as maintenance treatment only
- higher-dose inhaled corticosteroids.

Meta-analysis of six randomised controlled trials found that maintenance-and-reliever treatment with budesonide/formoterol reduced the risk of severe asthma flare-ups (use of oral corticosteroids for 3 days or more, hospitalisation or emergency department visits), compared with higher-dose inhaled corticosteroid alone, or in combination with a long-acting beta$_2$ agonist.[48]

In open-label studies in which patients were not selected for a previous history of flare-ups, there was no overall difference in time to first flare-up between budesonide/formoterol as maintenance-and-reliever regimen and conventional maintenance regimens (including inhaled corticosteroid or inhaled corticosteroid/long-acting beta$_2$ agonist combinations, leukotriene receptor antagonists, xanthines or any other asthma medicines) with rapid-onset beta$_2$ agonist reliever (selected according to clinician's choice).[49] However, the inhaled corticosteroid dose was higher with conventional maintenance regimens.

Note: The fluticasone propionate/formoterol combination is approved by the Therapeutic Goods Administration only for regular maintenance therapy.

Last reviewed version 2.0

Tiotropium for adults and adolescents

Tiotropium via mist inhaler (not dry-powder inhaler) is approved by the TGA for add-on maintenance treatment in patients with moderate-to-severe asthma.[50]

Tiotropium is well tolerated.[35, 8]

Note: PBS status as at March 2019:

Adults: Tiotropium is subsidised by the PBS for use in combination with a maintenance combination of an inhaled corticosteroid and a long acting beta$_2$ agonist for patients with severe asthma who have had at least one severe flare-up in the previous 12 months that required documented systemic corticosteroids, while receiving optimised asthma therapy with a combination of at least 800 mg budesonide per day or equivalent and a long acting beta$_2$ agonist, and correct inhaler technique has been assessed, demonstrated and documented.

Children and adolescents aged 6–17 years: Tiotropium is subsidised by the PBS for use in combination with a maintenance combination of an inhaled corticosteroid and a long acting beta2 agonist for patients with severe asthma who have had at least one severe flare-up in the previous 12 months that required documented systemic corticosteroids, while receiving optimised asthma therapy with a combination of a medium-to-high dose of an inhaled corticosteroid and a long acting beta2 agonist, and correct inhaler technique has been assessed, demonstrated and documented.

▶ Go to: *PBS listings*

Adults

Tiotropium added to inhaled corticosteroid therapy

A Cochrane review and meta-analysis that included five double-blind, double-dummy trials found that the addition of tiotropium to inhaled corticosteroid therapy reduced the risk of flare-ups requiring systemic corticosteroids and improved lung function, compared with the same dose of inhaled corticosteroid, in adults not taking a long-acting $beta_2$ agonist.[6]

Another systematic review and meta-analysis of long-acting muscarinic antagonists (tiotropium or umeclidinium) in patients with poorly controlled asthma despite taking inhaled corticosteroids reported that the addition of a long-acting muscarinic antagonist significantly reduced the risk of an asthma flare-up requiring systemic corticosteroids, or of asthma worsening, compared with placebo.[1] There were no significant effects on asthma control, reliever use or quality of life.[1] In most included studies participants were adults with a mean age between 30 and 40 years.[1]

However, there is insufficient evidence overall to support the use of tiotropium as an alternative to a long-acting $beta_2$ agonist as add-on therapy. In contrast, there is a large evidence base supporting the combination of inhaled corticosteroid and long-acting $beta_2$ agonist in adults.

Tiotropium versus long-acting $beta_2$ agonist added to inhaled corticosteroids

Few studies have compared tiotropium with long-acting $beta_2$ agonists as add-on therapy in patients taking inhaled corticosteroids. Direct evidence is mainly limited to studies of less than 6 months' duration comparing tiotropium with salmeterol. Meta-analysis of these studies showed no significant difference between treatment groups in flare-ups requiring oral corticosteroids, lung function, symptom control or asthma-related quality of life.[1]

While there is insufficient evidence to support the use of tiotropium as an alternative to a long-acting $beta_2$ agonist as add-on therapy in patients taking an inhaled corticosteroid, it may be a suitable alternative for patients who have experienced adverse effects of long-acting $beta_2$ agonist therapy.

