The principles of managing asthma in children aged 0–5 years and children aged 6 years and over, including initial assessments and treatment, adjusting treatment to maintain optimal asthma control without over-medicating, and providing information and support to help parents and children manage their asthma.
ABBREVIATIONS

CFC  chlorofluorocarbon
COPD  chronic obstructive pulmonary disease
COX  cyclo-oxygenase
ED  emergency department
EIB  exercise-induced bronchoconstriction
FEV₁  forced expiratory volume over one second
FVC  forced vital capacity
FSANZ  Food Standards Australia and New Zealand
GORD  gastro-oesophageal reflux disease
HFA  formulated with hydrofluoroalkane propellant
ICS  inhaled corticosteroid
ICU  intensive care unit
IgE  Immunoglobulin E
IV  intravenous
LABA  long-acting beta₂-adrenergic receptor agonist
LAMA  long-acting muscarinic antagonist
LTRA  leukotriene receptor antagonist
MBS  Medical Benefits Scheme
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
PaO₂  oxygen partial pressure on blood gas analysis
PBS  Pharmaceutical Benefits Scheme
PEF  peak expiratory flow
pMDI  pressurised metered-dose inhaler or ‘puffer’
SABA  short-acting beta₂-adrenergic receptor agonist
LAMA  long-acting muscarinic antagonist
TGA  Therapeutic Goods Administration

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ENDORSEMENT

The Australian Asthma Handbook has been officially endorsed by:

- The Royal Australian College of General Practitioners (RACGP)
- The Australian Primary Health Care Nurses Association (APNA)
- The Thoracic Society of Australia and New Zealand (TSANZ)

RECOMMENDED CITATION


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Managing asthma in children

Overview

The management of asthma and wheezing disorders in children is based on:

- confirming the diagnosis
- assessing the pattern of symptoms (including frequency of episodes and pattern of symptoms between episodes)
- assessing triggers
- discussing the goals of management with the child’s parents and the child (depending on age)
- choosing initial treatment based on the child’s age and pattern of symptoms
- reviewing and adjusting treatment periodically based on recent asthma symptom control and risk factors (see Figure: Stepped approach to adjusting asthma medication in children)
- managing comorbid conditions that affect asthma (e.g. allergic rhinitis)
- providing parents and children with information and skills to manage their asthma, including:
  - a written asthma action plan
  - information about avoiding triggers, where appropriate
  - training in correct use of medicines, including inhaler technique
  - information and support to maximise adherence
- managing flare-ups when they occur
- providing advice about avoidance of tobacco smoke, healthy eating, physical activity, healthy weight and immunisation.

In children, initial treatment after making the diagnosis of asthma is guided by the pattern and severity of asthma symptoms. The aims of asthma management are to ensure that the child’s asthma has been correctly diagnosed, and to enable the child to maintain a normal quality of life without interference from asthma or the side effects of asthma treatment.

For children already taking regular preventer treatment, adjustments to the treatment regimen are based on finding the lowest dose of medicines that will maintain good control of symptoms and prevent flare-ups.

Figure. Stepped approach to adjusting asthma medication in children
Please view and print this figure separately: https://www.asthmahandbook.org.au/figure/show/18

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

<table>
<thead>
<tr>
<th>Good control</th>
<th>Partial control</th>
<th>Poor control</th>
</tr>
</thead>
<tbody>
<tr>
<td>All of:</td>
<td>Any of:</td>
<td>Either of:</td>
</tr>
<tr>
<td>• Daytime symptoms(^\d) (\leq 2) days per week (lasting only a few minutes and rapidly relieved by rapid-acting bronchodilator)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• No limitation of activities(^\d)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• No symptoms(^\d) during night or when wakes up</td>
<td>• Daytime symptoms(^\d) &gt;2 days per week (lasting only a few minutes and rapidly relieved by rapid-acting bronchodilator)</td>
<td></td>
</tr>
<tr>
<td>• Any limitation of activities(^\ast)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Any symptoms during night or when wakes up(^\d\d)</td>
<td>• Daytime symptoms(^\d) &gt;2 days per week (lasting from minutes to hours or recurring, and partially or fully relieved by rapid-acting bronchodilator)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• \geq 3 features of partial control within the same week</td>
<td></td>
</tr>
<tr>
<td>Good control</td>
<td>Partial control</td>
<td>Poor control</td>
</tr>
<tr>
<td>--------------</td>
<td>-----------------</td>
<td>--------------</td>
</tr>
<tr>
<td>• Need for reliever(^9) ≤ 2 days per week</td>
<td>• Need for reliever(^9) &gt; 2 days per week</td>
<td></td>
</tr>
</tbody>
</table>

† e.g. wheezing or breathing problems
‡ child is fully active; runs and plays without symptoms
§ including no coughing during sleep
# not including short-acting beta\(_2\) agonist 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

**Note:** 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.

*Adapted from*
Asset ID: 23

**Table. Definitions of ICS dose levels in children**

<table>
<thead>
<tr>
<th>Inhaled corticosteroid</th>
<th>Daily dose (mcg)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Low</td>
</tr>
<tr>
<td><strong>Beclometasone dipropionate</strong>†</td>
<td>100–200</td>
</tr>
<tr>
<td><strong>Budesonide</strong></td>
<td>200–400</td>
</tr>
<tr>
<td><strong>Ciclesonide</strong> ‡</td>
<td>80–160</td>
</tr>
<tr>
<td><strong>Fluticasone propionate</strong></td>
<td>100–200</td>
</tr>
</tbody>
</table>

† 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*
Asset ID: 21

**In this section**

**0-5 years**
Managing wheezing and asthma in children aged 0–5 years
<table>
<thead>
<tr>
<th>Section</th>
<th>Description</th>
<th>URL</th>
</tr>
</thead>
<tbody>
<tr>
<td>6 years and over</td>
<td>Managing asthma in children aged 6 years and over</td>
<td><a href="https://www.asthmahandbook.org.au/management/children/6-years-and-over">https://www.asthmahandbook.org.au/management/children/6-years-and-over</a></td>
</tr>
</tbody>
</table>
Figure. Stepped approach to adjusting asthma medication in children

Before considering stepping up, check symptoms are due to asthma, inhaler technique is correct, and adherence is adequate.

Consider stepping up if good control is not achieved.

When asthma is stable and well controlled for more than 3 months, consider stepping down (e.g. reducing inhaled corticosteroid dose to low).

ICS: inhaled corticosteroid; SABA: short-acting beta_2_ agonist; LABA: long-acting beta_2_ agonist

* Or low-dose budesonide/formoterol combination, only for children aged 12 years or over who are using this combination as both maintenance and reliever.
§ In addition, manage flare-ups with extra treatment when they occur, and manage exercise-related asthma symptoms as indicated.

Back to top

Asset ID: 18
Managing wheezing and asthma in children aged 0–5 years

In this section

<table>
<thead>
<tr>
<th>Initial assessment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Assessing the pattern of symptoms in children 0–5 years</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Initial treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Considering if regular preventer treatment is indicated in children 0–5 years</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Other treatments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Considering other regular treatments in children 0–5 years</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Treatment review</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reviewing initial treatment in children 0–5 years</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Acute wheeze</th>
</tr>
</thead>
<tbody>
<tr>
<td>Managing acute wheezing episodes in children 0–5 years</td>
</tr>
</tbody>
</table>
Assessing the pattern of symptoms in children 0–5 years

Recommendations

Assess the frequency of wheezing and other symptoms to determine the pattern of symptoms.

Note: Applies to cases in which the diagnosis can be made with reasonable confidence.

►See: Making a provisional diagnosis in children

Table. Definitions of asthma patterns in children aged 0–5 years not taking regular preventer

<table>
<thead>
<tr>
<th>Category</th>
<th>Pattern and intensity of symptoms (when not taking regular treatment)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Infrequent intermittent asthma</td>
<td>Symptom-free for at least 6 weeks at a time (flare-ups up to once every 6 weeks on average but no symptoms between flare-ups)</td>
</tr>
<tr>
<td>Frequent intermittent asthma</td>
<td>Flare-ups more than once every 6 weeks on average but no symptoms between flare-ups</td>
</tr>
<tr>
<td>Persistent asthma</td>
<td><strong>Mild</strong></td>
</tr>
<tr>
<td></td>
<td>At least one of:</td>
</tr>
<tr>
<td></td>
<td>• Daytime symptoms† more than once per week but not every day</td>
</tr>
<tr>
<td></td>
<td>• Night-time symptoms‡ more than twice per month but not every week</td>
</tr>
<tr>
<td>Moderate</td>
<td>Any of:</td>
</tr>
<tr>
<td></td>
<td>• Daytime symptoms† daily</td>
</tr>
<tr>
<td></td>
<td>• Night-time symptoms‡ more than once per week</td>
</tr>
<tr>
<td></td>
<td>• Symptoms sometimes restrict activity or sleep</td>
</tr>
<tr>
<td>Severe</td>
<td>Any of:</td>
</tr>
<tr>
<td></td>
<td>• Daytime symptoms† continual</td>
</tr>
<tr>
<td></td>
<td>• Night-time symptoms‡ frequent</td>
</tr>
<tr>
<td></td>
<td>• Flare-ups frequent</td>
</tr>
<tr>
<td></td>
<td>• Symptoms frequently restrict activity or sleep</td>
</tr>
</tbody>
</table>
† Symptoms between flare-ups. A flare-up is defined as a period of worsening asthma symptoms, from mild (e.g. symptoms that are just outside the normal range of variation for the child, documented when well) to severe (e.g. events that require urgent action by parents and health professionals to prevent a serious outcome such as hospitalisation or death from asthma).

Note: Use this table when the diagnosis of asthma can be made with reasonable confidence (e.g. a child with wheezing accompanied by persistent cough or breathing difficulty, no signs or symptoms that suggest a potentially serious alternative diagnosis, and the presence of other factors that increase the probability of asthma such as family history of allergies or asthma).

Asset ID: 14

How this recommendation was developed

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

In a child with recurrent wheezing where the diagnosis of asthma is uncertain, determine whether the child has episodic (viral) wheeze or multiple-trigger wheeze.

Table. Definitions of wheezing patterns in children aged 0–5 years not taking regular preventer

<table>
<thead>
<tr>
<th>Episodic (viral) wheeze</th>
<th>Multiple-trigger wheeze</th>
</tr>
</thead>
<tbody>
<tr>
<td>Episodes of wheezing (e.g. for a few days when child has a viral cold)</td>
<td>Episodes of wheezing from time to time</td>
</tr>
<tr>
<td>No wheezing at other times</td>
<td>Child also coughs and wheezes at other times when does not have a viral cold (e.g. when cries, plays or laughs)</td>
</tr>
</tbody>
</table>

These categories describe the pattern of wheezing observed, not a diagnosis. They can be applied to children who may or may not have asthma. These terms are particularly useful for children who have recurrent wheezing, but the diagnosis is uncertain.

Sources


Asset ID: 19

How this recommendation was developed

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

- Brand et al. 2008

If the diagnosis of asthma was made in the past or elsewhere, confirm the diagnosis, if possible.

How this recommendation was developed

Consensus
Based on clinical experience and expert opinion (informed by evidence, where available).
### Classification of symptom patterns in children

The pattern and severity of symptoms in a child with asthma or wheezing disorder is a guide to initial treatment.

#### Table. Definitions of asthma patterns in children aged 0–5 years not taking regular preventer

<table>
<thead>
<tr>
<th>Category</th>
<th>Pattern and intensity of symptoms (when not taking regular treatment)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Infrequent intermittent asthma</strong></td>
<td>Symptom-free for at least 6 weeks at a time (flare-ups up to once every 6 weeks on average but no symptoms between flare-ups)</td>
</tr>
<tr>
<td><strong>Frequent intermittent asthma</strong></td>
<td>Flare-ups more than once every 6 weeks on average but no symptoms between flare-ups</td>
</tr>
<tr>
<td><strong>Persistent asthma</strong></td>
<td><strong>Mild</strong> At least one of:</td>
</tr>
<tr>
<td></td>
<td>• Daytime symptoms† more than once per week but not every day</td>
</tr>
<tr>
<td></td>
<td>• Night-time symptoms† more than twice per month but not every week</td>
</tr>
<tr>
<td></td>
<td><strong>Moderate</strong> Any of:</td>
</tr>
<tr>
<td></td>
<td>• Daytime symptoms† daily</td>
</tr>
<tr>
<td></td>
<td>• Night-time symptoms† more than once per week</td>
</tr>
<tr>
<td></td>
<td>• Symptoms sometimes restrict activity or sleep</td>
</tr>
<tr>
<td></td>
<td><strong>Severe</strong> Any of:</td>
</tr>
<tr>
<td></td>
<td>• Daytime symptoms† continual</td>
</tr>
<tr>
<td></td>
<td>• Night-time symptoms† frequent</td>
</tr>
<tr>
<td></td>
<td>• Flare-ups frequent</td>
</tr>
<tr>
<td></td>
<td>• Symptoms frequently restrict activity or sleep</td>
</tr>
</tbody>
</table>

† Symptoms between flare-ups. A flare-up is defined as a period of worsening asthma symptoms, from mild (e.g. symptoms that are just outside the normal range of variation for the child, documented when well) to severe (e.g. events that require urgent action by parents and health professionals to prevent a serious outcome such as hospitalisation or death from asthma).

**Note:** Use this table when the diagnosis of asthma can be made with reasonable confidence (e.g. a child with wheezing accompanied by persistent cough or breathing difficulty, no signs or symptoms that suggest a potentially serious alternative diagnosis, and the presence of other factors that increase the probability of asthma such as family history of allergies or asthma).

Asset ID: 14
### Table. Definitions of asthma patterns in children aged 6 years and over not taking regular preventer

<table>
<thead>
<tr>
<th>Category</th>
<th>Pattern and intensity of symptoms (when not taking regular treatment)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Infrequent intermittent asthma †</strong></td>
<td>Symptom-free for at least 6 weeks at a time (flare-ups up to once every 6 weeks on average but no symptoms between flare-ups)</td>
</tr>
<tr>
<td><strong>Frequent intermittent asthma</strong></td>
<td>Flare-ups more than once every 6 weeks on average but no symptoms between flare-ups</td>
</tr>
<tr>
<td><strong>Persistent asthma</strong></td>
<td><strong>Mild</strong> FEV₁ ≥80% predicted and at least one of:</td>
</tr>
<tr>
<td></td>
<td>• Daytime symptoms‡ more than once per week but not every day</td>
</tr>
<tr>
<td></td>
<td>• Night-time symptoms‡ more than twice per month but not every week</td>
</tr>
<tr>
<td><strong>Moderate</strong></td>
<td>Any of:</td>
</tr>
<tr>
<td></td>
<td>• FEV₁ &lt;80% predicted‡</td>
</tr>
<tr>
<td></td>
<td>• Daytime symptoms‡ daily</td>
</tr>
<tr>
<td></td>
<td>• Night-time symptoms‡ more than once per week</td>
</tr>
<tr>
<td></td>
<td>• Symptoms sometimes restrict activity or sleep</td>
</tr>
<tr>
<td><strong>Severe</strong></td>
<td>Any of:</td>
</tr>
<tr>
<td></td>
<td>• FEV₁ ≤60% predicted‡</td>
</tr>
<tr>
<td></td>
<td>• Daytime symptoms‡ continual</td>
</tr>
<tr>
<td></td>
<td>• Night-time symptoms‡ frequent</td>
</tr>
<tr>
<td></td>
<td>• Flare-ups frequent</td>
</tr>
<tr>
<td></td>
<td>• Symptoms frequently restrict activity or sleep</td>
</tr>
</tbody>
</table>

† It may not be appropriate to make the diagnosis of asthma in children aged 6 or older who wheeze only during upper respiratory tract infections. These children can be considered to have episodic (viral) wheeze.

‡ Symptoms between flare-ups. A flare-up is defined as a period of worsening asthma symptoms, from mild (e.g. symptoms that are just outside the normal range of variation for the child, documented when well) to severe (e.g. events that require urgent action by parents and health professionals to prevent a serious outcome such as hospitalisation or death from asthma).

Asset ID: 15

For children already taking regular preventer treatment, adjustments to the treatment regimen are based on finding the lowest dose of medicines that will maintain good control of symptoms.
**Short-term and long-term wheezing patterns in children: 0–5 years**

**Patterns of childhood wheezing over the short term**
Classifying a child’s current pattern of symptoms can be useful for making immediate management decisions. The following descriptions of wheezing patterns apply to the pattern of symptoms in children aged 0–5 years and are sometimes used in clinical trials:

**Episodic (viral) wheeze**: episodes of wheezing (e.g. for a few days when child has a viral cold), but no wheezing between episodes.\(^1, 2\)

**Multiple-trigger wheeze**: episodes of wheezing from time to time, with cough and wheeze between episodes when child does not have a viral cold (e.g. when the child cries, plays or laughs).\(^1, 2\)

However, these patterns are not stable over time and have limited use in predicting whether or not a wheezing preschool child will have asthma by primary school age.\(^3, 4\) An individual child is likely to show a different pattern within one year.\(^3\)

**Patterns of childhood wheezing over the long term**
Longitudinal population-based cohort studies\(^5, 6\) of preschool children with wheezing have identified various long-term patterns (wheezing phenotypes).\(^1\)

<table>
<thead>
<tr>
<th>Classification system/source</th>
<th>Phenotypes identified</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Tucson Children’s Respiratory Study</em> † ‡</td>
<td><strong>Transient wheeze</strong></td>
<td>Wheezing commences before the age of 3 years and disappear by age 6 years</td>
</tr>
<tr>
<td></td>
<td><strong>Persistent wheeze</strong></td>
<td>Wheezing continues until up to or after age 6 years</td>
</tr>
<tr>
<td></td>
<td><strong>Late-onset wheeze</strong></td>
<td>Wheezing starts after age 3 years.</td>
</tr>
<tr>
<td><em>Avon Longitudinal Study of Parents and Children</em> §</td>
<td><strong>Transient early wheeze</strong></td>
<td>Wheezing mainly occurs before 18 months, then mainly disappears by age 3.5 years. Not associated with hypersensitivity to airborne allergens</td>
</tr>
<tr>
<td></td>
<td><strong>Prolonged early wheeze</strong></td>
<td>Wheezing occurs mainly between age 6 months and 4.5 years, then mainly disappears before child’s 6th birthday. Not associated with hypersensitivity to airborne allergens. Associated with a higher risk of airway hyperresponsiveness and reduced lung function at age 8–9 years, compared with never/infrequent wheeze phenotype</td>
</tr>
<tr>
<td></td>
<td><strong>Intermediate-onset wheeze</strong></td>
<td>Wheezing begins sometime after age 18 months and before 3.5 years. Strongly associated with atopy (especially house mite, cat allergen), higher risk of airway hyperresponsiveness and reduced lung function at age 8–9 years, compared with never/infrequent wheeze phenotype</td>
</tr>
<tr>
<td></td>
<td><strong>Late-onset wheeze</strong></td>
<td>Wheezing mainly begins after age 3.5 years</td>
</tr>
</tbody>
</table>
### 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 (e.g., flare-ups, 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)

<table>
<thead>
<tr>
<th>Good control</th>
<th>Partial control</th>
<th>Poor control</th>
</tr>
</thead>
<tbody>
<tr>
<td>All of:</td>
<td>Any of:</td>
<td>Either of:</td>
</tr>
<tr>
<td>- Daytime symptoms(^\d) ≤2 days per week (lasting only a few</td>
<td>- Daytime symptoms(^\d) &gt;2 days per week (lasting only a few</td>
<td>- Daytime symptoms(^\d) &gt;2 days per week (lasting from</td>
</tr>
</tbody>
</table>

---

### Notes

Terms can only be identified after the child has stopped wheezing for several years and cannot be applied to a preschool child.

Transient wheeze, persistent wheeze and late-onset wheeze can be episodic or multiple-trigger wheeze.

