National Asthma Council Australia

AUSTRALIAN ASTHMA HANDBOOK

VERSION 2.0

CLINICAL ISSUES

Management challenges

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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

National Asthma Council Australia. *Australian Asthma Handbook*, Version 2.0. National Asthma Council Australia, Melbourne, 2019.

Available from: http://www.asthmahandbook.org.au

ISSN 2203-4722

SPONSORS

National Asthma Council Australia would like to acknowledge the support of the sponsors of Version 2.0 of the *Australian Asthma Handbook*:

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DISCLAIMER

Management challenges

Overview

People with asthma can experience recurring symptoms or flare-ups, despite preventer treatment. Only a small proportion of these people have severe asthma.

Note: Severe asthma is defined as asthma that is uncontrolled despite treatment with a high dose of an inhaled corticosteroid in combination with a 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.[1]

The most common reasons for experiencing poorly controlled asthma are:

- not using preventer at a therapeutic dose and/or frequency (e.g. adherence is suboptimal)
- incorrect inhaler technique
- other medical conditions affecting asthma symptoms or risk of flare-ups
- psychosocial factors that affect asthma self-management (e.g. life events, financial problems or mental health conditions).

The term 'difficult-to-treat asthma' is used for asthma that remains uncontrolled despite treatment with a high dose of an inhaled corticosteroid combined with a long-acting beta$_2$ agonist.[1] 'Difficult' refers to the pattern of clinical findings – not the person.

Asthma management involves identifying the optimal treatment plan for each person and support them to achieve the best possible asthma control, through effective self-management (adults and older children), or effective asthma management by parents/carers (younger children).

▶ Go to: *International Primary Care Respiratory Group's position paper on personalised care for adults with asthma* (Note that some statements in this position paper differ from Australian Asthma Handbook recommendations)

When a person's asthma is not well controlled despite treatment, working with the person (or parents/carers) to consider the possible reasons systematically, before adjusting the treatment, may avoid unnecessary or risky dose escalation. Consider:

- whether current treatment is appropriate
- inhaler technique
- frequency of preventer dosing
- whether the symptoms are due to asthma.
- the individual's triggers
- any comorbid conditions that may affect asthma symptoms, risk or management.

Note: The order in which these considerations are best addressed may differ, depending on the setting, the patient and the circumstances. Because they are interrelated, they may each need to be addressed more than once.

If asthma is still not well controlled after working through these issues and optimising treatment, consider the possibility of severe asthma.

Table. Troubleshooting checklist

Please view and print this figure separately: http://www.asthmahandbook.org.au/table/show/58

▶ See: *Severe asthma in adults and adolescents*

▶ See: *Managing severe asthma in children aged 1–5 years*

▶ See: *Managing difficult-to-treat and severe asthma in children aged 6 years and over*

In this section

Comprehensive review

Comprehensive review when asthma is not controlled by preventer treatment

http://www.asthmahandbook.org.au/clinical-issues/management-challenges/review

Treatment

Checking whether current prescribed treatment is appropriate

http://www.asthmahandbook.org.au/clinical-issues/management-challenges/treatment

Adherence technique

Checking whether the person has problems taking their medicine

http://www.asthmahandbook.org.au/clinical-issues/management-challenges/adherence-technique

Diagnosis

Checking whether current symptoms are due to asthma

http://www.asthmahandbook.org.au/clinical-issues/management-challenges/diagnosis

Triggers and comorbidities

Considering triggers and comorbidities

http://www.asthmahandbook.org.au/clinical-issues/management-challenges/triggers-comorbidities

Difficult-to-treat asthma

Considering non-pharmacological strategies to manage difficult-to-treat asthma in adults and adolescents and providing general care

http://www.asthmahandbook.org.au/clinical-issues/management-challenges/difficult-to-treat

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Comprehensive review when asthma is not controlled by preventer treatment

Recommendations

Offer a comprehensive asthma review for patients with asthma that is not well controlled despite treatment.

Note: This is especially important for patients with difficult-to-treat asthma: asthma that is not well controlled despite stepped-up preventer treatment (medium-dose inhaled corticosteroid plus long-acting beta$_2$ agonist in adults, or high-dose inhaled corticosteroid in children).

▶ **See:** *Planning and conducting asthma review in adults*

▶ **See:** *Planning routine asthma review for children*

How this recommendation was developed

Consensus

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

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If possible:

- **book a long appointment so you have time to listen to the person's experiences, concerns and thoughts about their asthma and their medication**
- **arrange a consultation with an asthma educator.**

How this recommendation was developed

Consensus

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

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More information

Living with asthma

People's experiences of asthma

More than three-quarters of Australians with asthma describe their general health as 'good' to 'excellent'.[1] However, the experience of living with asthma differs between individuals.

Experiences of asthma reported in research studies are diverse. They include:[2]

- 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:[3]

- 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:[3, 4]

- 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.

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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.[5] 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.[5]

▶ 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):[6]

- 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*

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 $beta_2$	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

	Medical history	Investigation findings	Other factors
	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		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
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,[7] 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.[8, 9]

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.[10] However, many of the studies were not optimally designed to answer this question,[11] 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.[12, 13] 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[14] 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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Culturally secure asthma care for Aboriginal and Torres Strait Islander people

Primary care services can aim to deliver healthcare that is culturally secure. However, only the Aboriginal or Torres Strait Islander person themselves can determine whether their care is culturally safe or respectful.[15]

Making the healthcare system a secure environment for Aboriginal and Torres Strait Islander peoples involves cultural respect, which involves not only respecting cultural difference but recognition, protection and continued advancement of the inherent rights, cultures and traditions of Aboriginal and Torres Strait Islander peoples.[16]

Cultural awareness (or 'cultural sensitivity') among individual health professionals involves sensitivity to the similarities and differences between different cultures to enable effective communication with members of another cultural group.[17]

Training in cultural awareness and 'cultural safety' is available for non-Indigenous health professionals who provide healthcare for Aboriginal and Torres Strait Islander people.

▶ Go to: Australian College of Rural and Remote Medicine's *Cultural awareness module for PIP Indigenous Health Incentive*
Go to: RACGP's *Cultural awareness and cultural safety training*

Involvement of Aboriginal and/or Torres Strait Islander health workers and health practitioners in asthma care

Aboriginal and Torres Strait Islander health workers and Aboriginal and Torres Strait Islander health practitioners can provide self-management education for people with asthma and parents of children with asthma. Culture-specific programs may be more appropriate than mainstream programs for Aboriginal and Torres Strait Islander people.[18]

An education program (three sessions) conducted by Aboriginal and Torres Strait Islander health workers in primary health care in the Torres Strait region reduced the number of school days missed due to wheezing among school-aged children, and increased carers' knowledge of asthma, the contents of the child's written asthma action plan, and where the written asthma action plan was kept.[19] However, it did not reduce the rate of asthma flare-ups, compared with children whose families did not participate.[19]

Aboriginal and Torres Strait Islander health workers and practitioners can provide health care services that are reimbursable through Medicare.[5, 20]

Confidentiality issues for adolescents

Adolescents' concerns about confidentiality prevent them using health care services, especially if substance use is likely to be raised. Adolescents are more likely to disclose information about health risk behaviours, and are more likely to return for review, if they know that confidential information will not be revealed to their parents or others.[21]

When adolescents are accompanied by parents or carers, health care providers should consider seeing the adolescent alone for part of each consultation.[21]

Health professionals should discuss confidentiality and its limits with adolescents.[21] Adolescents are more willing to communicate honestly with healthcare professionals who discuss confidentiality with them.[22]

Health professionals need to clearly explain which personal health information can be confidential and which must be shared with parents, and keep parents informed.