Tiotropium added to the combination of inhaled corticosteroid and long-acting $beta_2$ agonist

The addition of tiotropium bromide via mist inhaler therapy is effective in improving lung function and reducing worsening asthma in adults and adolescents with asthma that is uncontrolled despite taking a combination of inhaled corticosteroid and long-acting $beta_2$ agonist, but does not reduce the rate of severe flare-ups requiring oral corticosteroid.[1]

A Cochrane review[7] concluded that tiotropium in addition to the combination of an inhaled corticosteroid and a long-acting $beta_2$ agonist may have additional benefits over inhaled corticosteroid/long-acting $beta_2$ agonist alone in reducing the need for oral corticosteroids in adults with severe asthma.

Another systematic review and meta-analysis found that the addition of a long-acting muscarinic antagonist (tiotropium or umeclidinium) to the combination an inhaled corticosteroid and a long-acting $beta_2$ agonist in adults significantly reduced the rate of worsening asthma, but not the rate of severe flare-ups requiring oral corticosteroids, and had no significant effect on other outcomes including lung function or symptom control.[1]

Adolescents

Tiotropium added to inhaled corticosteroid therapy

A meta-analysis of randomised placebo-controlled clinical trials in adolescents with asthma found that tiotropium as an add-on in patients taking inhaled corticosteroids improved lung function, reduced the rate of flare-ups, and improved asthma symptom control.[8] In those with poorly controlled asthma despite treatment with medium-to-high doses of inhaled corticosteroids, tiotropium was not inferior to salmeterol.[8]

Another systematic review and meta-analysis of clinical trials of long-acting muscarinic antagonists in patients with poorly controlled asthma included only two trials evaluating tiotropium in adolescents aged 12–17 years. Tiotropium added to inhaled corticosteroid treatment was associated with numerical improvements in lung function, but this reached significance in comparison with placebo in only one study. Both studies in adolescents reported large placebo effects, which may have been due to improved adherence to inhaled corticosteroids during the trial.[1]

Tiotropium added to the combination of inhaled corticosteroid and long-acting $beta_2$ agonist

A meta-analysis of randomised placebo-controlled clinical trials in adolescents with asthma reported that, among patients taking a combination of an inhaled corticosteroid and salmeterol, the addition of tiotropium increased lung function, reduced the rate of flare-ups, and improved asthma symptom control.[8]

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Monoclonal antibody therapy for severe asthma

Three monoclonal antibody therapies (omalizumab, mepolizumab and benralizumab) are available in Australia for the treatment of patients with severe asthma whose asthma is uncontrolled despite optimised standard treatment including high-dose inhaled corticosteroids and long-acting beta$_2$ agonists.

Table. Monoclonal antibody therapies currently available in Australia for severe asthma

Name	Description	Indication*	Dosage & route of administration
Benralizumab (Fasenra)	**Anti-IL-5 receptor** Humanised monoclonal antibody directed against IL-5 receptor Rα on surface of eosinophils and basophils	Add-on treatment for uncontrolled severe eosinophilic asthma in adults and adolescents aged ≥ 12 years	Prefilled syringe for SC injection 30 mg SC every 4 weeks for three injections then every 8 weeks
Mepolizumab (Nucala)	**Anti-IL-5** Humanised monoclonal antibody directed against IL-5	Add-on treatment for uncontrolled severe eosinophilic asthma in adults and adolescents ≥12 years	Powder for SC injection in a single-use vial 100 mg SC every 4 weeks
Omalizumab (Xolair)	**Anti-IgE** Humanised monoclonal antibody directed against IgE	Add-on treatment for uncontrolled severe allergic asthma in adults, adolescents and children aged ≥6 years	Prefilled syringe for SC injection Dose calculated according to baseline IgE and body weight. Usual dose every 2–4 weeks (larger doses divided in 2 and administered every 2 weeks)

SC: subcutaneous

**Refer to TGA-approved indications and PBS criteria*

▶ Go to: *TGA product information*

▶ Go to: *PBS medicine listing*

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Monoclonal antibody therapy reduces the rate of severe flare-ups requiring systemic corticosteroids.[11, 13, 51, 9, 10, 18, 12, 14, 17, 16, 52] Many patients also experience improvement in asthma symptoms[11, 13, 9, 10, 18, 14, 52, 53, 19] and quality of life.[11, 18, 12, 15] Some studies have also shown a reduction in oral corticosteroid in patients with severe asthma.[11, 13, 22, 18, 16, 52]

These therapies are generally well tolerated.[11, 9, 10, 17, 54] Injection site reactions are among the most common adverse events. Systemic reactions, including anaphylaxis, are rare but can occur.[55]

Monoclonal antibody therapies are funded by PBS only when prescribed by specialists (respiratory physician, clinical immunologist, allergist or general physician or paediatrician experienced in severe asthma management), for patients attending a public or private hospital, and when patients meet certain general and product-specific criteria. After treatment is initiated by a specialist, ongoing maintenance doses can be administered in primary care, but regular review for continuing PBS-funded treatment must be carried out by the specialist.