### Sources


### Classification system/source

Phenotypes identified

<table>
<thead>
<tr>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strongly associated with atopy (especially house mite, cat allergen, grass pollen)</td>
</tr>
<tr>
<td><strong>Persistent wheeze</strong> Wheeze mainly begins after 6 months and continues through to primary school</td>
</tr>
<tr>
<td>Strongly associated with atopy</td>
</tr>
</tbody>
</table>

---

Early childhood wheezing phenotypes cannot be recognised or applied clinically, because they are recognised retrospectively.\(^1\) In an individual child with episodic wheeze, it is not possible to accurately predict epidemiological phenotype from clinical phenotype.\(^1\)

Currently available tools for predicting whether a wheezing preschool child will have asthma at school age (e.g. the Asthma Predictive Index\(^4\)) have limited clinical value.\(^4\)

----------

1. Go to: National Asthma Council Australia's *Asthma and wheezing in the first years of life* information paper
<table>
<thead>
<tr>
<th>Good control</th>
<th>Partial control</th>
<th>Poor control</th>
</tr>
</thead>
<tbody>
<tr>
<td>minutes and rapidly relieved by rapid-acting bronchodilator)</td>
<td>minutes and rapidly relieved by rapid-acting bronchodilator)</td>
<td>minutes to hours or recurring, and partially or fully relieved by rapid-acting bronchodilator)</td>
</tr>
<tr>
<td>• No limitation of activities‡</td>
<td>• Any limitation of activities*</td>
<td>• ≥3 features of partial control within the same week</td>
</tr>
<tr>
<td>• No symptoms§ during night or when wakes up</td>
<td>• Any symptoms during night or when wakes up††</td>
<td></td>
</tr>
<tr>
<td>• Need for reliever# ≤2 days per week</td>
<td>• Need for reliever# &gt;2 days per week</td>
<td></td>
</tr>
</tbody>
</table>

† e.g. wheezing or breathing problems
‡ child is fully active; runs and plays without symptoms
§ including no coughing during sleep
# not including short-acting beta₂ agonist 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

Note: 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.

Adapted from
Asset ID: 23

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

Parents commonly underestimate the severity of their child’s asthma and overestimate asthma control.⁸

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

- **Asthma Control Questionnaire (ACQ)** for children aged 6 years and over (must be administered by a trained interviewer in children aged 6–10 years) – asks questions about symptoms, effect of asthma on activity and use of relievers during the previous week.⁷ A lower score indicates better asthma control.
- **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.¹⁰,¹¹ 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 (about the child’s symptoms over the previous 4 weeks) and four for the child.¹²,¹³ A lower score indicates worse asthma control. Note: C-ACT is intended for US use.

Measures of airway inflammation
Measures of airway inflammation (e.g. sputum test, exhaled nitric oxide) are not used in clinical practice to guide treatment decisions. Tailoring the dose of inhaled corticosteroids based on exhaled nitric oxide appears to achieve only a small benefit in children, and may lead to higher doses.14

References

Considering if regular preventer treatment is indicated in children 0–5 years

Recommendations

Discuss the goals of asthma treatment with the child’s parents. Explain that the overall aims of treatment are to make sure asthma does not interfere with the child’s quality of life and to minimise the side effects of treatment by using the lowest level of medication required to maintain good asthma control.

Figure. Stepped approach to adjusting asthma medication in children

Please view and print this figure separately: https://www.asthmahandbook.org.au/figure/show/18

How this recommendation was developed

Consensus

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

Prescribe a reliever based on the child’s age and clinical significance of their symptoms. Educate parents how and when to give reliever, and advise them to carry reliever at all times to use when needed to manage symptoms.

Table. Non-emergency use of bronchodilators (relievers) in children aged 0–5 years

<table>
<thead>
<tr>
<th>Age</th>
<th>Notes</th>
<th>Salbutamol dose and delivery</th>
</tr>
</thead>
<tbody>
<tr>
<td>0–6 months</td>
<td>Consider discussing with a paediatric respiratory physician or paediatrician before prescribing an inhaled short-acting beta2 agonist (salbutamol).</td>
<td>2–4 puffs (100 mcg per puff) as needed via pressurised metered-dose inhaler, spacer and face mask</td>
</tr>
<tr>
<td>6–12 months</td>
<td>Consider managing wheezing episodes with an inhaled short-acting beta2 agonist bronchodilator (salbutamol) only if wheezing is associated with increased work of breathing (i.e. intercostal retraction). Use inhaled salbutamol with caution and discontinue if wheezing does not resolve promptly after use.</td>
<td>2–4 puffs (100 mcg per puff) as needed via pressurised metered-dose inhaler, spacer and face mask</td>
</tr>
<tr>
<td>1–5 years</td>
<td>Manage wheezing episodes with inhaled short-acting beta2 agonist (salbutamol) as needed if associated with increased work of breathing (i.e. intercostal retraction).</td>
<td>Usual dose: 2–4 puffs (100 mcg per puff) as needed via pressurised metered-dose inhaler, spacer and face mask (infants) or spacer (if old enough to cooperate)</td>
</tr>
</tbody>
</table>
Note: This table lists usual salbutamol doses to be administered by carers in the community to manage symptoms as needed. Doses are higher during acute episodes, including emergencies.

See: Managing acute asthma in adults and children

Asset ID: 24

How this recommendation was developed
Consensus
Based on clinical experience and expert opinion (informed by evidence, where available).

Consider regular preventer treatment according to age and pattern of symptoms.
Note: This assessment should be based on overall pattern of symptoms between flare-ups, not on symptoms seen during short-term (e.g. during a flare-up).

Table. Initial preventer treatment for children aged 0–5 years

<table>
<thead>
<tr>
<th>Age</th>
<th>Pattern of symptoms</th>
<th>Management options and notes *</th>
</tr>
</thead>
<tbody>
<tr>
<td>0–12 months</td>
<td>Intermittent asthma or Viral-induced wheeze</td>
<td>Regular preventer treatment is not recommended</td>
</tr>
<tr>
<td></td>
<td>Multiple-trigger wheeze</td>
<td>Refer for specialist assessment or obtain specialist advice before prescribing</td>
</tr>
<tr>
<td>1–2 years</td>
<td>Intermittent asthma or Viral-induced wheeze</td>
<td>Regular preventer treatment is not recommended</td>
</tr>
</tbody>
</table>
|                | Persistent asthma or Multiple-trigger wheeze | Consider a treatment trial with sodium cromoglycate 10 mg three times daily and review response in 2–4 weeks†  
Consider a treatment trial of low-dose inhaled corticosteroids only if wheezing symptoms are disrupting child's sleeping or play; review response in 4 weeks |
| 2–5 years      | Infrequent intermittent asthma or Viral-induced wheeze | Regular preventer treatment is not recommended |
|                | Frequent intermittent asthma or Mild persistent asthma | Consider regular treatment with montelukast 4 mg once daily and review response in 2–4 weeks  
If symptoms do not respond, consider regular treatment with a low dose of an inhaled corticosteroid and review response in 4 weeks |
<table>
<thead>
<tr>
<th>Age</th>
<th>Pattern of symptoms</th>
<th>Management options and notes *</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Episodic (viral) wheeze with frequent symptoms or Multiple-trigger wheeze</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Moderate–severe persistent asthma or Moderate–severe multiple-trigger wheeze</td>
<td>Consider regular treatment with a low dose of an inhaled corticosteroid and review response in 4 weeks</td>
</tr>
</tbody>
</table>

- Advise parents about potential adverse psychiatric effects of montelukast

* In addition to use of rapid-onset inhaled beta₂ agonist when child experiences difficulty breathing
† Starting dose sodium cromoglycate 10 mg (two inhalations of 5 mg/actuation inhaler) three times daily. If good response, reduce to 10 mg twice daily when stable. Cromone inhaler device mouthpieces require daily washing to avoid blocking.

Asset ID: 20

**Table. Definitions of asthma patterns in children aged 0–5 years not taking regular preventer**

<table>
<thead>
<tr>
<th>Category</th>
<th>Pattern and intensity of symptoms (when not taking regular treatment)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Infrequent intermittent asthma</strong></td>
<td>Symptom-free for at least 6 weeks at a time (flare-ups up to once every 6 weeks on average but no symptoms between flare-ups)</td>
</tr>
<tr>
<td><strong>Frequent intermittent asthma</strong></td>
<td>Flare-ups more than once every 6 weeks on average but no symptoms between flare-ups</td>
</tr>
</tbody>
</table>
| **Persistent asthma**        | **Mild**
|                              | At least one of:                                                                                       |
|                              | • Daytime symptoms† more than once per week but not every day                                           |
|                              | • Night-time symptoms† more than twice per month but not every week                                     |
| **Moderate**                 | Any of:                                                                                                 |
|                              | • Daytime symptoms† daily                                                                               |
|                              | • Night-time symptoms† more than once per week                                                          |
|                              | • Symptoms sometimes restrict activity or sleep                                                          |
| **Severe**                   | Any of:                                                                                                 |
**Pattern and intensity of symptoms (when not taking regular treatment)**

- **Daytime symptoms**: continual
- **Night-time symptoms**: frequent
- **Flare-ups**: frequent
- **Symptoms**: frequently restrict activity or sleep

† Symptoms between flare-ups. A flare-up is defined as a period of worsening asthma symptoms, from mild (e.g., symptoms that are just outside the normal range of variation for the child, documented when well) to severe (e.g., events that require urgent action by parents and health professionals to prevent a serious outcome such as hospitalisation or death from asthma).

Note: Use this table when the diagnosis of asthma can be made with reasonable confidence (e.g., a child with wheezing accompanied by persistent cough or breathing difficulty, no signs or symptoms that suggest a potentially serious alternative diagnosis, and the presence of other factors that increase the probability of asthma such as family history of allergies or asthma).

**Asset ID: 14**

**How this recommendation was developed**

Adapted from existing guidance

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

- van Asperen et al. 2010
- Brand et al. 2008

For children aged 2 years and older with frequent intermittent asthma or mild persistent asthma/wheezing, consider montelukast as first-choice preventer.

- Advise parents about potential adverse psychiatric effects of montelukast

**How this recommendation was developed**

Adapted from existing guidance

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

- van Asperen et al. 2010
- Brand et al. 2008

For children aged 2 years and older with moderate-to-severe persistent asthma, consider an inhaled corticosteroid (low dose) as first-choice preventer.

**Table. Definitions of ICS dose levels in children**

<table>
<thead>
<tr>
<th>Inhaled corticosteroid</th>
<th>Daily dose (mcg)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Low</td>
</tr>
<tr>
<td><strong>Beclometasone dipropionate</strong></td>
<td>100–200</td>
</tr>
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### Inhaled corticosteroid

<table>
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</tbody>
</table>

† 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**


Asset ID: 21

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Sodium cromoglycate can be considered for children less than 2 years old. Sodium cromoglycate or nedocromil can be considered for children older than 2 years who are unable to tolerate montelukast.

**How this recommendation was developed**

Adapted from existing guidance

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

- van Asperen et al. 2010

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Inhaled corticosteroid/long-acting beta₂ agonist combinations are not recommended for children aged 0–5 years.

**How this recommendation was developed**

Adapted from existing guidance

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

- van Asperen et al. 2010

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## More information

### Montelukast for children

Montelukast is registered by the TGA for use in children aged 2 years and older. Based on data from placebo-controlled trials, it has not been possible to define clinical indicators that predict which children will benefit most from montelukast therapy, compared with other treatment options. Comparative studies suggest that the main role for montelukast is as an alternative to low-dose inhaled corticosteroid in children with frequent intermittent asthma or mild persistent asthma.

**Children 0–5 years**
In preschool children with multiple-trigger wheeze, montelukast protects against airway hyperresponsiveness when taken with or without inhaled corticosteroids. Inhaled corticosteroids are more effective than montelukast in children with multiple-trigger wheeze aged 2–8 years, but this comparison has not been made in preschool children as a separate group.

In children aged 2–5 years with episodic (viral) wheeze, regular montelukast treatment reduces the risk of wheezing episodes. However, montelukast may not reduce symptoms in children aged 6–24 months with recurrent wheeze.

Note: Montelukast is not TGA-registered for use in children younger than 2 years.

A short course of montelukast, introduced at the first signs of an asthma episode or upper respiratory tract infection, can achieve a small reduction in symptoms, school absence and medical consultations in preschool and school-aged children with episodic wheeze. However, montelukast is not TGA-registered for intermittent use.

Children 6 years and over

In school-aged children with persistent asthma, inhaled corticosteroids are more effective than montelukast for a range of measures, including lung function.

In school-aged children with persistent exercise-induced symptoms despite taking regular inhaled corticosteroids, montelukast is effective in controlling symptoms and is more effective than long-acting beta₂ agonists.

In children who are already taking regular inhaled corticosteroids and have a beta₂ receptor genotype associated with increased susceptibility to flare-ups during regular long-acting beta₂ agonist therapy, montelukast may be more effective than salmeterol in reducing symptoms, reliever use and days absent from school due to asthma, based on the findings of a small randomised controlled clinical trial.

Montelukast for children: warning parents about potential psychiatric adverse effects

Montelukast is generally very well tolerated. However, post-marketing surveillance reports suggested a slight increase in the rate of psychiatric disorders that was possibly associated with use of leukotriene receptor antagonists in children; this association may have been confounded by asthma severity and concomitant medication. Montelukast use has also been associated with suicidal ideation, but a recent nested case-control study concluded that children with asthma aged 5–18 years taking leukotriene receptor antagonists were not at increased risk of suicide attempts. Behavioural and psychiatric adverse effects were rare in clinical trials.

The Thoracic Society of Australia and New Zealand advises that it is prudent to mention to parents the potential association of montelukast with behaviour-related adverse events when commencing treatment, and to cease therapy if such adverse events are suspected.

Cromones for children

0-5 years

Few clinical trials have assessed the use of inhaled sodium cromoglycate in preschool children and none have assessed nedocromil. Overall, sodium cromoglycate has not been shown to be effective in preschool children with multiple-trigger wheeze.

However, cromones are well tolerated and registered for use in infants. Therefore, a treatment trial can be considered before considering other preventers, particularly for children less than 2 years old.

6 years and over

Cromones are rarely prescribed in school-aged children.

Inhaled sodium cromoglycate might be effective in school-aged children, but interpretations of available evidence are inconsistent. Sodium cromoglycate is less effective than inhaled corticosteroid in achieving asthma control and improving lung function in children with persistent asthma.

Nedocromil sodium appears to be have some benefit in children with persistent asthma, but its relative effectiveness compared with inhaled corticosteroids is not clear. Long-term (4–6 years) treatment with budesonide achieved better
PRACTICAL ISSUES

Practical issues

Cromones (sodium cromoglycate and nedocromil) may not be practical for some patients, because they require three–four times daily dosing until control is gained, and inhaler devices for cromones tend to block easily.

Nedocromil can cause an unusual or unpleasant taste and is not tolerated by some children.

INHALED CORTICOSTEROIDS FOR CHILDREN: OVERVIEW

Inhaled corticosteroids for children: overview

The effectiveness of ICS in children appears to depend on several factors including the child's age, which triggers are causing symptoms, wheezing phenotype, tobacco smoke exposure and genotype. Overall, inhaled corticosteroids seem to be more effective in older children and those with more severe disease.

Early introduction of inhaled corticosteroid for children with recurrent wheeze does not prevent airway remodelling, improve long-term lung function or prevent the onset of persistent asthma, according to current evidence from long-term randomised controlled clinical trials in preschool children and school-aged children with intermittent or mild persistent asthma.

INHALED CORTICOSTEROIDS FOR CHILDREN: 0–5 YEARS

Inhaled corticosteroids for children: 0–5 years

In preschool children with episodic (viral) wheeze, limited available evidence suggests that regular treatment with inhaled corticosteroids does not reduce the risk of hospitalisation, flare-ups that require oral corticosteroid use, or reduce the frequency and duration of acute episodes. Inhaled corticosteroid treatment does not reduce these children's risk of developing persistent wheeze by age 6 years.

Regular treatment with inhaled corticosteroids improves wheezing, asthma symptoms and lung function and reduces flare-ups in infants and preschoolers with persistent (at least 6 months) wheezing or asthma.

In preschool children with multiple-trigger wheeze, regular inhaled corticosteroids are moderately effective in controlling symptoms, but less effective than in older children. When multiple-trigger wheeze improves markedly during a short treatment trial (e.g. 3 months), it is not possible to tell whether improvement was due to the treatment or natural resolution of symptoms.

INHALED CORTICOSTEROIDS FOR CHILDREN: DOSES

Inhaled corticosteroids for children: doses

In the majority of children, asthma control can be achieved with any of the following initial doses:

- budesonide 400 mcg/day
- beclometasone (Qvar) 200 mcg/day
- ciclesonide 160 mcg/day
- fluticasone propionate 200 mcg/day.

If these doses do not achieve control of symptoms, possible explanations include alternative diagnoses, adherence, incorrect inhaler technique, psychosocial factors and exposure to tobacco smoke or other triggers such as allergens.

Dose–response studies of inhaled corticosteroids show that the maximal efficacy is generally achieved at a dose equivalent to approximately 200 mcg/day fluticasone propionate, while the risk of adrenal suppression increases exponentially at doses above 500 mcg/day. Therefore (based on theoretical equivalents between different agents), upper limits of daily doses for children are:

- budesonide 800 mcg/day
- beclometasone dipropionate [Qvar] 400 mcg/day
- ciclesonide 320 mcg/day
- fluticasone propionate 500 mcg/day.

Higher doses are unlikely to be more effective, and are likely to cause systemic effects.

Most studies of inhaled corticosteroids in children have used twice-daily dosing. Ciclesonide is effective when given once daily. The dose of inhaled corticosteroid delivered to the lungs will depend on many factors, including the delivery device, the age of the child, individual variation in inhaler technique, and adherence.
Note: Do not use beclometasone dose recommendations from outdated or overseas guidelines based on older formulations containing CFC propellant – doses are different.

Table. Definitions of ICS dose levels in children

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† 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
Asset ID: 21

Inhaled corticosteroids for children: adverse effects

Topical
Hoarseness and pharyngeal candidiasis are not commonly reported among preschool children when using a metered-dose inhaler with spacer,² or among school-aged children.¹

Inhaled corticosteroids, particular dry-powder formulas with pH < 5.5, may dissolve tooth enamel in children.¹

Topical effects can be reduced by use of spacer devices (which reduce oropharyngeal deposition), and by mouth-rinsing and spitting after use.¹ Immediate quick mouth-rinsing removes more residual medicine in the mouth than delayed rinsing.²⁴

Systemic
Systemic effects of inhaled corticosteroids in children depend on the dose, but clinically significant adverse effects are uncommon.² The use of spacers and mouth rinsing will not reduce systemic effects, but may increase efficacy so that a lower dose is required.

Short-term suppression of linear growth has been demonstrated in children, but only minimal long-term effects on growth or bone density have been reported.¹ Some children may experience delay in the normal pubertal growth spurt due to asthma itself.¹ Treatment beginning before puberty is associated with a small (mean approximately 1 cm) reduction in adult height.²⁵

A research study using biochemical testing in a research setting showed that hypothalamic–pituitary–adrenal axis suppression may occur in up to two-thirds of children treated with inhaled corticosteroids, and may occur at even low doses.²⁶ However, clinically cases are rare.

Cases of symptomatic, clinically significant adrenal insufficiency in children due to inhaled corticosteroid treatment have been reported,²⁷,²⁸ including cases in Australia.²⁹ Most cases have involved children given more than 500 mcg per day fluticasone propionate.²⁷

The risk of hypothalamic–pituitary–adrenal axis suppression is higher among children receiving concomitant intranasal steroids and those with lower body mass index.²⁶ Risk is lower in obese children.²⁶
There are no nationally accepted protocols for routine assessment of adrenal function because it has not yet been possible to identify precisely which children should be tested, to interpret test results reliably, to identify the appropriate interval for retesting, and because a clinical benefit has not been clearly demonstrated.

Go to: The Thoracic Society of Australia and New Zealand’s Position Statement: The role of corticosteroids in the management of childhood asthma

### Table. Definitions of ICS dose levels in children

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

Source
Asset ID: 21

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**Inhaled corticosteroid/long-acting beta-2 agonist combinations for children: 0–5 years**

The combination of salmeterol plus fluticasone propionate in a single inhaler is registered for use in children 4 years and older. The use of long-acting beta_2_ agonists in combination with inhaled corticosteroids has not been studied in children under 4 years of age. Australian and international guidelines recommend against the use of long-acting beta_2_ agonists in children aged 5 years or less.

In children aged 5 years or less with asthma that is not adequately controlled by low-dose inhaled corticosteroid alone, adding montelukast is preferable to adding a long-acting beta_2_ agonist or increasing the dose of inhaled corticosteroids when the safety profiles of these options are compared.