Health care providers should advise adolescents that they can obtain their own Medicare card once they turn 15.[21]

▶ Go to: Royal Australasian College of Physicians' *Working with young people* online resource (see *Privacy and confidentiality in adolescent health care* in Topic 2: *Ethical and legal issues*)
Go to: Australian Government Department of Human Services' *Financial and health support for young people* webpage

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Checking whether current prescribed treatment is appropriate

▶ See also: *Severe asthma in adults and adolescents*

▶ See also: *Managing severe asthma in children aged 1–5 years*

▶ See also: *Managing difficult-to-treat and severe asthma in children aged 6 years and over*

Recommendations

Assess and record the person's level of recent asthma symptom 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** • **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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Asset ID: 33

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

Good control	Partial control	Poor control
All of: • **Daytime symptoms† ≤2 days per week (lasting only a few minutes and rapidly relieved by rapid-acting bronchodilator)**	**Any of:** • **Daytime symptoms† >2 days per week (lasting only a few minutes and rapidly relieved by rapid-acting bronchodilator)**	**Either of:** • **Daytime symptoms† >2 days per week (lasting from minutes to hours or recurring, and partially or fully relieved by SABA reliever)**

Good control	Partial control	Poor control
• No limitation of activities‡ • No symptoms§ during night or when wakes up • Need for SABA reliever# ≤2 days per week	• Any limitation of activities* • Any symptoms during night or when wakes up†† • Need for SABA reliever# >2 days per week	• ≥3 features of partial control within the same week

SABA: short-acting beta$_2$ agonist

† e.g. wheezing or breathing problems

‡ child is fully active; runs and plays without symptoms

§ including no coughing during sleep

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

*** e.g. wheeze or breathlessness during exercise, vigorous play or laughing**

†† e.g. waking with symptoms of wheezing or breathing problems

Notes:

Recent asthma control is based on symptoms over the previous 4 weeks. Each child's risk factors for future asthma outcomes should also be assessed and taken into account in management.

Validated questionnaires can be used for assessing recent symptom control:
Test for Respiratory and Asthma Control in Kids (TRACK) for children < 5 years
Childhood Asthma Control Test (C-ACT) for children aged 4–11 years

Last reviewed version 2.0

Asset ID: 23

How this recommendation was developed

Consensus

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

Last reviewed version 2.0

For adults, check risk factors and make sure the current treatment regimen is suitable for any risk factors identified.

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	**Ask about triggers for flare-ups, and lead time**

Risk factor	Clinical action †
12 months	
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

Last reviewed version 2.0

Asset ID: 41

How this recommendation was developed

Consensus

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

Last reviewed version 2.0

Check the preventer dose that the person is currently taking.

How this recommendation was developed

Consensus

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

Last reviewed version 2.0

If the person's asthma is uncontrolled despite appropriate preventer treatment for their age, check adherence and inhaler technique carefully before optimising the treatment regimen.

▶ **See:** *Checking whether the person has problems taking their medicine*

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

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*

Last reviewed version 2.0

Classification of recent asthma symptom control in children

Ongoing review of asthma involves both assessing recent asthma symptom control and assessing risks for poor asthma outcomes such as flare-ups and adverse effects of medicines.

Recent asthma symptom control is assessed according to the frequency of asthma symptoms over the previous 4 weeks.

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

Good control	Partial control	Poor control
All of: • Daytime symptoms† ≤2 days per week (lasting only a few minutes and rapidly relieved by rapid-acting bronchodilator) • No limitation of activities‡ • No symptoms§ during night or when wakes up • Need for SABA reliever# ≤2 days per week	Any of: • Daytime symptoms† >2 days per week (lasting only a few minutes and rapidly relieved by rapid-acting bronchodilator) • Any limitation of activities* • Any symptoms during night or when wakes up†† • Need for SABA reliever# >2 days per week	Either of: • Daytime symptoms† >2 days per week (lasting from minutes to hours or recurring, and partially or fully relieved by SABA reliever) • ≥3 features of partial control within the same week

SABA: short-acting beta$_2$ agonist

† e.g. wheezing or breathing problems

‡ child is fully active; runs and plays without symptoms

§ including no coughing during sleep

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

* e.g. wheeze or breathlessness during exercise, vigorous play or laughing

†† e.g. waking with symptoms of wheezing or breathing problems

Notes:

Recent asthma control is based on symptoms over the previous 4 weeks. Each child's risk factors for future asthma outcomes should also be assessed and taken into account in management.

Validated questionnaires can be used for assessing recent symptom control:
Test for Respiratory and Asthma Control in Kids (TRACK) for children < 5 years

Childhood Asthma Control Test (C-ACT) for children aged 4–11 years

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Asset ID: 23

Table. Risk factors for life-threatening asthma flare-ups in children

Asthma-related factors

Poor asthma control

Admission to hospital in preceding 12 months

History of intubation for acute asthma

Over-use of short-acting beta$_2$ agonist reliever

Abnormal spirometry findings

Reversible expiratory airflow limitation on spirometry despite treatment

Poor adherence to preventer

Incorrect inhaler technique for preventer

Poor adherence to asthma action plan

Exposure to clinically relevant allergens

Exposure to tobacco smoke

Other clinical factors

Allergies to foods, insects, medicines

Obesity

Family-related factors

Frequent failure to attend consultations/lack of follow-up after an acute flare-up

Significant parental psychological or socioeconomic problems

Parent/carer unequipped to manage asthma emergency

Last reviewed version 2.0

Asset ID: 116

Last reviewed version 2.0

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)[1] – 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'[2, 3]
- Asthma Score (also known as Asthma Control Test).[4]
- *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, [5, 6] or by telephone.[7]

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	•	•

Have you experienced any of the following more than once a week in the last month?	Yes	No
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.

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.[8]

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.[9]
- 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,[10] 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

§ White cell differential count on a peripheral blood sample is not currently recommended routinely in the investigation and

	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. History of delayed presentation to hospital during flare-ups History of sudden-onset	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
	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

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)

Risk factor	Clinical action †
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,[11] 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.[4, 12]

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.[13] However, many of the studies were not optimally designed to answer this question,[14] 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.[15, 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[8] 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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Approaches to assessment and monitoring of asthma control in children

Assessment of asthma control in children is based mainly on:

- recent asthma symptom control (assessed by the frequency and severity of symptoms between flare-ups
- the degree to which asthma symptoms affect daily activities such as interference with physical activity or missed school days)
- the frequency of flare-ups
- spirometry in children who are able to perform the test reliably.

Standardised questionnaires

Questionnaire-based instruments have been validated for assessing asthma control in children:

- *Test for Respiratory and Asthma Control in Kids (TRACK)* for children less than 5 years old – consists of five questions about frequency of respiratory symptoms (wheeze, cough, shortness of breath), activity limitation, and night-time awakenings in the past 4 weeks, rescue medication use in the past 3 months, and oral corticosteroid use in the previous year.[17, 18] A lower score indicates worse asthma control.

  Childhood Asthma Control Test (C-ACT) for children aged 4–11 years – consists of seven items: three for the parent/carer (about the child's symptoms over the previous 4 weeks) and four for the child.[19, 20] A lower score indicates worse asthma control. **Note:** C-ACT is intended for US use.

Lung function tests

Frequent spirometry to guide asthma treatment in children has not been shown to achieve superior outcomes to symptom-based treatment.[REFERENCE1739] Current evidence does not support use of home spirometers to guide asthma treatment in children.[22] However, low FEV_1 predicts clinically significant flare-ups, so spirometry should be performed at asthma reviews for children who are old enough to do the test.
The quality and utility of spirometry depends on the skill, clinical expertise and experience of the person doing and interpreting spirometry.