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Montelukast for adults: efficacy

In adults and adolescents with asthma that is not controlled by low-dose inhaled corticosteroid, the addition of a leukotriene receptor antagonist is less effective than the addition of a long-acting beta$_2$ agonist in reducing the rate of asthma flare-ups that require treatment with oral corticosteroids.[56] The addition of a leukotriene receptor antagonist is also associated with lesser improvement in lung function and quality of life than the addition of a long-acting beta$_2$ agonist.[56]

Montelukast taken 1 hour before exercise can be used to manage exercise-induced bronchoconstriction, but it is less effective than short-acting beta$_2$ agonists.[57]

Montelukast may improve lung function, reduce short-acting beta2 bronchodilator use, reduce symptoms, and improve quality of life in patients with aspirin-exacerbated respiratory disease.[58]

Montelukast is sometimes prescribed as add-on treatment for adults with severe asthma. Current evidence does not support its long-term use unless the patient shows a clear improvement in symptoms during a treatment trial.[33]

▶ Go to: *Investigation and management of exercise-induced bronchoconstriction*

Note: PBS status as at March 2019: Montelukast treatment is not subsidised by the PBS for people aged 15 years or over. Special Authority is available for DVA gold card holders or white card holders with approval for asthma treatments.

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Azithromycin for moderate-to-severe-asthma

Macrolide antibiotics have both anti-inflammatory effects and antimicrobial effects. Azithromycin and clarithromycin are used in the management of cystic fibrosis,[59] bronchiectasis[60] and COPD[32] to reduce exacerbation rates.

Efficacy in asthma

The role of macrolides in the treatment of severe asthma is uncertain.[32, 20] The long-term use of azithromycin in adults with severe asthma may reduce flare-ups and improve symptom control, based on limited evidence.[35]

An Australian placebo-controlled randomised controlled trial reported that 48 weeks' treatment with azithromycin 500 mg three times weekly reduced flare-ups and improved quality of life in adults with symptomatic asthma despite treatment with a moderate or high dose of inhaled corticosteroid and long-acting bronchodilator.[21] Although long-term macrolide therapy was initially expected to be of most benefit patients with neutrophilic asthma, in this study a significant reduction in exacerbations was seen both in patients with eosinophilic and those with non-eosinophilic asthma. The greatest benefit was in those with positive bacterial culture. The study reported a nonsignificant increase in azithromycin-resistant organisms in sputum of patients treated with azithromycin, compared with placebo, but it was not adequately powered to fully assess this effect.

An earlier 6-month placebo-controlled randomised controlled trial in patients with severe asthma reported that low-dose azithromycin added to inhaled corticosteroids and long-acting beta$_2$ agonist improved quality of life, but did not reduce the rate of severe flare-ups, improve asthma control or improve lung function.[22] However, among the subgroup of patients with non-eosinophilic severe asthma, azithromycin significantly reduced the rate of a combined endpoint of either severe flare-ups or lower respiratory tract infections requiring antibiotics.[22] Azithromycin was associated with an increased rate of oropharyngeal carriage of macrolide-resistant streptococci.[22]

Compared with standard doses for infections, macrolide doses evaluated in studies of long-term asthma treatment are generally lower.

The evidence for the use of macrolides in children and adolescents with severe asthma is limited and inconclusive due to a lack of completed trials.[35]

Safety

Although azithromycin is generally well tolerated, rare adverse effects include QTc prolongation and hearing impairment.[61] Patients with either of these problems were excluded from the randomised controlled trials assessing the use of azithromycin in the treatment of moderate-to-severe or severe asthma.[22, 21]

There are also concerns about the potential for development of resistance. Specialist advice is recommended, including consultation with a local infectious diseases expert, before prescribing macrolides for asthma.

Atypical mycobacterial infections, hearing impairment and prolonged QT interval should be ruled out before prescribing. Treatment-related adverse effects should be monitored by ECG, audiology and liver function tests.

Note: Azithromycin and clarithromycin are not registered by the TGA for the long-term treatment of asthma.