---

** 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 and the degree to which asthma symptoms affect daily activities such as interference with physical activity or missed school days), the frequency of flare-ups, and spirometry in children who are able to perform the test reliably.

Parents commonly underestimate the severity of their child’s asthma and overestimate asthma control.

**Standardised questionnaires**

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

- **Asthma Control Questionnaire (ACQ)** for children aged 6 years and over (must be administered by a trained interviewer in children aged 6–10 years) – asks questions about symptoms, effect of asthma on activity and use of relievers during the previous week. A lower score indicates better asthma control.
- **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
Measures of airway inflammation

Measures of airway inflammation (e.g. sputum test, exhaled nitric oxide) are not used in clinical practice to guide treatment decisions. Tailoring the dose of inhaled corticosteroids based on exhaled nitric oxide appears to achieve only a small benefit in children, and may lead to higher doses.40

Administration of inhaled medicines in children: 0–5 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.

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.2 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.41

Dry-powder inhalers are usually ineffective for preschool children because they cannot generate sufficient inspiratory air flow.2

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 firing the device.2 Note that breath-actuated pressurised metered-dose inhalers cannot be used with a spacer.

Even when using pressurised metered dose inhalers and spacers, drug delivery is very variable in young children.42 The inhaler design may improve spacer technique,42 but will not necessarily improve clinical outcomes. The amount of medicine delivered by inhaler devices to the lower airways varies from day to day in preschool children.2 This variation might explain fluctuations in effectiveness, even if the child’s parents have been trained to use the device correctly.

When administering salbutamol to relieve asthma symptoms in a preschool child, the standard recommendation is to shake the inhaler, fire one puff at a time into the spacer and have the child take 4–6 breaths in and out of the spacer (tidal breathing).43 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.44

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.41 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.

Correct use of inhaler devices

The majority of patients do not use inhaler devices correctly. Australian research studies have reported that only approximately 10% of patients use correct technique.45,46
High rates of incorrect inhaler use among children with asthma and adults with asthma or COPD have been reported, even among regular users. Regardless of the type of inhaler device prescribed, patients are unlikely to use inhalers correctly unless they receive clear instruction, including a physical demonstration, and have their inhaler technique checked regularly.

Poor inhaler technique has been associated with worse outcomes in asthma and COPD. It can lead to poor asthma symptom control and overuse of relievers and preventers. In patients with asthma or COPD, incorrect technique is associated with a 50% increased risk of hospitalisation, increased emergency department visits and increased use of oral corticosteroids due to flare-ups.

Correcting patients’ inhaler technique has been shown to improve asthma control, asthma-related quality of life and lung function.

Common errors and problems with inhaler technique

Common errors with manually actuated pressurised metered dose inhalers include:
- failing to shake the inhaler before actuating
- holding the inhaler in wrong position
- failing to exhale fully before actuating the inhaler
- actuating the inhaler too early or during exhalation (the medicine may be seen escaping from the top of the inhaler)
- actuating the inhaler too late while inhaling
- actuating more than once while inhaling
- inhaling too rapidly (this can be especially difficult for children to overcome)
- multiple actuations without shaking between doses.

Common errors for dry powder inhalers include:
- not keeping the device in the correct position while loading the dose (horizontal for Accuhaler and vertical for Turbuhaler)
- failing to exhale fully before inhaling
- failing to inhale completely
- inhaling too slowly and weakly
- exhaling into the device mouthpiece before or after inhaling
- failing to close the inhaler after use
- using past the expiry date or when empty.

Other common problems include:
- difficulty manipulating device due to problems with dexterity (e.g. osteoarthritis, stroke, muscle weakness)
- inability to seal the lips firmly around the mouthpiece of an inhaler or spacer
- inability to generate adequate inspiratory flow for the inhaler type
- failure to use a spacer when appropriate
- use of incorrect size mask
- inappropriate use of a mask with a spacer in older children.

How to improve patients’ inhaler technique

Patients’ inhaler technique can be improved by brief education, including a physical demonstration, from a health professional or other person trained in correct technique. The best way to train patients to use their inhalers correctly is one-to-one training by a healthcare professional (e.g. nurse, pharmacist, GP, specialist), that involves both verbal instruction and physical demonstration. Patients do not learn to use their inhalers properly just by reading the manufacturer’s leaflet. An effective method is to assess the individual’s technique by comparing with a checklist specific to the type of inhaler, and then, after training in correct technique, to provide written instructions about errors (e.g. a sticker attached to the device).

The National Asthma Council information paper on inhaler technique includes checklists for correct technique with all common inhaler types used in asthma or COPD.

Inhaler technique must be rechecked and training must be repeated regularly to help children and adults maintain correct technique.

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
References


Considering other regular treatments in children 0–5 years

Recommendations

Regular treatment with a theophyllines (aminophylline or theophylline) is not recommended for children aged 0–5 years.

*How this recommendation was developed*

Adapted from existing guidance
Based on reliable clinical practice guideline(s) or position statement(s):

- Brand et al. 2008

Ipratropium is not recommended for the regular management of asthma in children.

*How this recommendation was developed*

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

- Brand et al. 2008
- McDonald et al. 2003

More information

**Ipratropium for children**

Cochrane systematic reviews concluded that, overall, clinical trial evidence does not support the regular use of muscarinic antagonists (anticholinergic bronchodilators) in the maintenance treatment of asthma in children (i.e. outside the context of acute asthma).

See: Managing acute asthma in clinical settings

**Inhaled corticosteroid/long-acting beta-2 agonist combinations for children: 0–5 years**

The combination of salmeterol plus fluticasone propionate in a single inhaler is registered for use in children 4 years and older. The use of long-acting beta2 agonists in combination with inhaled corticosteroids has not been studied in children under 4 years old. Australian and international guidelines recommend against the use of long-acting beta2 agonists in children aged 5 years or less.

In children aged 5 years or less with asthma that is not adequately controlled by low-dose inhaled corticosteroid alone, adding montelukast is preferable to adding a long-acting beta2 agonist or increasing the dose of inhaled corticosteroids when the safety profiles of these options are compared.

References


Reviewing initial treatment in children 0–5 years

Recommendations

When prescribing any preventer medicine for a child, consider each treatment adjustment as a treatment trial: monitor response continually, review within 4 weeks, and adjust treatment according to response.

Figure. Stepped approach to adjusting asthma medication in children
Please view and print this figure separately: https://www.asthmahandbook.org.au/figure/show/18

Table. Reviewing and adjusting preventer treatment for children aged 0–5 years
Please view and print this figure separately: https://www.asthmahandbook.org.au/table/show/25

How this recommendation was developed

Adapted from existing guidance
Based on reliable clinical practice guideline(s) or position statement(s):

- van Asperen et al. 2010
- National Asthma Council Australia, 2010
- Brand et al. 2008

If symptoms have been well controlled for at least 3 months in a child taking regular inhaled corticosteroid treatment, reduce the dose to find the minimal dose needed to control symptoms.

Table. Definitions of ICS dose levels in children

<table>
<thead>
<tr>
<th>Inhaled corticosteroid</th>
<th>Daily dose (mcg)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Low</td>
<td>High</td>
</tr>
<tr>
<td>Beclometasone dipropionate †</td>
<td>100–200</td>
<td>&gt;200 (up to 400)</td>
</tr>
<tr>
<td>Budesonide</td>
<td>200–400</td>
<td>&gt;400 (up to 800)</td>
</tr>
<tr>
<td>Ciclesonide ‡</td>
<td>80–160</td>
<td>&gt;160 (up to 320)</td>
</tr>
<tr>
<td>Fluticasone propionate</td>
<td>100–200</td>
<td>&gt;200 (up to 500)</td>
</tr>
</tbody>
</table>

† 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


Asset ID: 21
If symptoms are well controlled for at least 3 months on the lowest available inhaled corticosteroid dose, consider the following options:

- Stop preventive treatment completely, while monitoring the response, to judge whether symptoms have resolved.
- Replace inhaled corticosteroid with a trial of montelukast or a cromone. If well controlled for a further 3 months, stop preventive treatment and monitor the response.
- Advise parents about potential adverse psychiatric effects of montelukast

Figure. Stepped approach to adjusting asthma medication in children
Please view and print this figure separately: https://www.asthmahandbook.org.au/figure/show/18

Table. Reviewing and adjusting preventive treatment for children aged 0–5 years
Please view and print this figure separately: https://www.asthmahandbook.org.au/table/show/25

If symptoms are not controlled, consider whether they may be due to a comorbidity or alternative diagnosis such as rhinosinusitis or suppurative lung disease.

If cough is the predominant symptom, carefully reassess the diagnosis before changing treatment. Do not use inhaled corticosteroids specifically for cough. Refer to national guidelines for diagnosis and management of cough.

Go to: Australian Cough Guidelines

How this recommendation was developed
Adapted from existing guidance
Based on reliable clinical practice guideline(s) or position statement(s):

- van Asperen et al. 2010
- Brand et al. 2008

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

- van Asperen et al. 2010
- Brand et al. 2008

How this recommendation was developed
Consensus
Based on clinical experience and expert opinion (informed by evidence, where available).

How this recommendation was developed
Adapted from existing guidance
Based on reliable clinical practice guideline(s) or position statement(s):

- van Asperen et al. 2010
- Gibson et al. 2010
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 and the degree to which asthma symptoms affect daily activities such as interference with physical activity or missed school days), the frequency of flare-ups, and spirometry in children who are able to perform the test reliably.

Parents commonly underestimate the severity of their child’s asthma and overestimate asthma control.\(^5\)

Standardised questionnaires

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

- **Asthma Control Questionnaire (ACQ)** for children aged 6 years and over (must be administered by a trained interviewer in children aged 6–10 years) – asks questions about symptoms, effect of asthma on activity and use of relievers during the previous week.\(^6\) A lower score indicates better asthma control.

- **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.\(^7, 8\) 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 (about the child’s symptoms over the previous 4 weeks) and four for the child.\(^9, 10\) A lower score indicates worse asthma control. **Note:** C-ACT is intended for US use.

Measures of airway inflammation

Measures of airway inflammation (e.g. sputum test, exhaled nitric oxide) are not used in clinical practice to guide treatment decisions. Tailoring the dose of inhaled corticosteroids based on exhaled nitric oxide appears to achieve only a small benefit in children, and may lead to higher doses.\(^11\)

Administration of inhaled medicines in children: 0–5 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.

During acute wheezing episodes, delivery of short-acting beta\(_2\) agonist to airways is more effective with a pressurised metered-dose inhaler plus spacer than with a nebuliser.\(^3\) 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.\(^12\)

Dry-powder inhalers are usually ineffective for preschool children because they cannot generate sufficient inspiratory airflow.\(^3\)

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 firing the device.\(^3\) Note that breath-actuated pressurised metered-dose inhalers cannot be used with a spacer.

Even when using pressurised metered dose inhalers and spacers, drug delivery is very variable in young children.\(^13\) The inhaler design may improve spacer technique,\(^13\) but will not necessarily improve clinical outcomes. The amount of medicine delivered by inhaler devices to the lower airways varies from day to day in preschool children.\(^3\) This variation might explain fluctuations in effectiveness, even if the child’s parents have been trained to use the device correctly.

When administering salbutamol to relieve asthma symptoms in a preschool child, the standard recommendation is to shake the inhaler, fire one puff at a time into the spacer and have the child take 4–6 breaths in and out of the spacer (tidal breathing).\(^14\) 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.\(^15\)

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. 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

Correct use of inhaler devices

The majority of patients do not use inhaler devices correctly. Australian research studies have reported that only approximately 10% of patients use correct technique. Regardless of the type of inhaler device prescribed, patients are unlikely to use inhalers correctly unless they receive clear instruction, including a physical demonstration, and have their inhaler technique checked regularly.

Poor inhaler technique has been associated with worse outcomes in asthma and COPD. It can lead to poor asthma symptom control and overuse of relievers and preventers. In patients with asthma or COPD, incorrect technique is associated with a 50% increased risk of hospitalisation, increased emergency department visits and increased use of oral corticosteroids due to flare-ups.

Correcting patients’ inhaler technique has been shown to improve asthma control, asthma-related quality of life and lung function.

Common errors and problems with inhaler technique

Common errors with manually actuated pressurised metered dose inhalers include:

- failing to shake the inhaler before actuating
- holding the inhaler in wrong position
- failing to exhale fully before actuating the inhaler
- actuating the inhaler too early or during exhalation (the medicine may be seen escaping from the top of the inhaler)
- actuating the inhaler too late while inhaling
- actuating more than once while inhaling
- inhaling too rapidly (this can be especially difficult for children to overcome)
- multiple actuations without shaking between doses.

Common errors for dry powder inhalers include:

- not keeping the device in the correct position while loading the dose (horizontal for Accuhaler and vertical for Turbuhaler)
- failing to exhale fully before inhaling
- failing to inhale completely
- inhaling too slowly and weakly
- exhaling into the device mouthpiece before or after inhaling
- failing to close the inhaler after use
- using past the expiry date or when empty.

Other common problems include:

- difficulty manipulating device due to problems with dexterity (e.g. osteoarthritis, stroke, muscle weakness)
- inability to seal the lips firmly around the mouthpiece of an inhaler or spacer
- inability to generate adequate inspiratory flow for the inhaler type
- failure to use a spacer when appropriate
- use of incorrect size mask
- inappropriate use of a mask with a spacer in older children.

How to improve patients’ inhaler technique
Patients’ inhaler technique can be improved by brief education, including a physical demonstration, from a health professional or other person trained in correct technique. The best way to train patients to use their inhalers correctly is one-to-one training by a healthcare professional (e.g. nurse, pharmacist, GP, specialist), that involves both verbal instruction and physical demonstration. Patients do not learn to use their inhalers properly just by reading the manufacturer’s leaflet. An effective method is to assess the individual’s technique by comparing with a checklist specific to the type of inhaler, and then, after training in correct technique, to provide written instructions about errors (e.g. a sticker attached to the device).

The National Asthma Council information paper on inhaler technique includes checklists for correct technique with all common inhaler types used in asthma or COPD.

Inhaler technique must be rechecked and training must be repeated regularly to help children and adults maintain correct technique.

Managing cough in children

When cough is the predominant symptom in a young child, careful assessment is needed to avoid making an incorrect diagnosis of asthma, or instigating inappropriate treatment. Cough alone (recurrent non-specific cough) is most likely due to recurrent viral bronchitis, which is unresponsive to both bronchodilators and preventive therapy including inhaled corticosteroids. Recurrent non-specific cough usually resolves by age 6 or 7 years and leaves no residual pulmonary pathology.

If cough is a problem for a child with known asthma, it should be managed according to national Cough in Children and Adults: Diagnosis and Assessment (CICADA) guidelines.

• There are significant concerns about use of cough medicines in children.

Montelukast for children: warning parents about potential psychiatric adverse effects

Montelukast is generally very well tolerated. However, post-marketing surveillance reports suggested a slight increase in the rate of psychiatric disorders that was possibly associated with use of leukotriene receptor antagonists in children; this association may have been confounded by asthma severity and concomitant medication. Montelukast use has also been associated with suicidal ideation, but a recent nested case-control study concluded that children with asthma aged 5–18 years taking leukotriene receptor antagonists were not at increased risk of suicide attempts. Behavioural and psychiatric adverse effects were rare in clinical trials.

The Thoracic Society of Australia and New Zealand advises that it is prudent to mention to parents the potential association of montelukast with behaviour-related adverse events when commencing treatment, and to cease therapy if such adverse events are suspected.

References


### Table. Reviewing and adjusting preventer treatment for children aged 0–5 years

<table>
<thead>
<tr>
<th>Initial treatment</th>
<th>When to schedule review</th>
<th>Management options and notes</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Treatment response</td>
</tr>
<tr>
<td><strong>Montelukast (children 2 years and over)</strong></td>
<td>2–4 weeks</td>
<td>Continue montelukast treatment</td>
</tr>
<tr>
<td><strong>Inhaled corticosteroid (low dose)</strong></td>
<td>4 weeks</td>
<td>Continue regular treatment at low dose</td>
</tr>
<tr>
<td></td>
<td></td>
<td>After ≥3 months, consider stopping treatment and reviewing in 4 weeks</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- Advise parents about potential adverse psychiatric effects of montelukast

† Symptom control not achieved with initial treatment after verifying treatment was taken as intended

‡ PBS status as at October 2016: Montelukast is not subsidised by the PBS for children aged 2–5 years with moderate-to-severe asthma, or when used in combination with another preventer.

Asset ID: 25
Managing acute wheezing episodes in children 0–5 years

Recommendations

Manage acute wheezing with an inhaled short-acting beta₂ agonist bronchodilator (reliever) as indicated, according to age and clinical significance. Educate parents how and when to give reliever.

- Do not prescribe oral salbutamol. Inhalation is the recommended route for delivering relievers for all children and adults.

Table. Non-emergency use of bronchodilators (relievers) in children aged 0–5 years

<table>
<thead>
<tr>
<th>Age</th>
<th>Notes</th>
<th>Salbutamol dose and delivery</th>
</tr>
</thead>
<tbody>
<tr>
<td>0–6 months</td>
<td>Consider discussing with a paediatric respiratory physician or paediatrician before prescribing an inhaled short-acting beta₂ agonist (salbutamol).</td>
<td>2–4 puffs (100 mcg per puff) as needed via pressurised metered-dose inhaler, spacer and face mask</td>
</tr>
<tr>
<td>6–12 months</td>
<td>Consider managing wheezing episodes with an inhaled short-acting beta₂ agonist bronchodilator (salbutamol) only if wheezing is associated with increased work of breathing (i.e. intercostal retraction) Use inhaled salbutamol with caution and discontinue if wheezing does not resolve promptly after use.</td>
<td>2–4 puffs (100 mcg per puff) as needed via pressurised metered-dose inhaler, spacer and face mask</td>
</tr>
<tr>
<td>1–5 years</td>
<td>Manage wheezing episodes with inhaled short-acting beta₂ agonist (salbutamol) as needed if associated with increased work of breathing (i.e. intercostal retraction).</td>
<td>Usual dose: 2–4 puffs (100 mcg per puff) as needed via pressurised metered-dose inhaler, spacer and face mask (infants) or spacer (if old enough to cooperate)</td>
</tr>
</tbody>
</table>

Note: This table lists usual salbutamol doses to be administered by carers in the community to manage symptoms as needed. Doses are higher during acute episodes, including emergencies.

See: Managing acute asthma in adults and children

Asset ID: 24

How this recommendation was developed

Consensus

Based on clinical experience and expert opinion (informed by evidence, where available).
Consider a course of oral corticosteroids for children with acute asthma/wheezing that is associated with increased work of breathing and is severe enough to require hospital admission. (Do not prescribe oral corticosteroids for children younger than 6 years unless acute wheezing is severe enough to require hospitalisation).

- **Adapted from existing guidance**
  - Based on reliable clinical practice guideline(s) or position statement(s):
    - van Asperen et al. 2010

Do not instruct parents to start a course of oral corticosteroids at their own discretion for wheezing children aged 0–5 years (e.g. as part of the child’s written asthma action plan). Instruct parents to seek medical advice each time.

- **Adapted from existing guidance**
  - Based on reliable clinical practice guideline(s) or position statement(s):
    - van Asperen et al. 2010
    - Brand et al. 2008

If frequent (four or more per year) courses of oral corticosteroids are needed to manage severe acute flare-ups, reassess regular medicine regimen and consider specialist referral.

- **Consensus**
  - Based on clinical experience and expert opinion (informed by evidence, where available), with particular reference to the following source(s):
    - van Asperen et al. 2010

Do not prescribe long-term oral corticosteroids without specialist assessment by a paediatric respiratory physician.

- **Adapted from existing guidance**
  - Based on reliable clinical practice guideline(s) or position statement(s):
    - van Asperen et al. 2010

Advise parents that children taking a regular preventer medicine should keep taking it during wheezing episodes.

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

Do not prescribe high-dose inhaled corticosteroids to manage symptoms, and do not recommend that parents give children high doses of inhaled corticosteroid treatment during wheezing episodes.