The results of one study in children aged 6–16 years with moderate atopic asthma suggest that asthma treatment guided by airway

hyperresponsiveness (measured by bronchial provocation testing) may have a benefit over symptom-guided treatment in improving lung, but this effect was lost after 3–7 years of usual care.[23, 24] Repeated bronchial provocation testing is not feasible in clinical practice.

Measures of airway inflammation

Measures of airway inflammation (e.g. sputum eosinophil count, exhaled nitric oxide measurement) are not recommended in primary care to guide treatment decisions, but are increasingly used in specialist clinics.

Asthma treatment guided by sputum eosinophil count has been shown to reduce the frequency of flare-ups in adults with asthma, but there is insufficient evidence to ascertain its value for children.[25]

Exhaled nitric oxide measurement may be useful in guiding asthma management in some children. In children not taking inhaled corticosteroid, a high nitric oxide level probably predicts a good short-term response to inhaled corticosteroid treatment,[26] but it does not distinguish between asthma and eosinophilic bronchitis and is often high in children with atopy. There is insufficient evidence to ascertain whether a low exhaled nitric oxide level predicts successful withdrawal from inhaled corticosteroids without asthma relapse,[26] or safety of treating asthma without inhaled corticosteroids.

A Cochrane review[27] found that exhaled nitric oxide-guided management was significantly better than other approaches to adjusting medicines for reducing the number of children with flare-ups and the number of children who needed oral corticosteroids, but did not reduce the frequency of flare-ups or the rate of flare-ups requiring hospitalisation, improve lung function or symptoms scores, or reduce inhaled corticosteroid doses. The authors concluded that it could not be recommended for all children but may be beneficial for a subset not yet defined.[27]

Towards personalised asthma care

Emerging understanding of asthma phenotypes and of genetic factors that predict therapeutic response to preventer options is leading to the possibility of personalised, genomics-based treatment for asthma in children.[28] In the near future, individual tailored therapy is may replace the standardised step model based on population data.

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.[29] Written asthma action plans are effective if based on symptoms[30] or personal best peak expiratory flow (not on percentage predicted).[29]

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[31, 32] is available online.

▶ Go to: National Asthma Council Australia's *Asthma Action Plan Library*
Download: Imperial College London's *Electronic Asthma Action Plan*

Written asthma action plans for children

Every child with asthma should have their own written asthma action plan.

A systematic review found that the use of written asthma action plans significantly reduces the rate of visits to acute care facilities, the number of school days missed and night-time waking, and improves symptoms.[33]

For children and adolescents, written asthma action plans that are based on symptoms appear to be more effective than action plans based on peak expiratory flow monitoring.[33]

A written asthma action plan should include all the following:

- a list of the child's usual medicines (names of medicines, doses, when to take each dose) – including treatment for related conditions such as allergic rhinitis
- clear instructions on what to do 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)
  - during an asthma emergency.
- instructions on when and how to get medical care (including contact telephone numbers)
- the name and contact details of the child's emergency contact person (e.g. parent)
- the name of the person writing the action plan, and the date it was issued.

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
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- 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)
- Children's written asthma action plans.

Some written asthma action plans are available in community languages.

Software for developing electronic pictorial asthma action plans[31, 32] 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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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.[34]

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.[34]

Prevalence

Severe asthma is uncommon. Less than 4% of adults with asthma have severe asthma.[35]

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.[36]

Severe asthma imposes a high burden of disease due to symptoms, flare-ups, medication-related adverse effects and costs.[37, 38]

Bronchiectasis, granulomas and other auto-immune disease processes can coexist with severe asthma.[36, 39] Aspirin-exacerbated respiratory disease can present as severe asthma.

Patterns of airway inflammation vary among people with severe asthma,[40] 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).[41] 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[36, 42]

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.[40]

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Common reasons for poor response to preventer treatment

Apparent lack of response to asthma treatment is commonly due to one or more of the following:[43]

- poor adherence (which may be due to lack of perceived need for the medication, concern about potential or actual side-effects, cost of medicines, a busy lifestyle, misunderstanding of the purpose and effects of asthma medicines, or inability to follow the medical instructions)
- poor inhaler technique
- mishandling devices (e.g. failure to clean spacer, allowing mouthpiece of dry-powder inhalers to become blocked)
- incorrect dose or frequency
- empty inhaler
- expired medicines
- continued exposure to smoke or allergen triggers.

Failure to identify these causes before adjusting medicines could result in over-medication with preventers.

▶ See: *Management challenges*

Last reviewed version 2.0

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Checking whether the person has problems taking their medicine

▶ See: *Providing information, skills and tools for asthma self-management for adults*

▶ See: *Supporting adolescents and young adults to self-manage their asthma*

▶ See: *Providing asthma management education for parents and children*

Recommendations

Check that the patient or parent/carer understands:

- **the condition**
- **the current treatment plan, including when and how much to take**
- **the actions to take when symptoms worsen.**

Make sure they have an up-to-date written asthma action plan.

How this recommendation was developed

Consensus

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

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Do not assume that the recorded dose is the dose the person is currently taking.

Ask which asthma medicines the person is using, how, at what dose, and when.

Note: Use non-judgmental words and an empathic tone, e.g: Acknowledge that many people don't take their medication every day for different reasons.

Ask: *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).*

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

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):

- Foster et al. 2012[1]

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Ask the person or parents about how they are managing with their asthma medication, to identify any common barriers to optimal use of medicines. Encourage them to tell you if they don't see the value of taking it, or if the cost of medicine is a burden.

Common barriers include:

- **misunderstanding purpose of medicines**
- **concerns about side effects**
- **taking wrong dose**

- **skipping doses or delaying buying prescription medicines to save on treatment costs**
- **incorrect inhaler technique**
- **poor perception of airflow limitation**
- **social pressure from peer group, employer, colleagues or family (e.g. expectation that should have grown out of asthma)**
- **beliefs about health that conflict with or undermine confidence in conventional asthma medicines.**

How this recommendation was developed

Consensus

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

Last reviewed version 2.0

If the cost of medicines is problem, consider whether there are any ways to reduce cost to the person.

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):

- Reddel et al. 2018 [2]

Last reviewed version 2.0

If you suspect over-reliance on short-acting beta$_2$ agonist reliever and low use of preventer for a patient for whom a preventer has been prescribed, counsel the person about the risk of reliever over-use.

Note:

Sample:

Many people see their reliever as convenient, safe and effective, but don't feel comfortable taking a preventer every day.

In reality it's the other way around: we know that people who rely too much on their reliever have a higher risk of very severe and even life-threatening asthma attacks. On the other hand, taking a low dose of a preventer every day is much safer and protective.

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):

- Reddel et al. 2017 [3]

Last reviewed version 2.0

Check inhaler technique by asking the person to demonstrate how they use their inhaler while watching carefully and checking against the checklist of correct steps for the particular device type. Correct any problems by demonstrating proper technique and coaching the person, then checking technique is now correct.

▶ **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

For patients who have difficulty using their asthma medicines, consider referral to an asthma educator, MedsCheck by a community pharmacist, or Home Medicines Review by an accredited pharmacist (if eligible) – particularly for those who need to take multiple medicines (e.g. for concurrent conditions).

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

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.[4]

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.[5] Written asthma action plans are effective if based on symptoms[6] or personal best peak expiratory flow (not on percentage predicted).[5]

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[7, 8] is available online.

▶ Go to: National Asthma Council Australia's *Asthma Action Plan Library*
Download: Imperial College London's *Electronic Asthma Action Plan*

Written asthma action plans for children

Every child with asthma should have their own written asthma action plan.