Note: Azithromycin is not subsidised by the PBS for long-term use.

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Oral corticosteroids for severe chronic asthma in adults

In an Australian severe asthma registry study, 24% of patients with severe asthma who had been referred to a severe asthma specialist for assessment were being treated with oral corticosteroids in addition to inhaled corticosteroids and long-acting beta$_2$ agonists.[62]

Efficacy

Maintenance treatment with oral corticosteroids for severe asthma has not been evaluated in randomised placebo-controlled trials.[32]

Small randomised trials of intramuscular depot triamcinolone in adults and children with severe asthma, in addition to maintenance or frequent oral corticosteroids, have reported reductions in hospitalisations and emergency department visits, improvement in lung

function, and reduced eosinophilic inflammation.[32] However, the use of triamcinolone is associated with more adverse effects than other systemic corticosteroids.

Maintenance treatment with oral corticosteroids should be avoided, if possible, because of the high risk of serious adverse effects. [REFERENCE2001], 64, 65

Monoclonal antibody therapy is one strategy to reduce oral corticosteroid use in adults with severe asthma.[11, 13, 22]

▶ Go to: *National Asthma Council Australia's information paper on Monoclonal antibody therapy for severe asthma*

Other strategies for reducing oral corticosteroid use are being evaluated, such as internet-guided titration based on home monitoring of symptoms and fraction of exhaled nitric oxide (FeNO).[66]

Safety

Oral corticosteroid use in adults with asthma is associated with serious adverse events including severe infections, peptic ulcers, affective disorders, cataracts, cardiovascular events including acute myocardial infarction and hypertension, diabetes, fractures and osteoporosis.[63, 67, 68]

Dose–response relationships have been demonstrated for these adverse effects.[63, 67, 68]

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Home Medicines Review and MedsCheck

Home Medicines Review

A Home Medicines Review involves the patient, their GP, an accredited pharmacist and a community pharmacy. Referral (Medicare Item 900) may be either direct to an accredited pharmacist, or to a community pharmacy that uses the services of an accredited pharmacist.

The accredited pharmacist visits the patient at their home, reviews their medicine regimen and provides a report to the person's GP and usual community pharmacy. The GP and patient then agree on a medication management plan.

The aims of Home Medicines Review include detecting and overcoming any problems with the person's medicines regimen, and improving the patient's knowledge and understanding of their medicines.

Patients could be eligible for a Home Medicines Review if they (any of):

- take more than 12 doses of medicine per day
- have difficulty managing their own medicines because of literacy or language difficulties, or impaired eyesight
- visit multiple specialists
- have been discharged from hospital in the previous four weeks
- have changed their medicines regimen during the past 3 months
- have experienced a change in their medical condition or abilities
- are not showing improvement in their condition despite treatment
- have problems managing their delivery device
- have problems taking medicines because of confusion, limited dexterity or poor eyesight.

▶ Go to: Medicare's *Home Medicines Review (HMR)*

MedsCheck

MedsCheck involves review of a patient's medicines by a registered pharmacist within the pharmacy.

Patients are eligible if they take multiple medicines, and they do not need a referral from a GP.

The pharmacist makes a list of all the person's medicines and medication or monitoring devices, and discusses them with the patient to identify any problems. If necessary, the pharmacist refers any issues back to the person's GP or other health professional.

▶ Go to: Australian Department of Health's *Medication Use Review (MedsCheck)*

Last reviewed version 2.0

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Monoclonal antibody therapy

Recommendations

When administering maintenance doses of monoclonal antibody therapy, instructions for storing, preparing and administering doses should be followed carefully. The patient must be monitored under direct observation by a health professional (e.g. registered nurse or GP) for at least 30 minutes after each injection.

- **Resuscitation facilities should be available**

Note: Monoclonal antibody therapies for asthma are prescribed by specialists. The first few (typically 3) doses are administered in a specialist clinic. Subsequent maintenance doses can be given in the GP's office or at home for patients participating in a home support program.

Ensure that dispensing arrangements are agreed between the patient, specialist and pharmacist and that the patient clearly understands the process for ordering injections.

How this recommendation was developed

Consensus

Based on clinical experience and expert opinion (informed by evidence, where available), with particular reference to named source(s):

- Centre of Excellence in Severe Asthma 2017[1, 2]

Last reviewed version 2.0

Ensure that patients understand that they must attend all scheduled specialist visits in order to remain eligible for access to monoclonal antibody therapy through the PBS.