**Table. Definitions of ICS dose levels in children**
<table>
<thead>
<tr>
<th>Inhaled corticosteroid</th>
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† 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

Asset ID: 21

How this recommendation was developed
Consensus
Based on clinical experience and expert opinion (informed by evidence, where available), with particular reference to the following source(s):
- Brand et al. 2008

More information

**Short-acting beta-2 agonist relievers for children: 0–5 years**
Inhaled short-acting beta2 agonists are effective bronchodilators in children aged 0–5 years.2
Short-acting beta2 agonists may be less effective for wheezing in children under 2 years old than in older children.3 However, many clinical trials in infants have included those with bronchiolitis, so there is limited evidence for the effects of short-acting beta2 agonists specifically in asthma.3 Studies conducted in emergency departments have shown that short-acting beta2 agonists are more effective than placebo in controlling acute wheeze in children under 2 years, but may not achieve clinically significant improvements.3
Paradoxical responses to inhaled short-acting beta2 agonists have been reported in infants.2 Bronchodilators are generally not recommended in children under 6 months old, consistent with current guidelines for the management of acute bronchiolitis.5
Inhaled short-acting beta2 agonists are generally well tolerated in children aged 0–5 years.2 Adverse effects (e.g. muscle tremor, headache, palpitations, agitation or hypokalaemia) have been reported at high doses.2
Oral short-acting beta2 agonists are associated with adverse effects2 and should not be used in any age group.

**Oral corticosteroids for children: 0–5 years**
Few clinical trials have assessed the effectiveness of oral corticosteroids for managing flare-ups of wheezing in preschool children,2 and there is very little evidence about their effects in children who are not being treated in hospitals or emergency departments.
Short courses of oral corticosteroids initiated by parents in response to the onset of wheezing symptoms do not appear to reduce the need for hospitalisation or treatment in the emergency department for preschool children. For children aged 1–5 years with wheezing due to a respiratory tract virus such as the common cold, a short course of oral prednisolone does not reduce the severity of symptoms.

Parent-initiated oral corticosteroid treatment in children
There is limited and inconclusive evidence from clinical trials evaluating the effectiveness of courses of oral corticosteroids initiated by parents in response to children's wheezing.
In children aged 6–14 years, a course of oral prednisolone initiated by parents in response to an asthma flare-up may reduce asthma symptoms and the number of missed school days.
In children aged 1–5 years with episodic wheezing, oral corticosteroids are not effective in managing the symptoms of acute lower respiratory tract illnesses.

Oral corticosteroids for children: adverse effects
A short course of oral corticosteroid therapy (less than 2 weeks) is associated with little risk of long-term suppression of the hypothalamus–pituitary–adrenal axis. However, risk can accumulate if frequent courses (four or more per year) are given.
Recurrent courses of oral corticosteroids may also affect bone mineral density, especially in boys.

Administration of inhaled medicines in children: 0–5 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.
During acute wheezing episodes, delivery of short-acting beta_2_ agonist to airways is more effective with a pressurised metered-dose inhaler plus spacer than with a nebuliser. 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.
Dry-powder inhalers are usually ineffective for preschool children because they cannot generate sufficient inspiratory airflow.
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 firing the device. Note that breath-actuated pressurised metered-dose inhalers cannot be used with a spacer.
Even when using pressurised metered dose inhalers and spacers, drug delivery is very variable in young children. The inhaler design may improve spacer technique, but will not necessarily improve clinical outcomes. The amount of medicine delivered by inhaler devices to the lower airways varies from day to day in preschool children. This variation might explain fluctuations in effectiveness, even if the child’s parents have been trained to use the device correctly.
When administering salbutamol to relieve asthma symptoms in a preschool child, the standard recommendation is to shake the inhaler, fire one puff at a time into the spacer and have the child take 4–6 breaths in and out of the spacer (tidal breathing). 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 inhaled 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.
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. 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.

Correct use of inhaler devices

The majority of patients do not use inhaler devices correctly. Australian research studies have reported that only approximately 10% of patients use correct technique.\textsuperscript{14, 15}

High rates of incorrect inhaler use among children with asthma and adults with asthma or COPD have been reported,\textsuperscript{16, 17, 18, 19, 20} even among regular users.\textsuperscript{21} Regardless of the type of inhaler device prescribed, patients are unlikely to use inhalers correctly unless they receive clear instruction, including a physical demonstration, and have their inhaler technique checked regularly.\textsuperscript{22}

Poor inhaler technique has been associated with worse outcomes in asthma and COPD. It can lead to poor asthma symptom control and overuse of relievers and preventers.\textsuperscript{16, 23, 24, 25} In patients with asthma or COPD, incorrect technique is associated with a 50% increased risk of hospitalisation, increased emergency department visits and increased use of oral corticosteroids due to flare-ups.\textsuperscript{21}

Correcting patients' inhaler technique has been shown to improve asthma control, asthma-related quality of life and lung function.\textsuperscript{26, 27}

Common errors and problems with inhaler technique

Common errors with manually actuated pressurised metered dose inhalers include:\textsuperscript{22}

- failing to shake the inhaler before actuating
- holding the inhaler in wrong position
- failing to exhale fully before actuating the inhaler
- actuating the inhaler too early or during exhalation (the medicine may be seen escaping from the top of the inhaler)
- actuating the inhaler too late while inhaling
- actuating more than once while inhaling
- inhaling too rapidly (this can be especially difficult for children to overcome)
- multiple actuations without shaking between doses.

Common errors for dry powder inhalers include:\textsuperscript{22}

- not keeping the device in the correct position while loading the dose (horizontal for Accuhaler and vertical for Turbuhaler)
- failing to exhale fully before inhaling
- failing to inhale completely
- inhaling too slowly and weakly
- exhaling into the device mouthpiece before or after inhaling
- failing to close the inhaler after use
- using past the expiry date or when empty.

Other common problems include:

- difficulty manipulating device due to problems with dexterity (e.g. osteoarthritis, stroke, muscle weakness)
- inability to seal the lips firmly around the mouthpiece of an inhaler or spacer
- inability to generate adequate inspiratory flow for the inhaler type
- failure to use a spacer when appropriate
- use of incorrect size mask
- inappropriate use of a mask with a spacer in older children.

How to improve patients' inhaler technique

Patients' inhaler technique can be improved by brief education, including a physical demonstration, from a health professional or other person trained in correct technique.\textsuperscript{22} The best way to train patients to use their inhalers correctly is one-to-one training by a healthcare professional (e.g. nurse, pharmacist, GP, specialist), that involves both verbal instruction and physical demonstration.\textsuperscript{28, 16, 29, 30} Patients do not learn to use their inhalers properly just by reading the manufacturer's leaflet.\textsuperscript{29} An effective method is to assess the individual's technique by comparing with a checklist specific
to the type of inhaler, and then, after training in correct technique, to provide written instructions about errors (e.g. a sticker attached to the device).

The National Asthma Council information paper on inhaler technique includes checklists for correct technique with all common inhaler types used in asthma or COPD.

Inhaler technique must be rechecked and training must be repeated regularly to help children and adults maintain correct technique.

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

References


Managing asthma in children aged 6 years and over

In this section

**Initial assessment**
Assessing symptoms and control in children 6 years and over

**Initial treatment**
Considering if regular preventer treatment is indicated in children 6 years and over

**Other treatments**
Considering other regular treatments in children 6 years and over

**Treatment review**
Reviewing initial treatment in children 6 years and over

**Further review**
Conducting further review after adjustment of initial treatment in children 6 years and over

**Flare-ups**
Managing flare-ups in children 6 years and over
Assessing symptoms and control in children 6 years and over

Recommendations

For children with a new asthma diagnosis or those not taking regular treatment, assess frequency and occurrence of symptoms to determine the pattern and severity of asthma.

Note: This assessment should be based on overall pattern of symptoms between flare-ups, not on symptoms seen during short-term (e.g. during a flare-up).

Table. Definitions of asthma patterns in children aged 6 years and over not taking regular preventer

<table>
<thead>
<tr>
<th>Category</th>
<th>Pattern and intensity of symptoms (when not taking regular treatment)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Infrequent intermittent asthma †</strong></td>
<td>Symptom-free for at least 6 weeks at a time (flare-ups up to once every 6 weeks on average but no symptoms between flare-ups)</td>
</tr>
<tr>
<td><strong>Frequent intermittent asthma</strong></td>
<td>Flare-ups more than once every 6 weeks on average but no symptoms between flare-ups</td>
</tr>
</tbody>
</table>
| **Persistent asthma**         | **Mild**  
FEV<sub>1</sub> ≥80% predicted and at least one of:  
  • Daytime symptoms ‡ more than once per week but not every day  
  • Night-time symptoms ‡ more than twice per month but not every week |
|                               | **Moderate**  
Any of:  
  • FEV<sub>1</sub> <80% predicted ‡  
  • Daytime symptoms ‡ daily  
  • Night-time symptoms ‡ more than once per week  
  • Symptoms sometimes restrict activity or sleep |
|                               | **Severe**  
Any of:  
  • FEV<sub>1</sub> ≤60% predicted ‡  
  • Daytime symptoms ‡ continual  
  • Night-time symptoms ‡ frequent  
  • Flare-ups frequent  
  • Symptoms frequently restrict activity or sleep |
† It may not be appropriate to make the diagnosis of asthma in children aged 6 or older who wheeze only during upper respiratory tract infections. These children can be considered to have episodic (viral) wheeze.

‡ Symptoms between flare-ups. A flare-up is defined as a period of worsening asthma symptoms, from mild (e.g. symptoms that are just outside the normal range of variation for the child, documented when well) to severe (e.g. events that require urgent action by parents and health professionals to prevent a serious outcome such as hospitalisation or death from asthma).

Assess level of asthma control based on:
• symptoms
• spirometry (for children able to perform spirometry reliably).

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

Most children aged 6 and older can perform spirometry reliably.

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

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

† e.g. wheezing or breathing problems
‡ child is fully active; runs and plays without symptoms
§ including no coughing during sleep
# not including short-acting beta₂ agonist 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

Note: 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.

Adapted from

Asset ID: 23

How this recommendation was developed

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

If the diagnosis of asthma was made in the past or elsewhere, confirm the diagnosis, if possible.

How this recommendation was developed

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

If parents or carers are present, arrange to see adolescents alone for part of the consultation so that you can confidentially discuss sensitive issues like adherence to asthma medicines and exposure to smoke from tobacco or other drugs.

How this recommendation was developed

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

**Adapted from existing guidance**  
Based on reliable clinical practice guideline(s) or position statement(s):

- The Royal Australasian College of Physicians, 2008

More information

**Classification of symptom patterns in children**
The pattern and severity of symptoms in a child with asthma or wheezing disorder is a guide to initial treatment.

| Table. Definitions of asthma patterns in children aged 0–5 years not taking regular preventer |
|-----------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------|
| Category                                      | Pattern and intensity of symptoms (when not taking regular treatment)                                                                 |
| **Infrequent intermittent asthma**            | Symptom-free for at least 6 weeks at a time (flare-ups up to once every 6 weeks on average but no symptoms between flare-ups)       |
| **Frequent intermittent asthma**              | Flare-ups more than once every 6 weeks on average but no symptoms between flare-ups                                              |
| **Persistent asthma**                         | **Mild** At least one of:                                                                                                                                 |


<table>
<thead>
<tr>
<th>Category</th>
<th>Pattern and intensity of symptoms (when not taking regular treatment)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>• Daytime symptoms† more than once per week but not every day</td>
</tr>
<tr>
<td></td>
<td>• Night-time symptoms† more than twice per month but not every week</td>
</tr>
<tr>
<td><strong>Moderate</strong></td>
<td>Any of:</td>
</tr>
<tr>
<td></td>
<td>• Daytime symptoms† daily</td>
</tr>
<tr>
<td></td>
<td>• Night-time symptoms† more than once per week</td>
</tr>
<tr>
<td></td>
<td>• Symptoms sometimes restrict activity or sleep</td>
</tr>
<tr>
<td><strong>Severe</strong></td>
<td>Any of:</td>
</tr>
<tr>
<td></td>
<td>• Daytime symptoms† continual</td>
</tr>
<tr>
<td></td>
<td>• Night-time symptoms† frequent</td>
</tr>
<tr>
<td></td>
<td>• Flare-ups frequent</td>
</tr>
<tr>
<td></td>
<td>• Symptoms frequently restrict activity or sleep</td>
</tr>
</tbody>
</table>

† Symptoms between flare-ups. A flare-up is defined as a period of worsening asthma symptoms, from mild (e.g. symptoms that are just outside the normal range of variation for the child, documented when well) to severe (e.g. events that require urgent action by parents and health professionals to prevent a serious outcome such as hospitalisation or death from asthma).

**Note:** Use this table when the diagnosis of asthma can be made with reasonable confidence (e.g. a child with wheezing accompanied by persistent cough or breathing difficulty, no signs or symptoms that suggest a potentially serious alternative diagnosis, and the presence of other factors that increase the probability of asthma such as family history of allergies or asthma).

Asset ID: 14

**Table. Definitions of asthma patterns in children aged 6 years and over not taking regular preventer**

<table>
<thead>
<tr>
<th>Category</th>
<th>Pattern and intensity of symptoms (when not taking regular treatment)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Infrequent intermittent asthma †</strong></td>
<td>Symptom-free for at least 6 weeks at a time (flare-ups up to once every 6 weeks on average but no symptoms between flare-ups)</td>
</tr>
<tr>
<td><strong>Frequent intermittent asthma</strong></td>
<td>Flare-ups more than once every 6 weeks on average but no symptoms between flare-ups</td>
</tr>
<tr>
<td><strong>Persistent asthma</strong></td>
<td><strong>Mild</strong></td>
</tr>
<tr>
<td></td>
<td>FEV₁ ≥80% predicted and at least one of:</td>
</tr>
</tbody>
</table>
### 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 (e.g., flare-ups, 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)

<table>
<thead>
<tr>
<th>Category</th>
<th>Pattern and intensity of symptoms (when not taking regular treatment)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>• Daytime symptoms\† more than once per week but not every day&lt;br&gt;• Night-time symptoms\† more than twice per month but not every week</td>
</tr>
<tr>
<td>Moderate</td>
<td>Any of:&lt;br&gt;• FEV₁ &lt;80% predicted\‡&lt;br&gt;• Daytime symptoms\‡ daily&lt;br&gt;• Night-time symptoms\‡ more than once per week&lt;br&gt;• Symptoms sometimes restrict activity or sleep</td>
</tr>
<tr>
<td>Severe</td>
<td>Any of:&lt;br&gt;• FEV₁ ≤60% predicted\‡&lt;br&gt;• Daytime symptoms\‡ continual&lt;br&gt;• Night-time symptoms\‡ frequent&lt;br&gt;• Flare-ups frequent&lt;br&gt;• Symptoms frequently restrict activity or sleep</td>
</tr>
</tbody>
</table>

\† It may not be appropriate to make the diagnosis of asthma in children aged 6 or older who wheeze only during upper respiratory tract infections. These children can be considered to have episodic (viral) wheeze.

\‡ Symptoms between flare-ups. A flare-up is defined as a period of worsening asthma symptoms, from mild (e.g., symptoms that are just outside the normal range of variation for the child, documented when well) to severe (e.g., events that require urgent action by parents and health professionals to prevent a serious outcome such as hospitalisation or death from asthma).

Asset ID: 15

For children already taking regular preventer treatment, adjustments to the treatment regimen are based on finding the lowest dose of medicines that will maintain good control of symptoms.
<table>
<thead>
<tr>
<th>Good control</th>
<th>Partial control</th>
<th>Poor control</th>
</tr>
</thead>
<tbody>
<tr>
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<td>• Any symptoms during night or when wakes up††</td>
<td></td>
</tr>
<tr>
<td>• Need for reliever# ≤2 days per week</td>
<td>• Need for reliever# &gt;2 days per week</td>
<td></td>
</tr>
</tbody>
</table>

† e.g. wheezing or breathing problems
‡ child is fully active; runs and plays without symptoms
§ including no coughing during sleep
# not including short-acting beta_2 agonist 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

Note: 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.

Adapted from
Asset ID: 23

**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 and the degree to which asthma symptoms affect daily activities such as interference with physical activity or missed school days), the frequency of flare-ups, and spirometry in children who are able to perform the test reliably.

Parents commonly underestimate the severity of their child’s asthma and overestimate asthma control.²

**Standardised questionnaires**

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

- Asthma Control Questionnaire (ACQ) for children aged 6 years and over (must be administered by a trained interviewer in children aged 6–10 years) – asks questions about symptoms, effect of asthma on activity and use of relievers during the previous week.³ A lower score indicates better asthma control.

- 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.⁴ ⁵ 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 (about the child’s symptoms over the previous 4 weeks) and four for the child.⁶ ⁷ A lower score indicates worse asthma control. Note: C-ACT is intended for US use.

**Measures of airway inflammation**
Measures of airway inflammation (e.g. sputum test, exhaled nitric oxide) are not used in clinical practice to guide treatment decisions. Tailoring the dose of inhaled corticosteroids based on exhaled nitric oxide appears to achieve only a small benefit in children, and may lead to higher doses.  

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.  
When adolescents are accompanied by parents or carers, health care providers should consider seeing the adolescent alone for part of each consultation.  
Health professionals should discuss confidentiality and its limits with adolescents. Adolescents are more willing to communicate honestly with healthcare professionals who discuss confidentiality with them.  
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.  

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. Mental health disorders (e.g. depression, anxiety, eating disorders) are common and clinically important among young people. A significant proportion of adult mental health problems emerge during adolescence.  
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. Although smoking rates among adolescents and young people are declining, approximately 6% of adolescents aged 15–17 years smoke, and 4% smoke at least daily. 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.  
Adolescents with chronic disease show higher rates of health risk behaviours than healthy adolescents. 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.  
Depression, risk behaviours and poor adherence to medicines are interrelated. Adolescents with asthma who adhere poorly to asthma treatment and hide their asthma are more likely to start smoking than other adolescents with asthma. Among adolescent boys, those with lower quality of life are most likely to start smoking.  
Adolescents often wish to discuss their health concerns with health professionals but are reluctant to discuss sensitive issues unless asked directly and confidentially.  

References


Considering if regular preventer treatment is indicated in children 6 years and over

Recommendations

Discuss the goals of asthma treatment with the child’s parents and the child (as appropriate to the child’s age and maturity). Explain that the overall aims of treatment are to make sure asthma does not interfere with the child’s quality of life and to minimise the side effects of treatment by using the lowest level of medication required to maintain good asthma control.

Figure. Stepped approach to adjusting asthma medication in children

Please view and print this figure separately: https://www.asthmahandbook.org.au/figure/show/18

How this recommendation was developed
Consensus
Based on clinical experience and expert opinion (informed by evidence, where available).

Prescribe a reliever. Educate children and parents how and when to use reliever, and advise them to carry reliever at all times.

Table. Non-emergency use of bronchodilators (relievers) in children aged 6–12 years

<table>
<thead>
<tr>
<th>Option</th>
<th>Notes</th>
<th>Dose and delivery</th>
</tr>
</thead>
<tbody>
<tr>
<td>Salbutamol</td>
<td>Suitable for children any age†</td>
<td>2–4 puffs (100 mcg per puff) via pressurised metered-dose inhaler and spacer</td>
</tr>
<tr>
<td></td>
<td>A spacer should be used during acute flare-ups (exacerbations)</td>
<td></td>
</tr>
<tr>
<td>Terbutaline</td>
<td>Generally suitable for children 6 years and older‡</td>
<td>1–2 inhalations (500 mcg/inhalation) via breath-actuated powder inhaler</td>
</tr>
</tbody>
</table>

Note: This table lists usual doses to be administered by carers in the community to manage symptoms as needed. Doses are higher during acute asthma, including emergencies.

† If able to use this type of inhaler correctly

- Do not prescribe oral salbutamol.

Asset ID: 28

How this recommendation was developed
Consensus
Based on clinical experience and expert opinion (informed by evidence, where available).
Consider regular preventer treatment according to pattern of symptoms. Explain to parents that preventer treatment should be taken every day and continued long term.