A systematic review found that the use of written asthma action plans significantly reduces the rate of visits to acute care facilities, the number of school days missed and night-time waking, and improves symptoms.[9]

For children and adolescents, written asthma action plans that are based on symptoms appear to be more effective than action plans based on peak expiratory flow monitoring.[9]

A written asthma action plan should include all the following:

- a list of the child's usual medicines (names of medicines, doses, when to take each dose) – including treatment for related conditions such as allergic rhinitis
- clear instructions on what to do 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)
  - during an asthma emergency.
- instructions on when and how to get medical care (including contact telephone numbers)
- the name and contact details of the child's emergency contact person (e.g. parent)
- the name of the person writing the action plan, and the date it was issued.

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Download: Imperial College London's *Electronic Asthma Action Plan*

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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,[1, 4-7] 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.[1, 4, 5, 14, 22, 23]

Poor asthma symptom control is often due to incorrect inhaler technique.[24, 25]

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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Administration of inhaled medicines in children: 1-5 years

To use inhaler devices correctly, parents and children need training in inhaler technique and in the care and cleaning of inhalers and spacers.

Children need careful supervision when taking their inhaled medicines (e.g. at preschool), especially when using a reliever for acute asthma symptoms.

Types of inhalers suitable for preschool children

Preschool children cannot use pressurised metered-dose inhalers properly unless a spacer is attached (with mask when necessary), because it is difficult for them to coordinate inspiratory effort with actuating the device.[10] Note that breath-actuated pressurised metered-dose inhalers cannot be used with a spacer.

Dry-powder inhalers are usually ineffective for preschool children because they cannot generate sufficient inspiratory air flow.[10]

Drug delivery is very variable in young children with any type of inhaler, including pressurised metered dose inhalers and spacers.20 Filter studies have shown high day-to-day variability in delivered doses in preschool children.[10] This variation might explain fluctuations in effectiveness, even if the child's parents have been trained to use the device correctly.

Table. Types of inhaler devices for delivering asthma and COPD medicines

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Pressurised metered-dose inhalers plus spacers for relievers

During acute wheezing episodes, delivery of short-acting beta2 agonist to airways is more effective with a pressurised metered-dose inhaler plus spacer than with a nebuliser.[10] In older children, salbutamol has also been associated with a greater increase in heart rate when delivered by nebuliser than when delivered by pressurised metered-dose inhaler plus spacer.[11]

When administering salbutamol to relieve asthma symptoms in a preschool child, the standard recommendation is to shake the inhaler, actuate one puff at a time into the spacer and have the child take 4–6 breaths in and out of the spacer (tidal breathing).[12] Fewer breaths may suffice; in children with asthma aged 2–7 years (not tested during an acute asthma episode), the number of tidal breaths needed to inhale salbutamol adequately from a spacer has been estimated at 2 breaths for small-volume spacers, 2 breaths for a spacer made from a 500-mL modified soft drink bottle, and 3 breaths for a large (Volumatic) spacer.[13]

Face masks for infants

When using a spacer with face mask (e.g. for an infant too young or uncooperative to be able to use a mouthpiece), effective delivery of medicine to the airways depends on a tight seal around the face.

When masks are used for inhaled corticosteroids, there is a risk of exposure to eyes and skin if the seal over the mouth and nose is not adequate. Parents should be advised to wash the child's face after administering inhaled corticosteroids by mask.

Babies are unlikely to inhale enough medicine while crying.[11] The use of a spacer and face mask for a crying infant may require patience and skill: the child can be comforted (e.g. held by a parent, in own pram, or sitting on the floor) while the mask is kept on, and the actuation carefully timed just before the next intake of breath. Most infants will tolerate the spacer and mask eventually. The child may be more likely to accept the spacer and mask if allowed to handle them first (and at other times), if the devices are personalised (e.g. with stickers), or if the mask has a scent associated with the mother (e.g. lip gloss). The use of a spacer with a coloured valve allows parents to see the valve move as the child breathes in and out.

▶ Go to: National Asthma Council Australia's information paper for health professionals on *Inhaler technique for people with asthma or COPD*

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Administration of inhaled medicines in children: 6 years and over

Parents, carers and children need training to use inhaler devices correctly, including inhaler technique, and care and cleaning of inhalers and spacers.

School-aged children (depending on the child's age, ability, and with individualised training) can learn to use a range of inhaler types, including manually actuated pressurised metered-dose inhalers with spacers, breath-actuated pressurised metered-dose inhalers (e.g. Autohaler), and dry-powder inhalers (e.g. Accuhaler, Turbuhaler).[14, 15, 16, 17, 18]

Table. Types of inhaler devices for delivering asthma and COPD medicines

Please view and print this figure separately: http://www.asthmahandbook.org.au/table/show/75

A pressurised metered-dose inhaler and spacer is an appropriate first choice for most children.[16]

School-aged children are unlikely to use their inhaler device correctly without careful training and repeated checking.[19]

▶ Go to: National Asthma Council Australia's *How to use a puffer and spacer for kids* video
Go to: National Asthma Council Australia's information paper for health professionals on *Inhaler technique for people with asthma or COPD*

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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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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.[20]

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.[21]

▶ Go to: The National Asthma Council Australia and Woolcock Institute *Peak Flow Chart*

Managing the costs of asthma medicines

Most adults and older adolescents with asthma should be taking a preventer inhaler to minimise symptoms, prevent loss of lung function over time, and to reduce the risk of flare-ups and asthma-related death.

For most patients, most of these benefits can be achieved with low doses of inhaled corticosteroids, provided that they are taken regularly and with correct inhaler technique.[2]

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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Table. Definitions of ICS dose levels in children

Inhaled corticosteroid	Daily dose (microg)	
	Low	High

Inhaled corticosteroid	Daily dose (microg)	
	Low	High
Beclometasone dipropionate †	100–200	>200 (maximum 400)
Budesonide	200–400	>400 (maximum 800)
Ciclesonide ‡	80–160	>160 (maximum 320)
Fluticasone propionate	100–200	>200 (maximum 500)

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

‡ Ciclesonide is registered by the TGA for use in children aged 6 and over

Source

van Asperen PP, Mellis CM, Sly PD, Robertson C. *The role of corticosteroids in the management of childhood asthma.* The Thoracic Society of Australia and New Zealand, 2010. Available from: http://www.thoracic.org.au/clinical-documents/area?command=record&id=14

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Despite PBS subsidisation, out-of-pocket cost is a major factor contributing to poor adherence to treatment to asthma treatment in Australia.[2]

The average cost to patients of treatment with low-dose inhaled corticosteroid is significantly lower than for combinations of an inhaled corticosteroid and a long-acting beta$_2$ agonist.[2]

The dose, frequency of administration and number of actuations in the inhaler affect the cost to the patient, so prescribing choices could make the treatment more affordable.[2] The cost of preventer treatment to the patient per month can range from less than $1 to more than $50.[2]

▶ Go to: *Minimising the costs of asthma therapy in Reddel et al (2018)*[2]

Prescribers should consider cost as a factor when prescribing, and should explain the cost of each option when discussing treatment options with the person.

Patients can save costs by using their inhaler correctly, so that the medicine is not wasted and the maximal therapeutic benefit is achieved from the lowest possible dose.