Note: The specialist prescriber must reapply for PBS application at prescribed intervals, which depend on the agent. Advise patients to make sure they receive advice on timing of required consultations and that they have booked a specialist appointment well before using their last injection.

▶ **Go to:** *PBS Listings*

How this recommendation was developed

Consensus

Based on clinical experience and expert opinion (informed by evidence, where available).

Last reviewed version 2.0

Advise patients who have been prescribed a monoclonal antibody therapy to keep taking their inhaled corticosteroid preventer. Continue to check adherence and inhaler technique regularly.

How this recommendation was developed

Consensus

Based on clinical experience and expert opinion (informed by evidence, where available).

Last reviewed version 2.0

Ensure that each patient has an up-to-date written asthma action plan: review it at least yearly or whenever the medication regimen is changed. Remind patients taking monoclonal antibody therapy to follow their written asthma action plan when symptoms worsen.

▶ **See:** *Preparing written asthma action plans for adults*

How this recommendation was developed

Consensus

Based on clinical experience and expert opinion (informed by evidence, where available).

Last reviewed version 2.0

More information

Monoclonal antibody therapy for severe asthma

Three monoclonal antibody therapies (omalizumab, mepolizumab and benralizumab) are available in Australia for the treatment of patients with severe asthma whose asthma is uncontrolled despite optimised standard treatment including high-dose inhaled corticosteroids and long-acting beta$_2$ agonists.

Table. Monoclonal antibody therapies currently available in Australia for severe asthma

Name	Description	Indication*	Dosage & route of administration
Benralizumab (Fasenra)	**Anti-IL-5 receptor** Humanised monoclonal antibody directed against IL-5 receptor Rα on surface of eosinophils and basophils	Add-on treatment for uncontrolled severe eosinophilic asthma in adults and adolescents aged ≥ 12 years	Prefilled syringe for SC injection 30 mg SC every 4 weeks for three injections then every 8 weeks
Mepolizumab (Nucala)	**Anti-IL-5** Humanised monoclonal antibody directed against IL-5	Add-on treatment for uncontrolled severe eosinophilic asthma in adults and adolescents ≥12 years	Powder for SC injection in a single-use vial 100 mg SC every 4 weeks
Omalizumab (Xolair)	**Anti-IgE** Humanised monoclonal antibody directed against IgE	Add-on treatment for uncontrolled severe allergic asthma in adults, adolescents and children aged ≥6 years	Prefilled syringe for SC injection Dose calculated according to baseline IgE and body weight. Usual dose every 2–4 weeks (larger doses divided in 2 and administered every 2 weeks)

SC: subcutaneous

**Refer to TGA-approved indications and PBS criteria*

▶ Go to: *TGA product information*

▶ Go to: *PBS medicine listing*

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Monoclonal antibody therapy reduces the rate of severe flare-ups requiring systemic corticosteroids.[3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13] Many patients also experience improvement in asthma symptoms[3, 4, 6, 7, 8, 10, 13, 14, 15] and quality of life.[3, 8, 9, 16] Some studies have also shown a reduction in oral corticosteroid in patients with severe asthma.[3, 4, 17, 8, 12, 13]

These therapies are generally well tolerated.[3, 6, 7, 11, 18] Injection site reactions are among the most common adverse events. Systemic reactions, including anaphylaxis, are rare but can occur.[19]

Monoclonal antibody therapies are funded by PBS only when prescribed by specialists (respiratory physician, clinical immunologist, allergist or general physician or paediatrician experienced in severe asthma management), for patients attending a public or private hospital, and when patients meet certain general and product-specific criteria. After treatment is initiated by a specialist, ongoing

maintenance doses can be administered in primary care, but regular review for continuing PBS-funded treatment must be carried out by the specialist.

Last reviewed version 2.0

Investigations for severe asthma

Allergy tests

Allergy tests (skin prick testing or specific IgE test) are used to identify sensitisation to potentially avoidable allergens that may be contributing to symptoms. Allergy tests should always be interpreted with consideration of the clinical history.

▶ Go to: *Allergies and asthma*

Specialist investigations before starting monoclonal antibody therapies

The following are required for PBS subsidy for monoclonal antibody therapies:

- blood eosinophil count within the previous 12 months – required for benralizumab and mepolizumab
- total serum IgE level within the previous 12 months – required for omalizumab
- allergy tests skin prick testing or specific IgE test – required for omalizumab.