**Table. Initial preventer treatment for children aged 6 years and over**

<table>
<thead>
<tr>
<th>Pattern of symptoms *</th>
<th>Management options and notes †</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Infrequent intermittent asthma ‡</strong></td>
<td>Regular preventer treatment is not recommended</td>
</tr>
<tr>
<td><strong>Frequent intermittent asthma</strong></td>
<td>Consider a treatment trial with montelukast 5 mg once daily; assess response after 2–4 weeks. A cromone (sodium cromoglycate or nedocromil) can be trialled as an alternative §</td>
</tr>
<tr>
<td><strong>Mild persistent asthma</strong></td>
<td>Consider a treatment trial with montelukast 5 mg once daily; assess response after 2–4 weeks. If inadequate response after checking adherence, consider treatment trial with inhaled corticosteroid (low dose). A cromone (sodium cromoglycate or nedocromil) can be trialled as an alternative §</td>
</tr>
<tr>
<td><strong>Moderate-to-severe persistent asthma</strong></td>
<td>Consider a treatment trial with regular inhaled corticosteroid (low dose); assess response after 4 weeks.</td>
</tr>
</tbody>
</table>

* Advise parents about potential adverse psychiatric effects of montelukast

* Pattern of symptoms when not taking regular preventer treatment
† In addition to use of rapid-onset inhaled beta2 agonist when child experiences difficulty breathing
‡ Also applies to children who wheeze only during upper respiratory tract infections and do not have a diagnosis of asthma
§ E.g. sodium cromoglycate 5 mg/actuation; 10 mg (two inhalations) three times daily, then 10 mg twice daily when stable. Note: Cromone inhaler device mouthpieces require daily washing to avoid blocking

Asset ID: 16

**Table. Definitions of asthma patterns in children aged 6 years and over not taking regular preventer**

<table>
<thead>
<tr>
<th>Category</th>
<th>Pattern and intensity of symptoms (when not taking regular treatment)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Infrequent intermittent asthma ‡</strong></td>
<td>Symptom-free for at least 6 weeks at a time (flare-ups up to once every 6 weeks on average but no symptoms between flare-ups)</td>
</tr>
<tr>
<td><strong>Frequent intermittent asthma</strong></td>
<td>Flare-ups more than once every 6 weeks on average but no symptoms between flare-ups</td>
</tr>
<tr>
<td><strong>Persistent asthma</strong></td>
<td>Mild</td>
</tr>
<tr>
<td>Category</td>
<td>Pattern and intensity of symptoms (when not taking regular treatment)</td>
</tr>
<tr>
<td>----------</td>
<td>-----------------------------------------------------------------------</td>
</tr>
<tr>
<td></td>
<td>• Daytime symptoms‡ more than once per week but not every day</td>
</tr>
<tr>
<td></td>
<td>• Night-time symptoms‡ more than twice per month but not every week</td>
</tr>
<tr>
<td>Moderate</td>
<td>Any of:</td>
</tr>
<tr>
<td></td>
<td>• FEV\textsubscript{1} &lt;80% predicted‡</td>
</tr>
<tr>
<td></td>
<td>• Daytime symptoms‡ daily</td>
</tr>
<tr>
<td></td>
<td>• Night-time symptoms‡ more than once per week</td>
</tr>
<tr>
<td></td>
<td>• Symptoms sometimes restrict activity or sleep</td>
</tr>
<tr>
<td>Severe</td>
<td>Any of:</td>
</tr>
<tr>
<td></td>
<td>• FEV\textsubscript{1} ≤60% predicted‡</td>
</tr>
<tr>
<td></td>
<td>• Daytime symptoms‡ continual</td>
</tr>
<tr>
<td></td>
<td>• Night-time symptoms‡ frequent</td>
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<tr>
<td></td>
<td>• Flare-ups frequent</td>
</tr>
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<td></td>
<td>• Symptoms frequently restrict activity or sleep</td>
</tr>
</tbody>
</table>

† It may not be appropriate to make the diagnosis of asthma in children aged 6 or older who wheeze only during upper respiratory tract infections. These children can be considered to have episodic (viral) wheeze.

‡ Symptoms between flare-ups. A flare-up is defined as a period of worsening asthma symptoms, from mild (e.g. symptoms that are just outside the normal range of variation for the child, documented when well) to severe (e.g. events that require urgent action by parents and health professionals to prevent a serious outcome such as hospitalisation or death from asthma).

Asset ID: 15

How this recommendation was developed

Adapted from existing guidance
Based on reliable clinical practice guideline(s) or position statement(s):

• van Asperen et al. 2010

If a child needs to use a short-acting beta\textsubscript{2} agonist reliever more than twice per week (not counting doses taken prophylactically before exercise for those with exercise-induced bronchoconstriction), consider starting regular preventer treatment.

How this recommendation was developed

Consensus
Based on clinical experience and expert opinion (informed by evidence, where available).
When starting regular inhaled corticosteroid treatment, begin with a low dose.

**Table. Definitions of ICS dose levels in children**

<table>
<thead>
<tr>
<th>Inhaled corticosteroid</th>
<th>Daily dose (mcg)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Low</td>
</tr>
<tr>
<td>Beclometasone dipropionate †</td>
<td>100–200</td>
</tr>
<tr>
<td>Budesonide</td>
<td>200–400</td>
</tr>
<tr>
<td>Ciclesonide ‡</td>
<td>80–160</td>
</tr>
<tr>
<td>Fluticasone propionate</td>
<td>100–200</td>
</tr>
</tbody>
</table>

† 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

Asset ID: 21

**Q. How this recommendation was developed**

Adapted from existing guidance

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

- van Asperen et al. 2010

**More information**

**Short-acting beta-2 agonist relievers for children: 6 years and over**

Inhaled short-acting beta₂ agonists are the major class of bronchodilators used for relief of symptoms in asthma. They are the most effective bronchodilators available and are recommended by international guidelines for use in children of all ages as well as in adults.

Children with controlled asthma need little or no reliever (on no more than 2 days per week).

Increased use of short-acting beta₂ agonists for relief of asthma symptoms, especially daily use, indicates deterioration of asthma control.

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

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

† e.g. wheezing or breathing problems
‡ child is fully active; runs and plays without symptoms
§ including no coughing during sleep
# not including short-acting beta\textsubscript{2} agonist 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

Note: 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.

Adapted from

Montelukast for children
Montelukast is registered by the TGA for use in children aged 2 years and older.\textsuperscript{5} Based on data from placebo-controlled trials, it has not been possible to define clinical indicators that predict which children will benefit most from montelukast therapy, compared with other treatment options.\textsuperscript{6,7}

Comparative studies suggest that the main role for montelukast is as an alternative to low-dose inhaled corticosteroid in children with frequent intermittent asthma or mild persistent asthma.\textsuperscript{6}

**Children 0–5 years**
In preschool children with multiple-trigger wheeze, montelukast protects against airway hyperresponsiveness when taken with or without inhaled corticosteroids.\textsuperscript{6} Inhaled corticosteroids are more effective than montelukast in children with multiple-trigger wheeze aged 2–8 years,\textsuperscript{8} but this comparison has not been made in preschool children as a separate group.\textsuperscript{8}

In children aged 2–5 years with episodic (viral) wheeze, regular montelukast treatment reduces the risk of wheezing episodes.\textsuperscript{10} However, montelukast may not reduce symptoms in children aged 6–24 months with recurrent wheeze.\textsuperscript{11}  

**Notes:** Montelukast is not TGA-registered for use in children younger than 2 years.  
A short course of montelukast, introduced at the first signs of an asthma episode or upper respiratory tract infection, can achieve a small reduction in symptoms, school absence and medical consultations in preschool and school-aged children with episodic wheeze.\textsuperscript{12} However, montelukast is not TGA-registered for intermittent use.

**Children 6 years and over**
In school-aged children with persistent asthma, inhaled corticosteroids are more effective than montelukast for a range of measures, including lung function.\textsuperscript{6}
In school-aged children with persistent exercise-induced symptoms despite taking regular inhaled corticosteroids, montelukast is effective in controlling symptoms and is more effective than long-acting beta₂ agonists.¹ ¹³

In children who are already taking regular inhaled corticosteroids and have a beta₂ receptor genotype associated with increased susceptibility to flare-ups during regular long-acting beta₂ agonist therapy,¹⁴ montelukast may be more effective than salmeterol in reducing symptoms, reliever use and days absent from school due to asthma, based on the findings of a small randomised controlled clinical trial.¹⁴

Montelukast for children: warning parents about potential psychiatric adverse effects

Montelukast is generally very well tolerated.¹ However, post-marketing surveillance reports suggested a slight increase in the rate of psychiatric disorders that was possibly associated with use of leukotriene receptor antagonists in children;¹⁵ this association may have been confounded by asthma severity and concomitant medication.¹ Montelukast use has also been associated with suicidal ideation, but a recent nested case-control study concluded that children with asthma aged 5–18 years taking leukotriene receptor antagonists were not at increased risk of suicide attempts.¹⁶ Behavioural and psychiatric adverse effects were rare in clinical trials.¹⁷¹⁸

The Thoracic Society of Australia and New Zealand advises that it is prudent to mention to parents the potential association of montelukast with behaviour-related adverse events when commencing treatment, and to cease therapy if such adverse events are suspected.¹

Cromones for children

0-5 years
Few clinical trials have assessed the use of inhaled sodium cromoglycate in preschool children and none have assessed nedocromil.⁸ Overall, sodium cromoglycate has not been shown to be effective in preschool children with multiple-trigger wheeze.⁸¹⁹

However, cromones are well tolerated and registered for use in infants. Therefore, a treatment trial can be considered before considering other preventers, particularly for children less than 2 years old.

6 years and over
Cromones are rarely prescribed in school-aged children.

Inhaled sodium cromoglycate might be effective in school-aged children, but interpretations of available evidence are inconsistent.¹ Sodium cromoglycate is less effective than inhaled corticosteroid in achieving asthma control and improving lung function in children with persistent asthma.²⁰

Nedocromil sodium appears to be have some benefit in children with persistent asthma, but its relative effectiveness compared with inhaled corticosteroids is not clear.²¹ Long-term (4–6 years) treatment with budesonide achieved better asthma control than long-term nedocromil in children with mild-to-moderate asthma aged 5–12 in a randomised placebo-controlled clinical trial.²²

Practical issues
Cromones (sodium cromoglycate and nedocromil) may not be practical for some patients, because they require three–four times daily dosing until control is gained, and inhaler devices for cromones tend to block easily.¹

Nedocromil can cause an unusual or unpleasant taste²³ and is not tolerated by some children.

Inhaled corticosteroids for children: overview
The effectiveness of ICS in children appears to depend on several factors including the child's age, which triggers are causing symptoms, wheezing phenotype, tobacco smoke exposure and genotype.²⁴ Overall, inhaled corticosteroids seem to be more effective in older children and those with more severe disease.¹

Early introduction of inhaled corticosteroid for children with recurrent wheeze does not prevent airway remodelling, improve long-term lung function or prevent the onset of persistent asthma, according to current evidence from long-term
randomised controlled clinical trials in preschool children and school-aged children with intermittent or mild persistent asthma.²

**Inhaled corticosteroids for children: 6 years and over**

Most clinical trials of regular inhaled corticosteroid treatment in children have been conducted among children with persistent asthma.¹ Beclometasone dipropionate, budesonide, ciclesonide and fluticasone propionate have all been shown to be effective in children. However, there have been relatively fewer studies of ciclesonide (a newer inhaled corticosteroid)² but, overall, randomised clinical trials show that it is equally effective as budesonide or fluticasone propionate in improving asthma symptoms and reducing flare-ups.²³

In school-aged children with mild persistent asthma, regular low-dose daily inhaled corticosteroid treatment reduces the rate of flare-ups that require treatment with oral corticosteroids, compared with no regular treatment and as-needed short-acting beta₂ agonist for wheezing episodes.²⁶

The Thoracic Society of Australia and New Zealand’s current position statement on the use of inhaled corticosteroids in children recommends regular treatment with inhaled corticosteroid for school-aged children with moderate-to-severe persistent asthma, or those with frequent intermittent asthma or mild persistent asthma if symptoms are not controlled by a 2- to 4-week treatment trial with a cromone (nedocromil or sodium cromoglycate) or montelukast.¹

**Inhaled corticosteroids for children: doses**

In the majority of children, asthma control can be achieved with any of the following initial doses:¹

- budesonide 400 mcg/day
- beclometasone (Qvar) 200 mcg/day
- ciclesonide 160 mcg/day
- fluticasone propionate 200 mcg/day.

If these doses do not achieve control of symptoms, possible explanations include alternative diagnoses, adherence, incorrect inhaler technique, psychosocial factors and exposure to tobacco smoke or other triggers such as allergens.¹

Dose–response studies of inhaled corticosteroids show that the maximal efficacy is generally achieved at a dose equivalent to approximately 200 mcg/day fluticasone propionate,¹ while the risk of adrenal suppression increases exponentially at doses above 500 mcg/day.¹ Therefore (based on theoretical equivalents between different agents), upper limits of daily doses for children are:

- budesonide 800 mcg/day
- beclometasone dipropionate [Qvar] 400 mcg/day
- ciclesonide 320 mcg/day
- fluticasone propionate 500 mcg/day.

Higher doses are unlikely to be more effective, and are likely to cause systemic effects.¹

Most studies of inhaled corticosteroids in children have used twice-daily dosing.¹ Ciclesonide is effective when given once daily.¹ The dose of inhaled corticosteroid delivered to the lungs will depend on many factors, including the delivery device, the age of the child, individual variation in inhaler technique, and adherence.¹

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

**Table. Definitions of ICS dose levels in children**

<table>
<thead>
<tr>
<th>Inhaled corticosteroid</th>
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† 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
Asset ID: 21

Inhaled corticosteroids for children: adverse effects

Topical
Hoarseness and pharyngeal candidiasis are not commonly reported among preschool children when using a metered-dose inhaler with spacer, or among school-aged children. Inhaled corticosteroids, particular dry-powder formulas with pH <5.5, may dissolve tooth enamel in children. Topical effects can be reduced by use of spacer devices (which reduce oropharyngeal deposition), and by mouth-rinsing and spitting after use. Immediate quick mouth-rinsing removes more residual medicine in the mouth than delayed rinsing.

Systemic
Systemic effects of inhaled corticosteroids in children depend on the dose, but clinically significant adverse effects are uncommon. The use of spacers and mouth rinsing will not reduce systemic effects, but may increase efficacy so that a lower dose is required. Short-term suppression of linear growth has been demonstrated in children, but only minimal long-term effects on growth or bone density have been reported. Some children may experience delay in the normal pubertal growth spurt due to asthma itself. Treatment beginning before puberty is associated with a small (mean approximately 1 cm) reduction in adult height.
A research study using biochemical testing in a research setting showed that hypothalamic–pituitary–adrenal axis suppression may occur in up to two-thirds of children treated with inhaled corticosteroids, and may occur at even low doses. However, clinically cases are rare. Cases of symptomatic, clinically significant adrenal insufficiency in children due to inhaled corticosteroid treatment have been reported, including cases in Australia. Most cases have involved children given more than 500 mcg per day fluticasone propionate. The risk of hypothalamic–pituitary–adrenal axis suppression is higher among children receiving concomitant intranasal steroids and those with lower body mass index. Risk is lower in obese children. There are no nationally accepted protocols for routine assessment of adrenal function because it has not yet been possible to identify precisely which children should be tested, to interpret test results reliably, to identify the appropriate interval for retesting, and because a clinical benefit has not been clearly demonstrated.

Go to: The Thoracic Society of Australia and New Zealand’s Position Statement: The role of corticosteroids in the management of childhood asthma

Table. Definitions of ICS dose levels in children
### Inhaled corticosteroid Daily dose (mcg)

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<td><em>Beclometasone dipropionate</em> †</td>
<td>100–200</td>
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</tr>
<tr>
<td><em>Budesonide</em></td>
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<td>&gt;400 (up to 800)</td>
</tr>
<tr>
<td><em>Ciclesonide</em> ‡</td>
<td>80–160</td>
<td>&gt;160 (up to 320)</td>
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<td><em>Fluticasone propionate</em></td>
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<td>&gt;200 (up to 500)</td>
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† 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**
Asset ID: 21

### Inhaled corticosteroid/long-acting beta-2 agonist combinations for children: 6 years and over

**Available combinations**
Three combinations of inhaled corticosteroid and long-acting beta_2_ agonist in a single inhaler are currently available:

- The combination of fluticasone propionate and salmeterol xinafoate in a single inhaler is registered for use in children aged 4 years and over.
- The combination of budesonide and formoterol in a single inhaler is registered for use in children aged 12 years and older.
- The combination of fluticasone propionate and formoterol in a single inhaler is TGA-registered for use in children aged 12 years and older.

**Role of combination therapy in children**
Evidence from clinical trials does not support the use of combination therapy with a long-acting beta_2_ agonist plus an inhaled corticosteroid as initial preventer treatment in children who are not already taking inhaled corticosteroids. Combination therapy is a step-up option for some children whose asthma is not well controlled by low-dose inhaled corticosteroids alone.

**Beta_2_ Receptor regulation**
Clinical response to long-acting beta_2_ agonists partly depends on genetics. A beta_2_ receptor genotype (Arg16 polymorphism in the beta_2_ receptor gene) pre-disposes children with asthma to down-regulation of the beta_2_ receptor and increased susceptibility to flare-ups during regular treatment with long-acting beta_2_ agonists. However, routine genetic testing to tailor asthma therapy is not yet available in clinical practice.

Systematic reviews and meta-analyses have led to concern about the possibility that the use of long-acting beta-agonists (even in combination with inhaled corticosteroids) might even increase the risk of flare-ups that require treatment with oral steroids or hospital admission, or of severe flare-ups. A meta-analysis by the US Food and Drug Administration found that the use of long-acting beta_2_ agonists was associated with increased risk of severe asthma-associated adverse events (both overall and among the subset of people using concomitant inhaled corticosteroid and long-acting beta_2_ agonist), and that this risk was greatest in children aged 4–11 years.

**Administration of inhaled medicines in children: 6 years and over**
School-aged children (depending on the child’s age, ability, and with individualised training) can correctly 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).

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

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

School-aged children are unlikely to use their inhaler device correctly without careful training.

**Correct use of inhaler devices**

The majority of patients do not use inhaler devices correctly. Australian research studies have reported that only approximately 10% of patients use correct technique.

High rates of incorrect inhaler use among children with asthma and adults with asthma or COPD have been reported, even among regular users. Regardless of the type of inhaler device prescribed, patients are unlikely to use inhalers correctly unless they receive clear instruction, including a physical demonstration, and have their inhaler technique checked regularly.

Poor inhaler technique has been associated with worse outcomes in asthma and COPD. It can lead to poor asthma symptom control and overuse of relievers and preventers. In patients with asthma or COPD, incorrect technique is associated with a 50% increased risk of hospitalisation, increased emergency department visits and increased use of oral corticosteroids due to flare-ups.

Correcting patients’ inhaler technique has been shown to improve asthma control, asthma-related quality of life and lung function.

**Common errors and problems with inhaler technique**

Common errors with manually actuated pressurised metered dose inhalers include:

- failing to shake the inhaler before actuating
- holding the inhaler in wrong position
- failing to exhale fully before actuating the inhaler
- actuating the inhaler too early or during exhalation (the medicine may be seen escaping from the top of the inhaler)
- actuating the inhaler too late while inhaling
- actuating more than once while inhaling
- inhaling too rapidly (this can be especially difficult for children to overcome)
- multiple actuations without shaking between doses.

Common errors for dry powder inhalers include:

- not keeping the device in the correct position while loading the dose (horizontal for Accuhaler and vertical for Turbuhaler)
- failing to exhale fully before inhaling
- failing to inhale completely
- inhaling too slowly and weakly
- exhaling into the device mouthpiece before or after inhaling
- failing to close the inhaler after use
- using past the expiry date or when empty.

Other common problems include:

- difficulty manipulating device due to problems with dexterity (e.g. osteoarthritis, stroke, muscle weakness)
- inability to seal the lips firmly around the mouthpiece of an inhaler or spacer
- inability to generate adequate inspiratory flow for the inhaler type
- failure to use a spacer when appropriate
- use of incorrect size mask
- inappropriate use of a mask with a spacer in older children.

**How to improve patients’ inhaler technique**

Patients’ inhaler technique can be improved by brief education, including a physical demonstration, from a healthcare professional or other person trained in correct technique. The best way to train patients to use their inhalers correctly is one-to-one training by a healthcare professional (e.g. nurse, pharmacist, GP, specialist), that involves both verbal
Patients do not learn to use their inhalers properly just by reading the manufacturer’s leaflet. An effective method is to assess the individual’s technique by comparing with a checklist specific to the type of inhaler, and then, after training in correct technique, to provide written instructions about errors (e.g. a sticker attached to the device).