Short-acting beta$_2$ agonists are generally less expensive per inhaler unit than preventers, so patients with financial concerns might try to manage with reliever only. Pharmacists and prescribers should discuss the different purposes of relievers and preventers, emphasising that overreliance on relievers increases the risk of severe flare-ups, and does not treat asthma itself. Long-term costs may be reduced through better control with regular preventer 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.[22] Mechanisms may include effects of stress on the immune system[22] 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.[23] There is a complex interrelationship between:[23]

- 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.[24] A person's level of health literacy is influenced by various factors including skills in reading, writing, numeracy, speaking, listening, cultural and conceptual knowledge.[23]

Inadequate health literacy is recognised as a risk factor for poorer health outcomes and less effective use of health care services.[23] Poor health literacy has been associated with poor asthma control,[25] poor knowledge of medications,[26] and incorrect inhaler technique.[26] 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.[23] Studies assessing the association between parents' health literacy and children's asthma have reported inconsistent findings.[23] Overall, there is not enough evidence to prove that low health literacy causes poor asthma control or inadequate self-management.[23]

Australian research suggests that there are probably many Australians with limited health literacy.[27] 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).[23] However, even well-educated patients might have trouble with basic health literacy skills.[23]

Attempting to assess every patient's health literacy is impractical and may be embarrassing for the person and time-consuming for the health professional.[23] Instead, it may be more effective for health professionals simply to assume that all patients have limited health literacy.[23] 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.[28] 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.[23]

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*

Psychosocial factors affecting adolescent health

Adolescence is a time of rapid growth and physical, cognitive, emotional and social development. An adolescent's age is not a reliable indicator of maturity in each of these areas.[29]

Mental health disorders (e.g. depression, anxiety, eating disorders) are common and clinically important among young people.[29] A significant proportion of adult mental health problems emerge during adolescence.[29]

Adolescence is also a time when people can begin risky behaviours (e.g. smoking, poor eating habits, physical inactivity, and drug and alcohol use), which can continue into adulthood.[29, 30] Although smoking rates among adolescents and young people are declining,[31] approximately 6% of adolescents aged 15–17 years smoke, and 4% smoke at least daily.[32] Smoking rates are higher among Aboriginal and Torres Strait Islander young people, young people living in rural and remote communities, and young people of lower socioeconomic status.[33, 31]

Adolescents with chronic disease show higher rates of health risk behaviours than healthy adolescents.[29, 34] Some risk behaviours are based on incorrect health beliefs (e.g. the myth that smoking cannabis is good for asthma).

Risk-taking behaviour – as well as poor understanding of their health condition – may contribute to the higher rate of food-induced fatal anaphylaxis among adolescents and young adults, compared with other age groups.[35]

Depression, risk behaviours and poor adherence to medicines are interrelated.[36] Adolescents with asthma who adhere poorly to asthma treatment and hide their asthma are more likely to start smoking than other adolescents with asthma.[37] Among adolescent boys, those with lower quality of life are most likely to start smoking.[37]

Adolescents often wish to discuss their health concerns with health professionals but are reluctant to discuss sensitive issues unless asked directly and confidentially.[29]

Living with asthma

People's experiences of asthma

More than three-quarters of Australians with asthma describe their general health as 'good' to 'excellent'.[38] However, the experience of living with asthma differs between individuals.

Experiences of asthma reported in research studies are diverse. They include:[39]

- 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:[40]

- 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:[40, 41]

- 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.

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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.

Asthma education programs for parents/carers and children

Asthma education for children and/or caregivers reduces the risk of emergency department visit for asthma, compared with usual care.[58]

However, the most effective components of education have not been clearly identified.[58, 59] There have been relatively few Australian controlled trials assessing education programs.[59]

There is not enough evidence to tell whether asthma education programs in the child's home are more effective in helping control asthma than asthma education provided somewhere else or standard care,[59] or to identify which types of education is more effective.

All age groups

A systematic review[60] found that asthma education programs were associated with moderate improvement in lung function and with a small reduction in school absence, restriction of physical activity, and emergency department visits. The greatest effects were in children with more severe asthma.[60]

Another systematic review found that educational programmes for the self-management of asthma in children and adolescents improved lung function, reduced the number of school days missed and the number of days with restricted activity, reduced the rate of visits to an emergency department, and possibly reduced the number of disturbed nights.[61]

0-5 years

There is little evidence about the effects of education for parents of preschool-aged children with asthma or wheezing. Most studies have investigated the effects of asthma management education for older children and their parents.[10] Limited evidence suggests that:

- education for parents of preschool children (e.g. written information and review by a health professional, small-group teaching by nurses or education in the family's home) may help improve asthma control[10]
- education programs are more likely to be effective if they involve multiple sessions, each longer than 20 minutes' duration.[10]

Opportunistic asthma education

In addition to the types of structured or formal asthma education evaluated in research trials, all health professionals who work with children with asthma and their parents/carers can provide asthma education whenever the opportunity occurs.

Table. Childhood asthma education checklist

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Resources

Education resources are available from the National Asthma Council Australia, Asthma Australia, and the Asthma Foundation in your state or territory.

▶ Go to: *National Asthma Council Australia*
Go to: *Asthma Australia*

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Checking whether current symptoms are due to asthma

▶ See also: *Severe asthma in adults and adolescents*

▶ See also: *Managing severe asthma in children aged 1–5 years*

▶ See also: *Managing difficult-to-treat and severe asthma in children aged 6 years and over*

Recommendations

Take a thorough history of respiratory symptoms, beginning from before the diagnosis of asthma was made. (If the patient is a child, start from birth.) Ask about:

- **symptoms**
- **factors that seem to worsen or improve asthma**
- **medical history**
- **medicines, including over-the-counter and complementary medicines.**

How this recommendation was developed

Consensus

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

Last reviewed version 2.0

In patients with a typical pattern of respiratory symptoms, 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.**

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	Dizziness, light-headedness, peripheral tingling
Symptoms recurrent or seasonal	Isolated cough with no other respiratory symptoms
Symptoms worse at night or in the early morning	Chronic sputum production
History of allergies (e.g. allergic rhinitis, atopic dermatitis)	No abnormalities on physical examination of chest when symptomatic (over several visits)
Symptoms obviously triggered by exercise, cold air, irritants, medicines (e.g. aspirin or beta blockers),	Change in voice Symptoms only present during upper respiratory tract infections Heavy smoker (now or in past) Cardiovascular disease

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
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 explanation** **Eosinophilia or raised blood IgE level, without other explanation** **Symptoms rapidly relieved by a SABA bronchodilator**	**Normal spirometry or PEF when symptomatic (despite repeated tests)**

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/.**

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Table. Findings that increase or decrease the probability of asthma in children

Asthma more likely	*Asthma less likely*
More than one of: • **wheeze** • **difficulty breathing** • **feeling of tightness in the chest** • **cough**	**Any of:** • **symptoms only occur when child has a cold, but not between colds** • **isolated cough in the absence of wheeze or difficulty breathing** • **history of moist cough** • **dizziness, light-headedness or peripheral tingling** • **repeatedly normal physical examination of chest when symptomatic** • **normal spirometry when symptomatic (children old enough to perform spirometry)** • **no response to a trial of asthma treatment** • **clinical features that suggest an alternative diagnosis**
AND	
Any of: • **symptoms recur frequently** • **symptoms worse at night and in the early morning** • **symptoms triggered by exercise, exposure to pets, cold air, damp air, emotions, laughing** • **symptoms occur when child doesn't have a cold** • **history of allergies (e.g. allergic rhinitis, atopic dermatitis)** • **family history of allergies** • **family history of asthma**	

Asthma more likely	*Asthma less likely*
• **widespread wheeze heard on auscultation** • **symptoms respond to treatment trial of reliever, with or without a preventer** • **lung function measured by spirometry increases in response to rapid-acting bronchodilator** • **lung function measured by spirometry increases in response to a treatment trial with inhaled corticosteroid (where indicated)**	

Sources

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**

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

Asset ID: 12

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.