Eosinophil count and serum IgE level are arranged by the prescribing specialist. Eosinophil counts may be normal in patients taking oral corticosteroids. The dose is sometimes reduced before repeating the test.[20]

▶ Go to: National Asthma Council Australia's *Monoclonal antibody therapy for severe asthma* information paper

Other specialist investigations to identify severe asthma phenotype

Sputum eosinophil count may help predict response to benralizumab and mepolizumab therapy, but the optimal cut-off value for this purpose has not been identified.[20]

Fractional FeNO may help predict response to monoclonal antibody therapies, but the evidence is inconclusive.[20]

Specialist investigations to investigate severe asthma or rule out other conditions

High-resolution computed tomography of the chest is the most common imaging modality used in the investigation of severe asthma.[21] Its main purpose is to exclude alternative diagnoses or comorbid conditions (e.g. bronchiectasis, emphysema, mucus plugging, fibrosis, paralysed hemidiaphragm, idiopathic interstitial pneumonia including eosinophilic pneumonia, allergic bronchopulmonary aspergillosis).

Bronchoscopy may be used to evaluate tissue inflammation and structural abnormalities.[22] Its main purpose is to rule out other causes of symptoms.[21]

Transbronchial biopsy of peripheral airways might help identify specific lesions or diseases (e.g. malignancy, sarcoidosis).[21]

▶ Go to: *Centre of Excellence in Severe Asthma's Severe asthma toolkit*

Last reviewed version 2.0

Written asthma action plans for adults

Every person with asthma should have their own written asthma action plan.

When provided with appropriate self-management education, self-monitoring and medical review, individualised written action plans consistently improve asthma health outcomes if they include two to four action points, and provide instructions for use of both inhaled corticosteroid and oral corticosteroids for treatment of flare-ups.[23] Written asthma action plans are effective if based on symptoms[24] or personal best peak expiratory flow (not on percentage predicted).[23]

How to develop and review a written asthma action plan

A written asthma action plan should include all the following:

- a list of the person's usual medicines (names of medicines, doses, when to take each dose) – including treatment for related conditions such as allergic rhinitis
- clear instructions on how to change medication (including when and how to start a course of oral corticosteroids) in all the following situations:
  - when asthma is getting worse (e.g. when needing more reliever than usual, waking up with asthma, more symptoms than usual, asthma is interfering with usual activities)
  - when asthma symptoms get substantially worse (e.g. when needing reliever again within 3 hours, experiencing increasing difficulty breathing, waking often at night with asthma symptoms)
  - when peak flow falls below an agreed rate (for those monitoring peak flow each day)
  - during an asthma emergency.

- instructions on when and how to get medical care (including contact telephone numbers)
- the name of the person writing the action plan, and the date it was issued.

Table. Options for adjusting medicines in a written asthma action plan for adults

Please view and print this figure separately: http://www.asthmahandbook.org.au/table/show/42

Table. Checklist for reviewing a written asthma action plan

- Ask if the person (or parent) knows where their written asthma action plan is.
- Ask if they have used their written asthma action plan because of worsening asthma.
- Ask if the person (or parent) has had any problems using their written asthma action plan, or has any comments about whether they find it suitable and effective.
- Check that the medication recommendations are appropriate to the person's current treatment.
- Check that all action points are appropriate to the person's level of recent asthma symptom control.
- Check that the person (or parent) understands and is satisfied with the action points.
- If the written asthma action plan has been used because of worsening asthma more than once in the past 12 months: review the person's usual asthma treatment, adherence, inhaler technique, and exposure to avoidable trigger factors.
- Check that the contact details for medical care and acute care are up to date.

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Templates for written asthma action plans

Templates are available from National Asthma Council Australia:

- National Asthma Council Australia colour-coded plan, available as a printed handout that folds to wallet size and as the *Asthma Buddy* mobile site
- Asthma Cycle of Care asthma action plan
- A plan designed for patients using budesonide/formoterol combination as maintenance and reliever therapy
- Remote Indigenous Australian Asthma Action Plan
- Every Day Asthma Action Plan (designed for remote Indigenous Australians who do not use written English – may also be useful for others for whom written English is inappropriate).

Some written asthma action plans are available in community languages.

Software for developing electronic pictorial asthma action plans[25, 26] is available online.

▶ Go to: National Asthma Council Australia's *Asthma Action Plan Library*
Download: Imperial College London's *Electronic Asthma Action Plan*

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