The National Asthma Council information paper on inhaler technique includes checklists for correct technique with all common inhaler types used in asthma or COPD.

Inhaler technique must be rechecked and training must be repeated regularly to help children and adults maintain correct technique.

References


Considering other regular treatments in children 6 years and over

Recommendations

Do not routinely prescribe theophyllines (aminophylline or theophylline) for children aged 6 years and over.

Note: Theophyllines are sometimes prescribed by specialists for children with difficult-to-control asthma.

How this recommendation was developed

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

Ipratropium is not recommended for the regular management of asthma in children.

How this recommendation was developed

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

- McDonald et al. 2003

More information

**Ipratropium for children**

Cochrane systematic reviews concluded that, overall, clinical trial evidence does not support the regular use of muscarinic antagonists (anticholinergic bronchodilators) in the maintenance treatment of asthma in children (i.e. outside the context of acute asthma).

See: Managing acute asthma in clinical settings

**Inhaled corticosteroid/long-acting beta-2 agonist combinations for children: 6 years and over**

Available combinations

Three combinations of inhaled corticosteroid and long-acting beta2 agonist in a single inhaler are currently available:

- The combination of fluticasone propionate and salmeterol xinafoate in a single inhaler is registered for use in children aged 4 years and over.
- The combination of budesonide and formoterol in a single inhaler is registered for use in children aged 12 years and older.
- The combination of fluticasone propionate and formoterol in a single inhaler is TGA-registered for use in children aged 12 years and older.

Role of combination therapy in children

Evidence from clinical trials does not support the use of combination therapy with a long-acting beta2 agonist plus an inhaled corticosteroid as initial preventer treatment in children who are not already taking inhaled corticosteroids.

Combination therapy is a step-up option for some children whose asthma is not well controlled by low-dose inhaled corticosteroids alone.
**Beta_2** receptor regulation

Clinical response to long-acting beta_2_ agonists partly depends on genetics. A beta_2_ receptor genotype (Arg16 polymorphism in the beta_2_ receptor gene) pre-disposes children with asthma to down-regulation of the beta_2_ receptor and increased susceptibility to flare-ups during regular treatment with long-acting beta_2_ agonists. However, routine genetic testing to tailor asthma therapy is not yet available in clinical practice.

Systematic reviews and meta-analyses have led to concern about the possibility that the use of long-acting beta-agonists (even in combination with inhaled corticosteroids) might even increase the risk of flare-ups that require treatment with oral steroids or hospital admission, or of severe flare-ups. A meta-analysis by the US Food and Drug Administration found that the use of long-acting beta-agonists was associated with increased risk of severe asthma-associated adverse events (both overall and among the subset of people using concomitant inhaled corticosteroid and long-acting beta_2_ agonist), and that this risk was greatest in children aged 4–11 years.

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**References**

Reviewing initial treatment in children 6 years and over

Recommendations

When prescribing any preventer medicine for a child, consider each treatment adjustment as a treatment trial: monitor response continually, review within 4 weeks, and adjust treatment according to response.

Figure. Stepped approach to adjusting asthma medication in children

Please view and print this figure separately: https://www.asthmahandbook.org.au/figure/show/18

Table. Reviewing and adjusting preventer treatment for children aged 6 years and over

Please view and print this figure separately: https://www.asthmahandbook.org.au/table/show/26

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† 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

Asset ID: 21

How this recommendation was developed

Adapted from existing guidance
Based on reliable clinical practice guideline(s) or position statement(s):

- van Asperen et al. 2010
- National Asthma Council Australia, 2010

If symptoms are not controlled by an initial low dose of inhaled corticosteroids, do not increase the dose or change the regimen until you have (all of):

- checked adherence to the inhaled corticosteroid
• checked the child’s inhaler technique
• reviewed the diagnosis (consider whether symptoms may be due to a comorbidity or alternative diagnosis such as rhinosinusitis, de-conditioning, obesity or upper airway dysfunction).

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Source

Asset ID: 21

How this recommendation was developed
Adapted from existing guidance
Based on reliable clinical practice guideline(s) or position statement(s):
• van Asperen et al. 2010

If asthma is not well controlled by regular low-dose inhaled corticosteroid treatment (and adherence is good, inhaler technique is correct and diagnosis has been confirmed), consider one of the following options:

• Increase the inhaled corticosteroid dose.
• Continue low-dose inhaled corticosteroid and add montelukast.
• Switch to an inhaled corticosteroid/long-acting beta₂ agonist combination at low dose.
• Advise parents about potential adverse psychiatric effects of montelukast

Note: TGA-registered indications for inhaled corticosteroid/long-acting beta₂ agonist combinations differ between products.

How this recommendation was developed
Adapted from existing guidance
Based on reliable clinical practice guideline(s) or position statement(s):
• van Asperen et al. 2010

In children taking regular inhaled corticosteroid treatment, the dose of inhaled corticosteroid should be adjusted to the lowest dose needed to maintain control.

How this recommendation was developed
More information

**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 and the degree to which asthma symptoms affect daily activities such as interference with physical activity or missed school days), the frequency of flare-ups, and spirometry in children who are able to perform the test reliably.

Parents commonly underestimate the severity of their child’s asthma and overestimate asthma control.

**Standardised questionnaires**

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

- **Asthma Control Questionnaire (ACQ)** for children aged 6 years and over (must be administered by a trained interviewer in children aged 6–10 years) – asks questions about symptoms, effect of asthma on activity and use of relievers during the previous week. A lower score indicates better asthma control.

- **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. 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 (about the child’s symptoms over the previous 4 weeks) and four for the child. A lower score indicates worse asthma control. Note: C-ACT is intended for US use.

**Measures of airway inflammation**

Measures of airway inflammation (e.g. sputum test, exhaled nitric oxide) are not used in clinical practice to guide treatment decisions. Tailoring the dose of inhaled corticosteroids based on exhaled nitric oxide appears to achieve only a small benefit in children, and may lead to higher doses.

**Eliminating 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:

- poor adherence (which may be due to misunderstanding of the purpose and effects of asthma medicines or inability to follow a written asthma action plan that is unclear)
- poor inhaler technique
- mishandling devices (e.g. failure to clean spacer, allowing mouthpiece of dry-powder inhalers to become blocked)
- incorrect dose or frequency
- expired medicines
- continued exposure to smoke or allergen triggers.

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

**Correct use of inhaler devices**

The majority of patients do not use inhaler devices correctly. Australian research studies have reported that only approximately 10% of patients use correct technique.

High rates of incorrect inhaler use among children with asthma and adults with asthma or COPD have been reported, even among regular users. Regardless of the type of inhaler device prescribed, patients are unlikely to use...
inhalers correctly unless they receive clear instruction, including a physical demonstration, and have their inhaler technique checked regularly.\textsuperscript{19}

Poor inhaler technique has been associated with worse outcomes in asthma and COPD. It can lead to poor asthma symptom control and overuse of relievers and preventers.\textsuperscript{13, 20, 21, 22} In patients with asthma or COPD, incorrect technique is associated with a 50\% increased risk of hospitalisation, increased emergency department visits and increased use of oral corticosteroids due to flare-ups.\textsuperscript{18}

Correcting patients’ inhaler technique has been shown to improve asthma control, asthma-related quality of life and lung function.\textsuperscript{23, 24}

**Common errors and problems with inhaler technique**

Common errors with manually actuated pressurised metered dose inhalers include:\textsuperscript{19}

- failing to shake the inhaler before actuating
- holding the inhaler in wrong position
- failing to exhale fully before actuating the inhaler
- actuating the inhaler too early or during exhalation (the medicine may be seen escaping from the top of the inhaler)
- actuating the inhaler too late while inhaling
- actuating more than once while inhaling
- inhaling too rapidly (this can be especially difficult for children to overcome)
- multiple actuations without shaking between doses.

Common errors for dry powder inhalers include:\textsuperscript{19}

- not keeping the device in the correct position while loading the dose (horizontal for Accuhaler and vertical for Turbuhaler)
- failing to exhale fully before inhaling
- failing to inhale completely
- inhaling too slowly and weakly
- exhaling into the device mouthpiece before or after inhaling
- failing to close the inhaler after use
- using past the expiry date or when empty.

Other common problems include:

- difficulty manipulating device due to problems with dexterity (e.g. osteoarthritis, stroke, muscle weakness)
- inability to seal the lips firmly around the mouthpiece of an inhaler or spacer
- inability to generate adequate inspiratory flow for the inhaler type
- failure to use a spacer when appropriate
- use of incorrect size mask
- inappropriate use of a mask with a spacer in older children.

**How to improve patients’ inhaler technique**

Patients’ inhaler technique can be improved by brief education, including a physical demonstration, from a health professional or other person trained in correct technique.\textsuperscript{19} The best way to train patients to use their inhalers correctly is one-to-one training by a healthcare professional (e.g. nurse, pharmacist, GP, specialist), that involves both verbal instruction and physical demonstration.\textsuperscript{25, 13, 26, 27} Patients do not learn to use their inhalers properly just by reading the manufacturer’s leaflet.\textsuperscript{26} An effective method is to assess the individual’s technique by comparing with a checklist specific to the type of inhaler, and then, after training in correct technique, to provide written instructions about errors (e.g. a sticker attached to the device).\textsuperscript{11, 24}

The National Asthma Council information paper on inhaler technique includes checklists for correct technique with all common inhaler types used in asthma or COPD.

Inhaler technique must be rechecked and training must be repeated regularly to help children and adults maintain correct technique.\textsuperscript{23, 13, 14}

Go to: National Asthma Council Australia’s [Using your inhaler](https://www.nationalasthma.org.au/healthcare-professionals/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](https://www.nationalasthma.org.au/healthcare-professionals/inhaler-technique-for-people-with-asthma-or-copd)

Go to: [NPS MedicineWise information on Inhaler devices for respiratory medicines](https://www.medicineswise.org.au/healthcare-professionals/inhaler-devices-for-respiratory-medicines)
**Step-up options in children with asthma that is not controlled by low-dose inhaled corticosteroids**

In children whose asthma is inadequately controlled by low-dose inhaled corticosteroids alone (and adherence is good, inhaler technique is correct and diagnosis has been confirmed), treatment options include:

- increasing the inhaled corticosteroid dose
- adding montelukast
- switching to inhaled corticosteroid/long-acting beta₂ agonist combination.

Table. Step-up options for children when good asthma control is not achieved with low-dose ICS

<table>
<thead>
<tr>
<th>Option</th>
<th>TGA-registered indications for add-on therapy</th>
<th>PBS considerations</th>
</tr>
</thead>
<tbody>
<tr>
<td>High-dose ICS</td>
<td>N/A</td>
<td>Subsidised</td>
</tr>
<tr>
<td>ICS plus montelukast</td>
<td>2 years and over</td>
<td>2–5 years: not subsidised*</td>
</tr>
<tr>
<td></td>
<td></td>
<td>6–14 years: not subsidised unless for exercise-induced bronchoconstriction despite ICS treatment†</td>
</tr>
<tr>
<td></td>
<td></td>
<td>15 years and over: not subsidised‡</td>
</tr>
<tr>
<td>ICS/long-acting beta₂ agonist combination</td>
<td>4 years and over for fluticasone propionate/ salmeterol xinafoate</td>
<td>Subsidised</td>
</tr>
<tr>
<td></td>
<td>12 years and over for budesonide/formoterol fumarate dihydrate</td>
<td></td>
</tr>
</tbody>
</table>

- Advise parents about potential adverse psychiatric effects of montelukast

* Montelukast is not subsidised for use in combination with other preventers or for children who require inhaled corticosteroids.

† Montelukast is subsidised for prevention of exercise-induced asthma if asthma is otherwise well controlled while taking optimal-dose inhaled corticosteroids – it is not otherwise subsidised in combination with inhaled corticosteroids (or inhaled corticosteroid/long-acting beta₂ agonist combinations).

‡ Montelukast is not subsidised for people aged over 15 years.

Asset ID: 27

In the majority of children with persistent asthma that requires preventive treatment, control can be achieved with one of these options.¹

**Increasing inhaled corticosteroid dose versus adding a long-acting beta₂ agonist**

In children with persistent asthma taking regular inhaled corticosteroid, the addition of long-acting beta₂ agonists improves lung function and reduces reliever use, compared with placebo or increasing the dose of inhaled corticosteroid, but does not appear to reduce the rate of asthma flare-ups requiring treatment with oral corticosteroids.²⁸,²⁹,³⁰

Overall, evidence from randomised clinical trials suggests that, for children and adolescents (aged 4–18 years) with persistent asthma that is inadequately controlled despite treatment with regular inhaled corticosteroids, increasing the dose of inhaled corticosteroid is equally effective as maintaining the inhaled corticosteroid dose but adding a long-acting beta₂ agonist (i.e. switching to long-acting beta₂ agonist/inhaled corticosteroid combination therapy) in in reducing the rate of asthma flare-ups that require treatment with systematic corticosteroids.³⁰

Children appear to benefit less from combination inhaled corticosteroid/long-acting beta₂ agonist treatment than adolescents. In adolescents with persistent asthma that is not controlled by a low dose of inhaled corticosteroids, the
Combination of a long-acting beta\textsubscript{2} agonist and an inhaled corticosteroid is modestly more effective in reducing the risk of flare-ups requiring oral corticosteroids than a higher dose of inhaled corticosteroids.\textsuperscript{31}

**Adding montelukast versus adding a long-acting beta\textsubscript{2} agonist**

There is insufficient evidence from randomised clinical trials to determine, overall, whether adding a long-acting beta\textsubscript{2} agonist or adding montelukast is more effective overall in children whose asthma is not controlled by regular inhaled corticosteroids.\textsuperscript{32}

Clinical response to long-acting beta\textsubscript{2} agonists partly depends on genetics. A beta\textsubscript{2} receptor genotype (Arg16 polymorphism in the beta\textsubscript{2} receptor gene) pre-disposes children with asthma to down-regulation of the beta\textsubscript{2} receptor and increased susceptibility to flare-ups during regular treatment with regular long-acting beta\textsubscript{2} agonists.\textsuperscript{33} However, routine genetic testing to tailor asthma therapy is not yet available in clinical practice.

Among children 6 years and over with asthma that is not controlled by low-dose inhaled corticosteroids, the optimal regimen varies between individuals.\textsuperscript{34} Responses vary between individuals: best response is achieved in some children by adding a long-acting beta\textsubscript{2} agonist, others by adding montelukast, and others by increasing the dose of inhaled corticosteroid or adding montelukast.\textsuperscript{34}

For children aged 6–14 years with persistent asthma and exercise-induced bronchoconstriction, adding montelukast is more effective in protecting against exercise-induced bronchoconstriction than switching to a combination of inhaled corticosteroid and a long-acting beta\textsubscript{2} agonist.\textsuperscript{35} The use of montelukast also avoids beta-receptor tolerance associated with long-acting beta\textsubscript{2} agonists, so a short-acting beta\textsubscript{2} agonist taken after exercise produces a greater bronchodilator response than it does in children taking regular long-acting beta\textsubscript{2} agonist.\textsuperscript{35}

Overall, adding montelukast is the best option when effects on exercise-induced symptoms and safety are also considered.\textsuperscript{36}

**Montelukast for children**

Montelukast is registered by the TGA for use in children aged 2 years and older.\textsuperscript{37}

Based on data from placebo-controlled trials, it has not been possible to define clinical indicators that predict which children will benefit most from montelukast therapy, compared with other treatment options.\textsuperscript{2, 38}

Comparative studies suggest that the main role for montelukast is as an alternative to low-dose inhaled corticosteroid in children with frequent intermittent asthma or mild persistent asthma.\textsuperscript{2}

**Children 0–5 years**

In preschool children with multiple-trigger wheeze, montelukast protects against airway hyperresponsiveness when taken with or without inhaled corticosteroids.\textsuperscript{39} Inhaled corticosteroids are more effective than montelukast in children with multiple-trigger wheeze aged 2–8 years,\textsuperscript{40} but this comparison has not been made in preschool children as a separate group.\textsuperscript{39}

In children aged 2–5 years with episodic (viral) wheeze, regular montelukast treatment reduces the risk of wheezing episodes.\textsuperscript{41} However, montelukast may not reduce symptoms in children aged 6–24 months with recurrent wheeze.\textsuperscript{42}

**Note:** Montelukast is not TGA-registered for use in children younger than 2 years.

A short course of montelukast, introduced at the first signs of an asthma episode or upper respiratory tract infection, can achieve a small reduction in symptoms, school absence and medical consultations in preschool and school-aged children with episodic wheeze.\textsuperscript{43} However, montelukast is not TGA-registered for intermittent use.

**Children 6 years and over**

In school-aged children with persistent asthma, inhaled corticosteroids are more effective than montelukast for a range of measures, including lung function.\textsuperscript{2}

In school-aged children with persistent exercise-induced symptoms despite taking regular inhaled corticosteroids, montelukast is effective in controlling symptoms and is more effective than long-acting beta\textsubscript{2} agonists.\textsuperscript{1, 35}

In children who are already taking regular inhaled corticosteroids and have a beta\textsubscript{2} receptor genotype associated with increased susceptibility to flare-ups during regular long-acting beta\textsubscript{2} agonist therapy,\textsuperscript{33} montelukast may be more effective than salmeterol in reducing symptoms, reliever use and days absent from school due to asthma, based on the findings of a small randomised controlled clinical trial.\textsuperscript{33}
Montelukast for children: warning parents about potential psychiatric adverse effects

Montelukast is generally very well tolerated. However, post-marketing surveillance reports suggested a slight increase in the rate of psychiatric disorders that was possibly associated with use of leukotriene receptor antagonists in children; this association may have been confounded by asthma severity and concomitant medication. Montelukast use has also been associated with suicidal ideation, but a recent nested case-control study concluded that children with asthma aged 5–18 years taking leukotriene receptor antagonists were not at increased risk of suicide attempts. Behavioural and psychiatric adverse effects were rare in clinical trials.

The Thoracic Society of Australia and New Zealand advises that it is prudent to mention to parents the potential association of montelukast with behaviour-related adverse events when commencing treatment, and to cease therapy if such adverse events are suspected.

Cromones for children

0-5 years

Few clinical trials have assessed the use of inhaled sodium cromoglycate in preschool children and none have assessed nedocromil. Overall, sodium cromoglycate has not been shown to be effective in preschool children with multiple-trigger wheeze. However, cromones are well tolerated and registered for use in infants. Therefore, a treatment trial can be considered before considering other preventers, particularly for children less than 2 years old.

6 years and over

Cromones are rarely prescribed in school-aged children. Inhaled sodium cromoglycate might be effective in school-aged children, but interpretations of available evidence are inconsistent. Sodium cromoglycate is less effective than inhaled corticosteroid in achieving asthma control and improving lung function in children with persistent asthma. Nedocromil sodium appears to be have some benefit in children with persistent asthma, but its relative effectiveness compared with inhaled corticosteroids is not clear. Long-term (4–6 years) treatment with budesonide achieved better asthma control than long-term nedocromil in children with mild-to-moderate asthma aged 5–12 in a randomised placebo-controlled clinical trial.

Practical issues

Cromones (sodium cromoglycate and nedocromil) may not be practical for some patients, because they require three–four times daily dosing until control is gained, and inhaler devices for cromones tend to block easily. Nedocromil can cause an unusual or unpleasant taste and is not tolerated by some children.

Inhaled corticosteroids for children: overview

The effectiveness of ICS in children appears to depend on several factors including the child's age, which triggers are causing symptoms, wheezing phenotype, tobacco smoke exposure and genotype. Overall, inhaled corticosteroids seem to be more effective in older children and those with more severe disease. Early introduction of inhaled corticosteroid for children with recurrent wheeze does not prevent airway remodelling, improve long-term lung function or prevent the onset of persistent asthma, according to current evidence from long-term randomised controlled clinical trials in preschool children and school-aged children with intermittent or mild persistent asthma.