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

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.[1, 2, 3, 4] 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

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[5, 6] and is commonly misdiagnosed as asthma.[7, 8] It can cause severe acute episodes of dyspnoea that occur either unpredictably or due to exercise.[7] Inspiratory stridor associated with vocal cord dysfunction is often described as 'wheezing',[7] but symptoms do not respond to asthma treatment.[6, 9]

Upper airway dysfunction can coexist with asthma.[5] 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.[5]

Upper airway dysfunction probably has multiple causes.[5] In some people it is probably due to hyperresponsiveness of the larynx in response to intrinsic and extrinsic triggers.[5, 10] Triggers can include exercise, psychological conditions, airborne irritants, rhinosinusitis, gastro-esophageal reflux disease, and medicines.[6, 8]

Upper airway dysfunction should be considered when spirometry shows normal FEV_1/FVC ratio in a patient with suspected asthma[8] 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.[7] Direct observation of the vocal cords is the best method to confirm the diagnosis of upper airway dysfunction.[5]

Cough and asthma in adults

When no other asthma symptoms are present, chronic cough (present for more than 8 weeks) is unlikely to indicate asthma.

Chronic cough may be due to asthma if:[11]

- cough is episodic
- cough with exercise is associated with other symptoms that suggest airflow limitation (expiratory wheeze or breathlessness)
- spirometry confirms reversible airflow limitation.

If cough is due to asthma, it should respond to treatment with an inhaled corticosteroid preventer taken regularly and reliever as needed).[11]

Findings that suggest a serious alternative or comorbid diagnosis that requires further investigation include:[11]

- haemoptysis
- smoker with > 20 pack–year smoking history
- smoker aged over 45 years with a new cough, altered cough, or cough with voice disturbance
- prominent dyspnoea, especially at rest or at night
- substantial sputum production
- hoarseness
- fever
- weight loss
- complicated gastro-oesophageal reflux disease
- swallowing disorders with choking or vomiting
- recurrent pneumonia
- abnormal clinical respiratory examination.

▶ Go to: *Australian Cough Guidelines*

Cough and asthma in children

Relationship of cough to asthma in children

- Misdiagnosis of nonspecific cough as asthma can result in overtreatment in children.
- Cough can indicate the possibility of a serious underlying illness and warrant further assessment and investigations.[11]

Table. Red flags for cough in children

Wet or productive cough lasting more than 4 weeks
Obvious difficulty breathing, especially at rest or at night

Systemic symptoms: fever, failure to thrive or poor growth velocity

Feeding difficulties (including choking or vomiting)

Recurrent pneumonia

Inspiratory stridor (other than during acute tracheobronchitis)

Abnormalities on respiratory examination

Abnormal findings on chest X-ray

'Clubbing' of fingers

Source

Gibson PG, Chang AB, Glasgow NJ *et al*., CICADA: Cough in Children and Adults: Diagnosis and Assessment. Australian cough guidelines summary statement. *Med J Aust*, 2010; 192: 265-71. Available from: http://www.ncbi.nlm.nih.gov/pubmed/20201760

Asset ID: 13

Chronic cough (cough lasting more than 4 weeks) without other features of asthma is unlikely to be due to asthma.[11]

Cough is a frequent symptom in children with asthma, but may have a different mechanism from other symptoms of asthma (e.g. wheeze, chest tightness or breathlessness). Children who have recurrent cough, but do not wheeze, are unlikely to have asthma.[12] A very small minority of children with recurrent nocturnal cough, but no other asthma symptoms, may be considered to have a diagnosis of atypical asthma.[12] This diagnosis should be only made in consultation with a paediatric respiratory physician.

In children with no abnormalities detected on physical examination, chest X-ray or spirometry, and no wheezing or breathlessness, chronic cough is most likely:[11]

- due to protracted bacterial bronchitis (resolves with 2–6 weeks' treatment with antibiotics)[11]
- post-viral (resolves with time)
- due to exposure to tobacco smoke and other pollutants.[11]

Frequency of cough reported by parents correlates poorly with frequency measured using diary cards or by audio recording monitors.[13]

0-5 years

Most cases of coughing in preschool children are **not due to asthma**:

- Recurrent cough in preschool children, in the absence of other signs, is most likely due to recurrent viral bronchitis. Cough due to viral infection is unresponsive to bronchodilators and preventers such as montelukast, cromones or inhaled corticosteroids.
- Children attending day care or preschool can have a succession of viral infections that merge into each other,[13] giving the false appearance of chronic cough (cough lasting more than 4 weeks).

In preschool-aged children, cough may be due to asthma when it occurs during episodes of wheezing and breathlessness or when the child does not have a cold.

6 years and over

Chronic cough may be due to asthma if the cough is episodic and associated with other features of asthma such as expiratory wheeze, exercise-related breathlessness, or airflow limitation objectively demonstrated by spirometry (particularly if responsive to a bronchodilator).[11]

▶ Go to: *Australian Cough Guidelines*

Alternative diagnoses in children

Other conditions characterised by wheezing, breathlessness or cough can be confused with asthma. These include:

- protracted bacterial bronchitis[11, 14]
- habit-cough syndrome[11]
- upper airway dysfunction.[7]

Table. Conditions that can be confused with asthma in children

Conditions characterised by cough
Pertussis (whooping cough)
Post-viral cough
Cystic fibrosis
Airway abnormalities (e.g. tracheobronchomalacia)
Protracted bacterial bronchitis in young children
Habit-cough syndrome
Conditions characterised by wheezing
Upper airway dysfunction
Inhaled foreign body causing partial airway obstruction
Tracheobronchomalacia
Conditions characterised by difficulty breathing
Hyperventilation
Anxiety
Breathlessness on exertion due to poor cardiopulmonary fitness
Upper airway dysfunction

Source

Weinberger M, Abu-Hasan M. Pseudo-asthma: when cough, wheezing, and dyspnea are not asthma. *Pediatrics* 2007; 120: 855-64. Available from: http://pediatrics.aappublications.org/content/120/4/855.full

Last reviewed version 2.0

Asset ID: 11

Table. Findings that increase or decrease the probability of asthma in children

Asthma more likely	*Asthma less likely*
More than one of: • wheeze • difficulty breathing • feeling of tightness in the chest • cough	Any of: • symptoms only occur when child has a cold, but not between colds • isolated cough in the absence of wheeze or difficulty breathing • history of moist cough • dizziness, light-headedness or peripheral tingling
AND	

Asthma more likely	*Asthma less likely*
Any of: • symptoms recur frequently • symptoms worse at night and in the early morning • symptoms triggered by exercise, exposure to pets, cold air, damp air, emotions, laughing • symptoms occur when child doesn't have a cold • history of allergies (e.g. allergic rhinitis, atopic dermatitis) • family history of allergies • family history of asthma • widespread wheeze heard on auscultation • symptoms respond to treatment trial of reliever, with or without a preventer • lung function measured by spirometry increases in response to rapid-acting bronchodilator • lung function measured by spirometry increases in response to a treatment trial with inhaled corticosteroid (where indicated)	• repeatedly normal physical examination of chest when symptomatic • normal spirometry when symptomatic (children old enough to perform spirometry) • no response to a trial of asthma treatment • clinical features that suggest an alternative diagnosis

Sources

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

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

Asset ID: 12

▶ Go to: *Australian Cough Guidelines*

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.[15] Normal FEV_1/FVC values derived from population studies vary,[16, 17] but are usually greater than:[16]

- 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.[17]

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.[18, 15] 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.[19,20]

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

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.[21]

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.[21]

Prevalence

Severe asthma is uncommon. Less than 4% of adults with asthma have severe asthma.[22]

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.[23]

Severe asthma imposes a high burden of disease due to symptoms, flare-ups, medication-related adverse effects and costs.[24, 25]

Bronchiectasis, granulomas and other auto-immune disease processes can coexist with severe asthma.[23, 26] Aspirin-exacerbated respiratory disease can present as severe asthma.

Patterns of airway inflammation vary among people with severe asthma,[27] 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).[28] 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[23, 29]

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.[27]

Last reviewed version 2.0

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Considering triggers and comorbidities

Recommendations

Ask the person or parents/carers about what triggers asthma symptoms or flare-ups, so you can identify those that are clinically relevant to the individual and whether they are potentially avoidable.

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

Ask about exposure to cigarette smoke.

How this recommendation was developed

Consensus

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

Last reviewed version 2.0

Ask the person about their other health conditions and consider whether comorbid medical conditions may be affecting asthma control, e.g.:

- **uncontrolled allergic rhinitis/rhinosinusitis**
- **gastro-oesophageal reflux disease**
- **nasal polyposis**
- **obesity**
- **upper airway dysfunction**
- **cardiovascular disease.**

How this recommendation was developed

Consensus

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

Last reviewed version 2.0

Ask the person about all the medicines (including complementary medicines) they take for other health conditions, and consider if these may be affecting asthma.

How this recommendation was developed

Consensus

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

Last reviewed version 2.0

Ask about the person's current main health concerns and main general concerns, in order to understand whether other health or life priorities may be affecting asthma self-management.

How this recommendation was developed

Consensus

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

Last reviewed version 2.0

Ask the person about possible contact with new allergens (e.g. pets, moulds).

How this recommendation was developed

Consensus

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

Last reviewed version 2.0

Ask about possible exposure to irritants or allergens in the workplace or due to a new activity or hobby.

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**

Agent	Occupations
Low molecular weight agents	
	• **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**
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**

Asset ID: 45

Table. Questions to consider for patients with suspected work-related asthma

Was there any unusual exposure to any substance at work within the 24 hours before symptoms began?
Did the person's co-workers experience respiratory symptoms?
Does the person's asthma symptoms improve when away from work (e.g. weekends, holidays)?
Are symptoms of rhinitis or conjunctivitis worse at work?

Source: **Adapted from Tarlo SM, Balmes J, Balkissoon R *et al.* Diagnosis and management of work-related asthma: American College Of Chest Physicians Consensus Statement.** *Chest* **2008; 134(3 Suppl): 1S-41S. Available from: http://journal.publications.chestnet.org/article.aspx?articleid=1044851**

Asset ID: 46

Table. Features of history in work-related asthma

	Work-exacerbated asthma	**Occupational asthma**	
		Sensitiser-induced occupational asthma	**Irritant-induced occupational asthma**
Onset of asthma symptoms	**Before or during working life**	**Typically weeks to months after first exposure to sensitiser**	**Typically within 24 hours of major exposure to respiratory irritant**
Pattern of asthma symptoms	**Worse on workdays**	**Worse during or after work shift and improve when away from work**	**Persist for at least 12 weeks with no previous chronic lung disease**
Other factors	**Exposure to dust, smoke, fumes, cold**	**Exposure to known sensitiser**	**Exposure to large amount of respiratory irritant**

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**

Tarlo SM, Liss GM. Occupational asthma: an approach to diagnosis and management. *Can Med Assoc J* **2003; 168: 867-71. Available from: http://www.cmaj.ca/content/168/7/867.full**

Asset ID: 47

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

Investigation of work-related asthma symptoms

Asking all workers with asthma whether their asthma symptoms improve when away from work is a useful screening tool. Those who

answer 'yes' need investigation for work-related asthma.[1]

Investigation of suspected work-related asthma is complex. It involves confirming the diagnosis of asthma, identifying the workplace as the cause of asthma symptoms, and identifying the specific causal agents. This involves taking a detailed history, further investigations (e.g. serial peak expiratory flow measurement, skin prick tests, bronchial provocation [challenge] testing) and sometimes worksite visits.[2, 3]

People with suspected work-related asthma should ask their employer to provide a safety data sheet containing information about the constituents and properties of substances used at the workplace. Information about safety data sheets (previously called Material Safety Data Sheets) is available from Safe Work Australia.

Accurate diagnosis and documentation are essential to support a potential Workers Compensation claim. This normally requires a report from a specialist with experience investigating work-related asthma.

▶ Go to: *Safe Work Australia*

Effects of smoking on asthma control and medicines

Smoking reduces the probability of achieving good asthma control.[4] 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.[5]

Smoking reduces response to inhaled corticosteroids and oral corticosteroids in people with asthma.[6, 7, 8, 9, 10] 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.[10]

Therapeutic response to montelukast appears to be unchanged by smoking.[8] Therefore, montelukast may be useful in smokers with mild asthma.[11, 12]

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.

Effects of exposure to environmental tobacco smoke on asthma

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.[5]

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.[13] Among children treated in referral clinics, the prevalence of gastro-oesophageal reflux disease is higher among those with asthma than those without asthma,[14] but the causal link is unclear.[14]

Asthma may contribute to gastro-oesophageal reflux disease via changes in intrathoracic pressure or the effects of asthma medicines on the gastro-oesophageal sphincter.[13]

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).[13]

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.[13]

Hyperventilation and asthma

Attacks of hyperventilation can be confused with asthma symptoms in people with asthma and in those without asthma.[15] Some patients with asthma who experience hyperventilation attacks cannot readily distinguish the sensation of dyspnoea associated with hyperventilation from that associated with their asthma.[15]

Obesity links with asthma

Prevalence and mechanisms

Obesity (defined as BMI ≥ 30 kg/m^2) is associated with an increased prevalence of asthma.[13]

Obesity could contribute to asthma development or worsening via mechanical, inflammatory and genetic/developmental factors.[13] Increased rates of obstructive sleep apnoea or gastro-oesophageal reflux disease among obese people do not entirely explain the higher

rates of symptoms and morbidity seen in obese people with asthma, compared people with asthma who have a normal BMI.[16]

Asthma in obese patients appears to be a specific phenotype[13, 17] associated with changes in lung function caused by breathing at low lung volumes, a systemic inflammatory process, and a reduced response to asthma medicines.[13] Obesity reduces chest wall compliance, which results in reduced lung volumes, increased work of breathing and increased energy and oxygen costs of breathing.[18]

Considerations for diagnosis and assessment

Obese people with asthma report more dyspnoea and asthma-like symptoms than non-obese patients.[18]

Respiratory symptoms associated with obesity can mimic asthma.[18]

In obese patients it is especially important to confirm a previous diagnosis of asthma by objective measures of variable airflow limitation.[19]

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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[20, 21] and is commonly misdiagnosed as asthma.[15, 22] It can cause severe acute episodes of dyspnoea that occur either unpredictably or due to exercise.[15] Inspiratory stridor associated with vocal cord dysfunction is often described as 'wheezing',[15] but symptoms do not respond to asthma treatment.[21, 23]

Upper airway dysfunction can coexist with asthma.[20] 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.[20]

Upper airway dysfunction probably has multiple causes.[20] In some people it is probably due to hyperresponsiveness of the larynx in response to intrinsic and extrinsic triggers.[20, 24] Triggers can include exercise, psychological conditions, airborne irritants, rhinosinusitis, gastro-esophageal reflux disease, and medicines.[21, 22]

Upper airway dysfunction should be considered when spirometry shows normal FEV_1/FVC ratio in a patient with suspected asthma[22] 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.[15] Direct observation of the vocal cords is the best method to confirm the diagnosis of upper airway dysfunction.[20]

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.[25] 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.[26]

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.[27]

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.[19, 28, 29, 30, 31] However, the use of antihistamines in children has not been shown to prevent them developing asthma.[25]

The presence of allergic rhinitis is associated with worse asthma control in children and adults.[32, 33, 34, 35] 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.[36]

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.[37] 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.[38]

▶ Go to: ASCIA's *Pollen calendar*
Go to: National Asthma Council Australia's *Epidemic thunderstorm asthma* information paper

Last reviewed version 2.0

Aspirin and nonsteroidal anti-inflammatory drugs as asthma triggers

Most people with asthma can tolerate aspirin (acetylsalicylic acid) and NSAIDs.