Inhaled corticosteroids for children: 6 years and over

Most clinical trials of regular inhaled corticosteroid treatment in children have been conducted among children with persistent asthma. Beclometasone dipropionate, budesonide, ciclesonide and fluticasone propionate have all been shown to be effective in children. However, there have been relatively fewer studies of ciclesonide (a newer inhaled...
corticosteroid)\textsuperscript{1} but, overall, randomised clinical trials show that it is equally effective as budesonide or fluticasone propionate in improving asthma symptoms and reducing flare-ups.\textsuperscript{54}

In school-aged children with mild persistent asthma, regular low-dose daily inhaled corticosteroid treatment reduces the rate of flare-ups that require treatment with oral corticosteroids, compared with no regular treatment and as-needed short-acting beta\textsubscript{2} agonist for wheezing episodes.\textsuperscript{55}

The Thoracic Society of Australia and New Zealand’s current position statement on the use of inhaled corticosteroids in children recommends regular treatment with inhaled corticosteroid for school-aged children with moderate-to-severe persistent asthma, or those with frequent intermittent asthma or mild persistent asthma if symptoms are not controlled by a 2- to 4-week treatment trial with a cromone (nedocromil or sodium cromoglycate) or montelukast.\textsuperscript{1}

**Inhaled corticosteroids for children: doses**

In the majority of children, asthma control can be achieved with any of the following initial doses:\textsuperscript{1}

- budesonide 400 mcg/day
- beclometasone (Qvar) 200 mcg/day
- ciclesonide 160 mcg/day
- fluticasone propionate 200 mcg/day.

If these doses do not achieve control of symptoms, possible explanations include alternative diagnoses, adherence, incorrect inhaler technique, psychosocial factors and exposure to tobacco smoke or other triggers such as allergens.\textsuperscript{1}

Dose–response studies of inhaled corticosteroids show that the maximal efficacy is generally achieved at a dose equivalent to approximately 200 mcg/day fluticasone propionate,\textsuperscript{1} while the risk of adrenal suppression increases exponentially at doses above 500 mcg/day.\textsuperscript{1} Therefore (based on theoretical equivalents between different agents), upper limits of daily doses for children are:

- budesonide 800 mcg/day
- beclometasone dipropionate [Qvar] 400 mcg/day
- ciclesonide 320 mcg/day
- fluticasone propionate 500 mcg/day.

Higher doses are unlikely to be more effective, and are likely to cause systemic effects.\textsuperscript{1}

Most studies of inhaled corticosteroids in children have used twice-daily dosing.\textsuperscript{1} Ciclesonide is effective when given once daily.\textsuperscript{1} The dose of inhaled corticosteroid delivered to the lungs will depend on many factors, including the delivery device, the age of the child, individual variation in inhaler technique, and adherence.\textsuperscript{1}

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

**Table. Definitions of ICS dose levels in children**

<table>
<thead>
<tr>
<th>Inhaled corticosteroid</th>
<th>Daily dose (mcg)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Low</td>
</tr>
<tr>
<td><strong>Beclometasone dipropionate †</strong></td>
<td>100–200</td>
</tr>
<tr>
<td><strong>Budesonide</strong></td>
<td>200–400</td>
</tr>
<tr>
<td><strong>Ciclesonide ‡</strong></td>
<td>80–160</td>
</tr>
<tr>
<td><strong>Fluticasone propionate</strong></td>
<td>100–200</td>
</tr>
</tbody>
</table>

† 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**

**Inhaled corticosteroids for children: adverse effects**

**Topical**

Hoarseness and pharyngeal candidiasis are not commonly reported among preschool children when using a metered-dose inhaler with spacer, or among school-aged children. \(^1\)

Inhaled corticosteroids, particular dry-powder formulas with pH < 5.5, may dissolve tooth enamel in children. \(^1\)

Topical effects can be reduced by use of spacer devices (which reduce oropharyngeal deposition), and by mouth-rinsing and spitting after use. \(^1\) Immediate quick mouth-rinsing removes more residual medicine in the mouth than delayed rinsing. \(^5^6\)

**Systemic**

Systemic effects of inhaled corticosteroids in children depend on the dose, but clinically significant adverse effects are uncommon. \(^1\) The use of spacers and mouth rinsing will not reduce systemic effects, but may increase efficacy so that a lower dose is required.

Short-term suppression of linear growth has been demonstrated in children, but only minimal long-term effects on growth or bone density have been reported. \(^1\) Some children may experience delay in the normal pubertal growth spurt due to asthma itself. \(^1\) Treatment beginning before puberty is associated with a small (mean approximately 1 cm) reduction in adult height. \(^5^7\)

A research study using biochemical testing in a research setting showed that hypothalamic–pituitary–adrenal axis suppression may occur in up to two-thirds of children treated with inhaled corticosteroids, and may occur at even low doses. \(^5^8\) However, clinically cases are rare.

Cases of symptomatic, clinically significant adrenal insufficiency in children due to inhaled corticosteroid treatment have been reported, including cases in Australia. \(^6^1\) Most cases have involved children given more than 500 mcg per day fluticasone propionate. \(^5^9\)

The risk of hypothalamic–pituitary–adrenal axis suppression is higher among children receiving concomitant intranasal steroids and those with lower body mass index. \(^5^8\) Risk is lower in obese children. \(^5^8\)

There are no nationally accepted protocols for routine assessment of adrenal function because it has not yet been possible to identify precisely which children should be tested, to interpret test results reliably, to identify the appropriate interval for retesting, and because a clinical benefit has not been clearly demonstrated.

Go to: The Thoracic Society of Australia and New Zealand’s Position Statement: The role of corticosteroids in the management of childhood asthma

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**Table. Definitions of ICS dose levels in children**

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<td><strong>Fluticasone propionate</strong></td>
<td>100–200</td>
</tr>
</tbody>
</table>

† Dose equivalents for Qvar (TGA-registered CFC-free formulation of beclometasone dipropionate)
Inhaled corticosteroid/long-acting beta-2 agonist combinations for children: 6 years and over

Available combinations
Three combinations of inhaled corticosteroid and long-acting beta-2 agonist in a single inhaler are currently available:

- The combination of fluticasone propionate and salmeterol xinafoate in a single inhaler is registered for use in children aged 4 years and over. 62
- The combination of budesonide and formoterol in a single inhaler is registered for use in children aged 12 years and older. 63
- The combination of fluticasone propionate and formoterol in a single inhaler is TGA-registered for use in children aged 12 years and older. 64

Role of combination therapy in children
Evidence from clinical trials does not support the use of combination therapy with a long-acting beta-2 agonist plus an inhaled corticosteroid as initial preventer treatment in children who are not already taking inhaled corticosteroids. 65,31
Combination therapy is a step-up option for some children whose asthma is not well controlled by low-dose inhaled corticosteroids alone.

Beta2 receptor regulation
Clinical response to long-acting beta2 agonists partly depends on genetics. A beta2 receptor genotype (Arg16 polymorphism in the beta2 receptor gene) pre-disposes children with asthma to down-regulation of the beta2 receptor and increased susceptibility to flare-ups during regular treatment with long-acting beta2 agonists. 33 However, routine genetic testing to tailor asthma therapy is not yet available in clinical practice.
Systematic reviews and meta-analyses have led to concern about the possibility that the use of long-acting beta-agonists (even in combination with inhaled corticosteroids) might even increase the risk of flare-ups that require treatment with oral steroids or hospital admission, or of severe flare-ups. 5,36,66 A meta-analysis by the US Food and Drug Administration found that the use of long-acting beta2 agonists was associated with increased risk of severe asthma-associated adverse events (both overall and among the subset of people using concomitant inhaled corticosteroid and long-acting beta2 agonist), and that this risk was greatest in children aged 4–11 years. 66

Managing cough in children
When cough is the predominant symptom in a young child, careful assessment is needed to avoid making an incorrect diagnosis of asthma, or instigating inappropriate treatment. 67 Cough alone (recurrent non-specific cough) is most likely due to recurrent viral bronchitis, which is unresponsive to both bronchodilators and preventive therapy including inhaled corticosteroids. Recurrent non-specific cough usually resolves by age 6 or 7 years and leaves no residual pulmonary pathology.
If cough is a problem for a child with known asthma, it should be managed according to national Cough in Children and Adults: Diagnosis and Assessment (CICADA) guidelines. 67

- There are significant concerns about use of cough medicines in children.

Go to: Australian Cough Guidelines
Go to: Therapeutic Goods Administration (TGA) recommendations on the use of cough and cold medicines in children

References

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

Source
Asset ID: 21

References

Go to: Australian Cough Guidelines
Go to: Therapeutic Goods Administration (TGA) recommendations on the use of cough and cold medicines in children

78


### Table. Reviewing and adjusting preventer treatment for children aged 6 years and over

<table>
<thead>
<tr>
<th>Initial treatment</th>
<th>When to schedule review</th>
<th>Management options and notes</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Treatment response (symptoms well controlled)</td>
</tr>
<tr>
<td><strong>Montelukast or cromones</strong></td>
<td>2–4 weeks</td>
<td>Continue treatment</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Stop treatment and start treatment with an inhaled corticosteroid, starting with a low dose</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Set review date (e.g. 3 months)</td>
</tr>
<tr>
<td><strong>Inhaled corticosteroid (low dose)</strong></td>
<td>4 weeks</td>
<td>Continue regular treatment at low dose</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Consider one of the following options:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Add montelukast in addition to inhaled corticosteroid (children 6–14 years)‡</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Increase the dose of inhaled corticosteroid; reassess in 2–4 weeks</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Switch to combination long-acting beta₂ agonist/inhaled corticosteroid</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Set review date (e.g. 3 months)</td>
</tr>
</tbody>
</table>

- Advise parents about potential adverse psychiatric effects of montelukast
- † Symptom control not achieved with initial treatment after verifying treatment was taken as intended
- ‡ Before considering a change in the treatment regimen:
  - review the diagnosis, adherence and inhaler technique
  - consider referral to a specialist (e.g. paediatric respiratory physician or paediatrician, if available) for assessment.

§ PBS status as at October 2016: Montelukast treatment is not subsidised by the PBS for people aged 15 years or over.

Asset ID: 26
Conducting further review after adjustment of initial treatment in children 6 years and over

Recommendations

If symptoms have been controlled for at least 3 months in a child taking regular inhaled corticosteroid treatment, reduce the dose and review within 4 weeks.

*Figure. Stepped approach to adjusting asthma medication in children*

Please view and print this figure separately: https://www.asthmahandbook.org.au/figure/show/18

How this recommendation was developed

Adapted from existing guidance

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

- van Asperen et al. 2010

If symptoms have been controlled for at least 3 months in a child taking regular low-dose inhaled corticosteroid/long-acting beta2 agonist combination, consider replacing with (one of):

- low-dose inhaled corticosteroid and concomitant montelukast
- low-dose inhaled corticosteroid
- montelukast
- a cromone.
- Advise parents about potential adverse psychiatric effects of montelukast

*Figure. Stepped approach to adjusting asthma medication in children*

Please view and print this figure separately: https://www.asthmahandbook.org.au/figure/show/18

How this recommendation was developed

Adapted from existing guidance

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

- van Asperen et al. 2010
- National Asthma Council Australia, 2010

If symptoms are well controlled for at least 3 months on the lowest available inhaled corticosteroid dose, consider the following options:

- Stop preventer treatment completely, while monitoring the response, to judge whether symptoms have resolved.
- Replace inhaled corticosteroid with a trial of montelukast or a cromone. If well controlled for a further 3 months, stop preventer treatment and monitor the response.
- Advise parents about potential adverse psychiatric effects of montelukast

How this recommendation was developed
In children with persistent exercise-induced respiratory symptoms despite regular treatment with inhaled corticosteroids, consider adding montelukast (children 6–14 years).

- Advise parents about potential adverse psychiatric effects of montelukast

*How this recommendation was developed*

**Consensus**

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

- van Asperen *et al.* 2010
- National Asthma Council Australia, 2010

If asthma seems to be severe or is difficult to control, review the diagnosis, check the child’s technique when using inhaler devices, check that the dose and regimen is correct, and whether the child is exposed to environmental triggers.

*How this recommendation was developed*

**Consensus**

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

- Bush and Saglani, 2010
- Bush *et al.* 2011

If asthma control is still not achieved after eliminating common reasons for treatment failure, consider referral to a paediatric respiratory physician or paediatrician.

*How this recommendation was developed*

**Consensus**

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

- Chung *et al.* 2014

Regular treatment with a theophylline (aminophylline or theophylline) is not recommended routinely for children, but might be considered by a specialist respiratory physician for children with difficult-to-treat asthma.

*How this recommendation was developed*

**Consensus**

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

Omalizumab treatment may be considered for adolescents 12 years and over with moderate-to-severe allergic asthma despite inhaled corticosteroid treatment, and raised IgE levels.
Note: For adolescents with severe allergic asthma who may be eligible for PBS subsidy, whose asthma is not well-controlled despite optimal inhaled therapy, refer immediately for specialist assessment, because patients only become eligible for PBS subsidisation for omalizumab after at least 12 months' care by a specialist experienced in the management of severe asthma. After treatment is established, ongoing treatment with omalizumab may be administered by a GP, with 6-monthly review of ongoing eligibility at the specialist clinic.

**How this recommendation was developed**

Adapted from existing guidance

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

- Katelaris et al. 2009
- Chung et al. 2014

Omalizumab treatment can be considered for children aged 6 to 11 years with severe allergic asthma (documented exacerbations despite daily high-dose inhaled corticosteroids) and raised IgE levels.

Note: PBS status as at October 2016: For children aged 6 to 11 years, omalizumab treatment is not subsidised by the PBS.

**How this recommendation was developed**

Adapted from existing guidance

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

- Chung et al. 2014
- Katelaris et al. 2009

**More information**

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**Eliminating 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:4

- poor adherence (which may be due to misunderstanding of the purpose and effects of asthma medicines or inability to follow a written asthma action plan that is unclear)
- poor inhaler technique
- mishandling devices (e.g. failure to clean spacer, allowing mouthpiece of dry-powder inhalers to become blocked)
- incorrect dose or frequency
- 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: Troubleshooting

**Correct use of inhaler devices**

The majority of patients do not use inhaler devices correctly. Australian research studies have reported that only approximately 10% of patients use correct technique.6, 9

High rates of incorrect inhaler use among children with asthma and adults with asthma or COPD have been reported,10, 11, 12, 13, 14 even among regular users.15 Regardless of the type of inhaler device prescribed, patients are unlikely to use inhalers correctly unless they receive clear instruction, including a physical demonstration, and have their inhaler technique checked regularly.16

Poor inhaler technique has been associated with worse outcomes in asthma and COPD. It can lead to poor asthma symptom control and overuse of relievers and preventers.10, 17, 18, 19 In patients with asthma or COPD, incorrect technique is associated with a 50% increased risk of hospitalisation, increased emergency department visits and increased use of oral corticosteroids due to flare-ups.15
Correcting patients' inhaler technique has been shown to improve asthma control, asthma-related quality of life and lung function.\textsuperscript{20, 21}

**Common errors and problems with inhaler technique**

Common errors with manually actuated pressurised metered dose inhalers include:\textsuperscript{16}

- failing to shake the inhaler before actuating
- holding the inhaler in wrong position
- failing to exhale fully before actuating the inhaler
- actuating the inhaler too early or during exhalation (the medicine may be seen escaping from the top of the inhaler)
- actuating the inhaler too late while inhaling
- actuating more than once while inhaling
- inhaling too rapidly (this can be especially difficult for children to overcome)
- multiple actuations without shaking between doses.

Common errors for dry powder inhalers include:\textsuperscript{16}

- not keeping the device in the correct position while loading the dose (horizontal for Accuhaler and vertical for Turbuhaler)
- failing to exhale fully before inhaling
- failing to inhale completely
- inhaling too slowly and weakly
- exhaling into the device mouthpiece before or after inhaling
- failing to close the inhaler after use
- using past the expiry date or when empty.

Other common problems include:

- difficulty manipulating device due to problems with dexterity (e.g. osteoarthritis, stroke, muscle weakness)
- inability to seal the lips firmly around the mouthpiece of an inhaler or spacer
- inability to generate adequate inspiratory flow for the inhaler type
- failure to use a spacer when appropriate
- use of incorrect size mask
- inappropriate use of a mask with a spacer in older children.

**How to improve patients' inhaler technique**

Patients' inhaler technique can be improved by brief education, including a physical demonstration, from a health professional or other person trained in correct technique.\textsuperscript{16} The best way to train patients to use their inhalers correctly is one-to-one training by a healthcare professional (e.g. nurse, pharmacist, GP, specialist), that involves both verbal instruction and physical demonstration.\textsuperscript{22, 10, 23, 24} Patients do not learn to use their inhalers properly just by reading the manufacturer's leaflet.\textsuperscript{23} An effective method is to assess the individual's technique by comparing with a checklist specific to the type of inhaler, and then, after training in correct technique, to provide written instructions about errors (e.g. a sticker attached to the device).\textsuperscript{8, 21}

The National Asthma Council information paper on inhaler technique includes checklists for correct technique with all common inhaler types used in asthma or COPD.

Inhaler technique must be rechecked and training must be repeated regularly to help children and adults maintain correct technique.\textsuperscript{20, 10, 11}

▶ Go to: National Asthma Council Australia’s [Using your inhaler](https://www.nationalasthma.org.au/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](https://www.nationalasthma.org.au/inhaler-technique)

▶ Go to: NPS MedicineWise information on [Inhaler devices for respiratory medicines](https://www.nps.org.au/)

**Step-up options in children with asthma that is not controlled by low-dose inhaled corticosteroids**

In children whose asthma is inadequately controlled by low-dose inhaled corticosteroids alone (and adherence is good, inhaler technique is correct and diagnosis has been confirmed), treatment options include:

- increasing the inhaled corticosteroid dose
- adding montelukast
- switching to inhaled corticosteroid/long-acting beta\textsubscript{2} agonist combination.
In the majority of children with persistent asthma that requires preventive treatment, control can be achieved with one of these options.1

**Increasing inhaled corticosteroid dose versus adding a long-acting beta_2_ agonist**

In children with persistent asthma taking regular inhaled corticosteroid, the addition of long-acting beta_2_ agonists improves lung function and reduces reliever use, compared with placebo or increasing the dose of inhaled corticosteroid, but does not appear to reduce the rate of asthma flare-ups requiring treatment with oral corticosteroids.25,26,27 Overall, evidence from randomised clinical trials suggests that, for children and adolescents (aged 4–18 years) with persistent asthma that is inadequately controlled despite treatment with regular inhaled corticosteroids, increasing the dose of inhaled corticosteroid is equally effective as maintaining the inhaled corticosteroid dose but adding a long-acting beta_2_ agonist (i.e. switching to long-acting beta_2_ agonist/inhaled corticosteroid combination therapy) in in reducing the rate of asthma flare-ups that require treatment with systematic corticosteroids.27

Children appear to benefit less from combination inhaled corticosteroid/long-acting beta_2_ agonist treatment than adolescents. In adolescents with persistent asthma that is not controlled by a low dose of inhaled corticosteroids, the combination of a long-acting beta_2_ agonist and an inhaled corticosteroid is modestly more effective in reducing the risk of flare-ups requiring oral corticosteroids than a higher dose of inhaled corticosteroids.28

**Adding montelukast versus adding a long-acting beta_2_ agonist**

There is insufficient evidence from randomised clinical trials to determine, overall, whether adding a long-acting beta_2_ agonist or adding montelukast is more effective overall in children whose asthma is not controlled by regular inhaled corticosteroids.29

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### Table. Step-up options for children when good asthma control is not achieved with low-dose ICS

<table>
<thead>
<tr>
<th>Option</th>
<th>TGA-registered indications for add-on therapy</th>
<th>PBS considerations</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>High-dose ICS</strong></td>
<td>N/A</td>
<td>Subsidised</td>
</tr>
<tr>
<td><strong>ICS plus montelukast</strong></td>
<td>2 years and over</td>
<td>2–5 years: not subsidised*</td>
</tr>
<tr>
<td></td>
<td></td>
<td>6–14 years: not subsidised unless for exercise-induced bronchoconstriction despite ICS treatment†</td>
</tr>
<tr>
<td></td>
<td></td>
<td>15 years and over: not subsidised‡</td>
</tr>
<tr>
<td><strong>ICS/long-acting beta_2_ agonist combination</strong></td>
<td>4 years and over for fluticasone propionate/ salmeterol xinafoate</td>
<td>Subsidised</td>
</tr>
<tr>
<td></td>
<td>12 years and over for budesonide/formoterol fumarate dihydrate</td>
<td></td>
</tr>
</tbody>
</table>

- Advise parents about potential adverse psychiatric effects of montelukast

* Montelukast is not subsidised for use in combination with other preventers or for children who require inhaled corticosteroids.