Aspirin-exacerbated respiratory disease is a syndrome of airway inflammation that includes asthma, nasal polyposis, chronic rhinosinusitis and reaction to NSAIDs. It can present with severe sudden-onset asthma.

Known aspirin sensitivity occurs in an estimated:[39, 40]

- 0.5–2.5% of the general population
- 4–11% of adults with asthma
- 30% of patients with asthma and nasal polyposis.

In addition, a substantial proportion may be unaware that they are sensitive to aspirin. Aspirin challenge studies have identified aspirin sensitivity in approximately 5% of children with asthma, 21% of adults with asthma, and 30–42% of people with both asthma and nasal polyposis.

People with aspirin-exacerbated respiratory disease may react to one or more anti-inflammatory agents. In a study of 659 patients with skin or airway reactions to NSAIDs challenged with paracetamol, aspirin and a range of nonselective NSAIDs (COX-1 and COX-2 inhibitors) that included piroxicam, diclofenac, ibuprofen and indomethacin), 76% showed cross-reaction to chemically distinct or unrelated COX-1 inhibitors and 24% reacted only to a single cyclo-oxygenase inhibitor.[41] Nonselective NSAIDS available in Australia also include ketoprofen, naproxen and piroxicam. People with NSAID intolerance are unlikely to react to 'coxib'-type COX-2-selective NSAIDs (celecoxib, etoricoxib, parecoxib).[42] Meloxicam has been reported to cause bronchoconstriction at higher doses.[42]

People with aspirin-exacerbated respiratory disease could be at risk if they use complementary medicines that contain salicylates (e.g. willowbark) or salicin (e.g. meadowsweet).

Challenge testing is sometimes necessary to confirm the diagnosis in people who have not reported a clear association between aspirin and symptoms.

Management of aspirin-exacerbated respiratory disease involves avoidance of aspirin and NSAIDs.[43] Aspirin desensitisation is available.[43, 44]

▶ Go to: National Asthma Council Australia's quick reference guide, *Aspirin/NSAID-intolerant asthma: pharmacy notes*

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.[45]

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,[46, 47] and asthma deaths have been

reported.[48, 49] Changing from timolol (nonselective) to betaxolol (selective) might improve respiratory function.[47] Blocking the tear duct for 2–3 minutes after administering drops (punctual occlusion) may reduce risk of respiratory effects by minimising systemic absorption.[50]

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.[46] 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[51]
- bee products (pollen, propolis, royal jelly).[52, 53, 54]
- complementary medicines that contain salicylates (e.g. willowbark) or salicin (e.g. meadowsweet) – could present a risk to people with aspirin-exacerbated respiratory disease

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Managing difficult-to-treat asthma in adults and adolescents: non-pharmacological strategies and general care

Recommendations

If the person smokes, strongly advise them to 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).

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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[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**
- **DXA 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.

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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,[1, 4-7] 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.[1, 4, 5, 14, 22, 23]

Poor asthma symptom control is often due to incorrect inhaler technique.[24, 25]

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.[28] Written asthma action plans are effective if based on symptoms[29] or personal best peak expiratory flow (not on percentage predicted).[28]

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[30, 31] 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.[32]

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.[33] In patients with partly and uncontrolled asthma, weekly self-monitoring and monthly treatment adjustment may improve asthma control.[34]

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.[32] 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.[32]

Information alone does not appear to improve health outcomes in adults with asthma, although perceived symptoms may improve.[35]

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.[36] 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.[37]

During adolescence, young people get their asthma knowledge mainly from parents.[36] 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,[38, 39, 40, 41] improve asthma knowledge,[38, 39, 42] improve ability to use a spacer correctly,[38] improve adolescents' confidence or belief in their ability (self-efficacy) to manage their asthma,[38, 41] increase behaviour to prevent asthma symptoms,[41] increase use of preventer medicines,[41] increase use of written asthma action plans,[41] reduce symptoms[38, 41] reduce limitation of activity due to asthma,[41] reduce school absences due to asthma,[38, 41] and reduce rates of acute care visits, emergency department visits, and hospitalisations.[41]

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.[39, 40, 43] Asthma self-management programs for adolescents that use peer leaders can:

- significantly influence self-management behaviour, compared with adult-led programs[43]
- achieve clinically important improvements in health-related quality of life,[39, 40] increase adolescents' belief in their ability (self-efficacy) to resist smoking,[39] and increase asthma self-management knowledge[39] (compared with adolescents at schools not involved in this type of program[39] or with baseline[40])
- may be particularly beneficial for boys from low socioeconomic status background.[40]

The Triple A (Adolescent Asthma Action) program is a school-based peer-led adolescent asthma self-management education program developed in Australia.[44]

▶ 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)[45, 46, 47] 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.[48, 34, 49, 50, 51, 52] However, it has been evaluated in only one good-quality double-blind sham-controlled trial.[50] 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[53] 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.[53]

An ongoing real-world US study[54] 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.[54] However, baseline adherence and inhaler technique were not reported.

Potential short-term adverse effects include worsening asthma, atelectasis, and pneumonia.[55] 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.[56, 57] People with obstructive airways disease, including asthma and COPD have a higher risk of invasive pneumococcal disease.[57]

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.[57, 58, [REFERENCE927], 59]

A 2017 systematic review[59] 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.[59] However, the quality of the included studies was low and were at high or unclear risk of bias.[59]

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*[56] 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.[56] There is no significant increase in asthma flare-ups immediately after vaccination with inactivated influenza vaccination.[58]

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*.[56]

▶ 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:[60]

- The rate of of dysphonia among patients taking inhaled corticosteroids has been estimated at 5–20%.[61] However, higher rates of up to 58% have been reported in some studies.[62] 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.[61]

When taking inhaled corticosteroids via pressurised metered-dose inhalers, the use of a spacer reduces the risk of dysphonia and candidiasis.[63] Spacers improve delivery of the medicine to the airways.

Quick mouth rinsing immediately after inhaling effectively removes a high proportion of remaining medicine.[64] 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.[65] 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.[66]

▶ 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,[67] 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.[68]

Cross-sectional studies show a dose–response relationship between inhaled corticosteroid use for asthma or COPD, and risk of cataracts in adults.[69]

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).[70]

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.[71] Mid and high doses are consistently associated with a higher intensity and a higher prevalence of reported adverse effects, after controlling for other factors.[71]

A high proportion of people with asthma may have misunderstandings and fears about using inhaled corticosteroids,[72, 73] such as fears about weight gain, unwanted muscle development, bone fractures, susceptibility to infections and reduction of efficacy of the medicine over time.[72] Most people do not discuss their concerns about inhaled corticosteroid treatment with health professionals.[72] Safety concerns are a major reason for poor adherence, particularly general concerns about corticosteroids rather than concerns about specific adverse effects.[74]

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