† Montelukast is subsidised for prevention of exercise-induced asthma if asthma is otherwise well controlled while taking optimal-dose inhaled corticosteroids – it is not otherwise subsidised in combination with inhaled corticosteroids (or inhaled corticosteroid/long-acting beta_2_ agonist combinations).

‡ Montelukast is not subsidised for people aged over 15 years.

Asset ID: 27
Clinical response to long-acting beta<sub>2</sub> agonists partly depends on genetics. A beta<sub>2</sub> receptor genotype (Arg16 polymorphism in the beta<sub>2</sub> receptor gene) pre-disposes children with asthma to down-regulation of the beta<sub>2</sub> receptor and increased susceptibility to flare-ups during regular treatment with regular long-acting beta<sub>2</sub> agonists. However, routine genetic testing to tailor asthma therapy is not yet available in clinical practice.

Among children 6 years and over with asthma that is not controlled by low-dose inhaled corticosteroids, the optimal regimen varies between individuals. Responses vary between individuals: best response is achieved in some children by adding a long-acting beta<sub>2</sub> agonist, others by adding montelukast, and others by increasing the dose of inhaled corticosteroid or adding montelukast.

For children aged 6–14 years with persistent asthma and exercise-induced bronchoconstriction, adding montelukast is more effective in protecting against exercise-induced bronchoconstriction than switching to a combination of inhaled corticosteroid and a long-acting beta<sub>2</sub> agonist. The use of montelukast also avoids beta-receptor tolerance associated with long-acting beta<sub>2</sub> agonists, so a short-acting beta<sub>2</sub> agonist taken after exercise produces a greater bronchodilator response than it does in children taking regular long-acting beta<sub>2</sub> agonist.

Overall, adding montelukast is the best option when effects on exercise-induced symptoms and safety are also considered.

▶ See: Investigation and management of exercise-induced bronchoconstriction

**Definitions of severe and difficult-to-treat asthma**

Although most people's asthma can be effectively treated with currently available medicines, a substantial subset of people have uncontrolled asthma (as indicated by persisting symptoms, low lung function and/or flare-ups) despite treatment. These patients are described as having difficult-to-treat asthma.

Some patients with difficult-to-treat asthma have severe asthma. Asthma severity is classified retrospectively according to the level of treatment needed to achieve or maintain good asthma control, rather than by the intensity or frequency of symptoms. International guidelines have been published for the assessment and management of patients with severe asthma. Severe asthma (also called severe refractory asthma or severe treatment-resistant asthma) is defined as asthma for which good control is not achieved despite the highest level of recommended treatment, or asthma for which control can be maintained only with the highest level of recommended treatment. It is estimated that 5-10% of patients with asthma have severe asthma.

Not all patients with difficult-to-treat asthma have severe asthma. ‘Difficult-to-treat asthma’ includes asthma that is uncontrolled due to adherence issues, inappropriate or incorrect use of medicines, environmental triggers or comorbidities. Patients whose asthma control improves rapidly with correction of such problems are not considered to have severe asthma.

Treatment-resistant asthma or severe refractory asthma can only be diagnosed after confirming the diagnosis, confirming good adherence to high-dose inhaled corticosteroid and correct inhaler technique, excluding alternative or overlapping diagnoses, identifying and minimising exposure to preventable triggers including allergens, irritants and medicines that cause bronchoconstriction, managing comorbidities, and closely monitoring for at least 6 months.

Omalizumab is a treatment option for some adults, adolescents and children with severe asthma. The definition of severe asthma proposed by the World Health Organization (WHO) Consultation on Severe Asthma for global use is ‘uncontrolled asthma which can result in risk of frequent severe exacerbations (or death) and/or adverse reactions to medications and/or chronic morbidity (including impaired lung function or reduced lung growth in children). The WHO definition of severe asthma includes a category called ‘severe untreated asthma’, a term recommended only for use in countries that lack access to standard asthma medications such as inhaled corticosteroids.

Patients with severe symptoms due to untreated asthma may be found, after starting regular treatment, to have mild asthma (i.e. asthma that is easily controlled with low-dose inhaled corticosteroids).

▶ Go to: European Respiratory Society and American Thoracic Society guidelines on definition, evaluation and treatment of severe asthma

**Omalizumab**

Omalizumab is a treatment option for some adults and children aged 6 years and over with difficult-to-treat asthma. It is approved by the Therapeutic Goods Administration for use in:

![Image](investigation-and-management-of-exercise-induced-bronchoconstriction)
• adults and adolescents aged 12 years and over with moderate-to-severe allergic asthma that is not controlled while taking inhaled corticosteroid and who have raised IgE levels.
• children aged 6 to 11 years with severe allergic asthma who have documented exacerbations despite daily high-dose inhaled corticosteroids and who have raised IgE levels.

When given in addition to inhaled corticosteroids, omalizumab is effective in helping control asthma in patients with severe asthma, particularly those with asthma that is not controlled despite regular treatment with inhaled corticosteroid at medium-to-high dose plus long-acting beta₂ agonist, with or without other add-on treatments. Clinical trials have shown that omalizumab reduces the rate of asthma flare-ups, enables a reduction in inhaled corticosteroid dose, improves symptoms, reduces short-acting beta₂ agonist reliever requirement, improves quality of life and achieves a small increase in FEV₁.

Omalizumab treatment is generally well tolerated, but is associated with injection site reactions. It has been associated with anaphylactoid reactions, which can occur more than 2 hours after injection, so patients must carry adrenalin for self-administration (e.g. EpiPen) at all times. Early reports suggested that omalizumab may be associated with an increased risk of malignancy. However, subsequent pooled results indicate that a causal relationship between omalizumab therapy and malignancy is unlikely.

Note: Omalizumab treatment in adults and adolescents is subsidised through the PBS for use in patients with severe allergic asthma who meet certain criteria, including monitoring for at least 12 months by a specialist (respiratory physician, clinical immunologist, allergist or general physician) experienced in the management of patients with severe asthma. PBS criteria for continuation of treatment include demonstration of a therapeutic response by recording asthma symptom control, at baseline and after 6 months of treatment, using the 5-item Asthma Control Questionnaire (ACQ-5).

As at October 2016, omalizumab treatment is not subsidised by the PBS for children aged 6 to 11 years.

Montelukast for children: warning parents about potential psychiatric adverse effects

Montelukast is generally very well tolerated. However, post-marketing surveillance reports suggested a slight increase in the rate of psychiatric disorders that was possibly associated with use of leukotriene receptor antagonists in children; this association may have been confounded by asthma severity and concomitant medication. Montelukast use has also been associated with suicidal ideation, but a recent nested case-control study concluded that children with asthma aged 5–18 years taking leukotriene receptor antagonists were not at increased risk of suicide attempts. Behavioural and psychiatric adverse effects were rare in clinical trials.

The Thoracic Society of Australia and New Zealand advises that it is prudent to mention to parents the potential association of montelukast with behaviour-related adverse events when commencing treatment, and to cease therapy if such adverse events are suspected.

References


Managing flare-ups in children 6 years and over

Recommendations

Ensure all children with asthma have a rapid-acting inhaled bronchodilator (reliever) inhaler with them at all times.
Educate parents how and when to give reliever.

- Do not prescribe oral salbutamol. Inhalation is the recommended route for delivering relievers for all children and adults.

Table. Non-emergency use of bronchodilators (relievers) in children aged 6–12 years

<table>
<thead>
<tr>
<th>Option</th>
<th>Notes</th>
<th>Dose and delivery</th>
</tr>
</thead>
<tbody>
<tr>
<td>Salbutamol</td>
<td>Suitable for children any age†</td>
<td>2–4 puffs (100 mcg per puff) via pressurised metered-dose inhaler and spacer</td>
</tr>
<tr>
<td></td>
<td>A spacer should be used during acute flare-ups (exacerbations)</td>
<td></td>
</tr>
<tr>
<td>Terbutaline</td>
<td>Generally suitable for children 6 years and older†</td>
<td>1–2 inhalations (500 mcg/inhalation) via breath-actuated powder inhaler</td>
</tr>
</tbody>
</table>

Note: This table lists usual doses to be administered by carers in the community to manage symptoms as needed. Doses are higher during acute asthma, including emergencies.

† If able to use this type of inhaler correctly

- Do not prescribe oral salbutamol.

Asset ID: 28

How this recommendation was developed

Consensus

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

Consider prescribing a short course of prednisolone for children with acute asthma if a β₂ agonist reliever (either of):

- does not relieve symptoms for at least 4 hours
- is needed approximately every 4 hours over a period of 24 hours.

Recommended dose: a single starting dose of 2 mg/kg (maximum 50 mg) orally, then 1 mg/kg once daily for 3 days.

How this recommendation was developed

Adapted from existing guidance

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

- van Asperen et al. 2010 ¹
If a child requires more than 4 courses of oral corticosteroids within a 12-month period, reassess the treatment regimen and consider specialist referral.

*How this recommendation was developed*

**Consensus**

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

- van Asperen et al. 2010

Do not prescribe long-term oral corticosteroids without specialist assessment by a paediatric respiratory physician.

*How this recommendation was developed*

**Adapted from existing guidance**

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

- van Asperen et al. 2010

For all children using a regular preventer (montelukast, inhaled corticosteroid, or combination of inhaled corticosteroid plus long-acting beta$_2$ agonist) explain to children and parents that the child should keep taking it during asthma flare-ups, including acute asthma episodes that require treatment in an emergency department.

*How this recommendation was developed*

**Consensus**

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

Do not routinely prescribe antibiotics for children with upper respiratory tract infections who experience acute wheeze or asthma associated with infections, if antibiotics would not otherwise be indicated.

*How this recommendation was developed*

**Selected evidence**

Based on a limited structured literature review or published systematic review, which identified the following relevant evidence:

- Graham et al. 2001
- Fonseca-Aten et al. 2006
- Schwerk et al. 2011
- Johnston, 2006
- Bush et al. 2011

More information

**Short-acting beta-2 agonist relievers for children: 6 years and over**

Inhaled short-acting beta$_2$ agonists are the major class of bronchodilators used for relief of symptoms in asthma. They are the most effective bronchodilators available and are recommended by international guidelines for use in children of all ages as well as in adults.

Children with controlled asthma need little or no reliever (on no more than 2 days per week).

Increased use of short-acting beta$_2$ agonists for relief of asthma symptoms, especially daily use, indicates deterioration of asthma control.
### Table. Definition of levels of recent asthma symptom control in children (regardless of current treatment regimen)

<table>
<thead>
<tr>
<th>Good control</th>
<th>Partial control</th>
<th>Poor control</th>
</tr>
</thead>
<tbody>
<tr>
<td>All of:</td>
<td>Any of:</td>
<td>Either of:</td>
</tr>
<tr>
<td>- Daytime symptoms(^{†}) (\leq 2) days per week (lasting only a few minutes and rapidly relieved by rapid-acting bronchodilator)</td>
<td>- Daytime symptoms(^{†}) (&gt; 2) days per week (lasting only a few minutes and rapidly relieved by rapid-acting bronchodilator)</td>
<td>- Daytime symptoms(^{†}) (&gt; 2) days per week (lasting from minutes to hours or recurring, and partially or fully relieved by rapid-acting bronchodilator)</td>
</tr>
<tr>
<td>- No limitation of activities(^{‡})</td>
<td>- Any limitation of activities(^{*})</td>
<td>- (\geq 3) features of partial control within the same week</td>
</tr>
<tr>
<td>- No symptoms(^{§}) during night or when wakes up</td>
<td>- Any symptoms during night or when wakes up(^{††})</td>
<td></td>
</tr>
<tr>
<td>- Need for reliever(^{#}) (\leq 2) days per week</td>
<td>- Need for reliever(^{#}) (&gt; 2) days per week</td>
<td></td>
</tr>
</tbody>
</table>

\(^{†}\) e.g. wheezing or breathing problems  
\(^{‡}\) child is fully active; runs and plays without symptoms  
\(^{§}\) including no coughing during sleep  
\(^{#}\) not including short-acting beta\(_2\) agonist 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

**Note:** 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.

**Adapted from**

Asset ID: 23

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**Administration of inhaled medicines in children: 6 years and over**

School-aged children (depending on the child’s age, ability, and with individualised training) can correctly use a range of inhaler types,\(^{10}\) including manually actuated pressurised metered-dose inhalers with spacers,\(^{11}\) breath-actuated pressurised metered-dose inhalers (e.g. Autohaler), and dry-powder inhalers (e.g. Accuhaler, Turbuhaler).\(^{11,12}\)  

A pressurised metered-dose inhaler and spacer is an appropriate first choice for most children.\(^{10}\)  

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

School-aged children are unlikely to use their inhaler device correctly without careful training.\(^{13}\)

**Oral corticosteroids for children: 6 years and over**

A short course of oral corticosteroid may be helpful in gaining rapid asthma control, with a low risk of additional systemic adverse effects.\(^{1}\)
Rarely, long-term systemic corticosteroids may be needed for children with severe persistent asthma that is poorly
controlled despite high-dose inhaled corticosteroids and long-acting beta₂ agonists.¹ However, significant adverse effects
may occur due to recurrent or long-term systemic corticosteroids.¹

▶ See: Managing acute asthma in clinical settings

**Parent-initiated oral corticosteroid treatment in children**

There is limited and inconclusive evidence from clinical trials evaluating the effectiveness of courses of oral
corticosteroids initiated by parents in response to children’s wheezing.¹⁴

In children aged 6–14 years, a course of oral prednisolone initiated by parents in response to an asthma flare-up may
reduce asthma symptoms and the number of missed school days.¹⁵

In children aged 1–5 years with episodic wheezing, oral corticosteroids are not effective in managing the symptoms of
acute lower respiratory tract illnesses.¹⁶

**Oral corticosteroids for children: adverse effects**

A short course of oral corticosteroid therapy (less than 2 weeks) is associated with little risk of long-term suppression of
the hypothalamus–pituitary–adrenal axis.¹ However, risk can accumulate if frequent courses (four or more per year) are
given.¹

Recurrent courses of oral corticosteroids may also affect bone mineral density, especially in boys.¹

**Asthma triggers in children: respiratory tract infections**

The common cold is a frequent cause of asthma flare-ups in children. Children with asthma have a deficient immune
response to rhinovirus infections, irrespective of whether they are atopic.¹⁷

Few studies have assessed clinical outcomes in children with acute asthma treated with antibiotics.²,³,⁴

Although upper respiratory tract bacterial infections are associated with increased levels of inflammatory cytokines in the
airway,⁵ which may contribute to wheezing in children, there is insufficient evidence to determine whether antibiotic
treatment improves short-term or long-term clinical outcomes.

Macrolide antibiotics may have beneficial effects in asthma through mechanisms other than their antibacterial
action,⁶ but their use in children has not been well investigated.⁶

*The Australian Immunisation Handbook*¹⁸ recommends annual influenza vaccine for children and adults with asthma that is
severe enough to require frequent hospital visits and the use of multiple asthma medicines. It is also recommended for
children aged 6 months–5 years (using specific brands registered for use in children).¹⁸ Pneumococcal vaccination is
recommended for all children under 2 years.¹⁸

Asthma, atopic dermatitis (eczema) and allergic rhinitis (hay fever) are not contraindications to any vaccine, unless the
child is receiving high-dose oral steroid therapy.

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.¹⁹,²⁰,²¹

To be effective, influenza vaccination must be given every year before the influenza season.

There is no significant increase in asthma flare-ups immediately after vaccination with inactivated influenza vaccination.¹⁹

For information about immunisation, refer to the current version of *The Australian Immunisation Handbook*.¹⁸

Note: National immunisation guidelines include specific recommendations about influenza and pneumococcal vaccinations for
Aboriginal and Torres Strait Islander children.

▶ Go to: The Australian Immunisation Handbook

**References**


Administering inhaled medicines correctly in children

Recommendations

For babies and children too young to use a mouthpiece (most children under 4 years), deliver inhaled medicines via a pressurised metered-dose inhaler and small-volume spacer with tightly fitting facemask.

How this recommendation was developed
Adapted from existing guidance
Based on reliable clinical practice guideline(s) or position statement(s):

- Brand et al. 2008 ¹

For children who are able to cooperate and understand how to seal their lips tightly around a spacer mouthpiece (usually those aged 4 years and over), deliver inhaled medicines via a pressurised metered-dose inhaler and small-volume spacer with a mouthpiece.

How this recommendation was developed
Consensus
Based on clinical experience and expert opinion (informed by evidence, where available).

Advise patients and parents to wash standard plastic spacers (e.g. Able Spacer Universal, Breath-A-Tech, Volumatic) before first use to reduce electrostatic charge. This should be done by disassembling if necessary, washing in warm water and dishwashing detergent, then allowing to air dry without rinsing or wiping.

If a new plastic spacer must be used immediately, it can be primed by firing multiple (at least 10) puffs of medicine into the spacer. (This is an arbitrary number of actuations in the absence of evidence that would enable a precise guideline.) Patients should follow the manufacturer’s instructions.

Note: Priming or washing spacers to reduce electrostatic charge before using for the first time is only necessary for standard plastic spacers (e.g. Able Spacer Universal, Breath-A-Tech, Volumatic). It is not necessary for antistatic polymer spacers (e.g. Able A2A, AeroChamber Plus, Breathe Eazy, La Petite E-Chamber, La Grande E-Chamber, Space Chamber, OptiChamber Diamond), or disposable cardboard spacers.

Table. Types of spacers

<table>
<thead>
<tr>
<th>Name</th>
<th>Material</th>
<th>Cleaning necessary</th>
<th>Priming necessary*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Able A2A</td>
<td>Antistatic polymer</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Able Spacer Universal</td>
<td>Plastic</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>AeroChamber Plus</td>
<td>Polycarbonate polyurethane</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Breath-A-Tech</td>
<td>Plastic</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Breathe Eazy</td>
<td>Polycarbonate polyurethane</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>DispozABLE</td>
<td>Cardboard</td>
<td>No</td>
<td>No</td>
</tr>
</tbody>
</table>
**Table. Types of spacers**

<table>
<thead>
<tr>
<th>Name</th>
<th>Material</th>
<th>Cleaning necessary</th>
<th>Priming necessary*</th>
</tr>
</thead>
<tbody>
<tr>
<td>La Grande E-Chamber</td>
<td>Polycarbonate polyurethane</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>LiteAire</td>
<td>Cardboard</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>La Petite E-Chamber</td>
<td>Polycarbonate polyurethane</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>OptiChamber Diamond</td>
<td>Thermoplastic polymer</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Space Chamber</td>
<td>Polypropylene</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Volumatic</td>
<td>Plastic</td>
<td>Yes</td>
<td>Yes</td>
</tr>
</tbody>
</table>

* Before first use only, by either of these methods:

- Washing: disassemble (if necessary), wash in warm water and dishwashing detergent, then allow to air dry without rinsing or wiping.
- Actuating medicine: fire multiple (at least 10) actuations of medicine into the spacer, following manufacturer’s instructions. (This is an arbitrary number of actuations in the absence of evidence that would enable a precise guideline.)

For patients using standard plastic spacers (e.g. Able Spacer Universal, Breath-A-Tech, Volumatic) or antistatic polymer spacers (e.g. Able A2A, AeroChamber Plus, Breathe Eazy, La Petite E-Chamber, La Grande E-Chamber, OptiChamber Diamond), advise patients and parents to clean the spacer monthly and after the resolution of any respiratory tract infection.

To clean a spacer:

- Dismantle as per manufacturer’s instructions, if necessary.
- Wash parts in warm water with liquid dishwashing detergent.
- Allow to air dry without rinsing.
- Reassemble carefully, if necessary.

Note: Do not dry spacers with a cloth or paper towel. Wiping can increase the electrostatic charge on the inside of the spacer, which can reduce the available dose.

**How this recommendation was developed**

Consensus

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

- Berg, 1995²
- Brand et al. 2008¹
- Dompeling et al. 2001³
- National Asthma Council Australia, 2008⁴
<table>
<thead>
<tr>
<th>Name</th>
<th>Material</th>
<th>Cleaning necessary</th>
<th>Priming necessary*</th>
</tr>
</thead>
<tbody>
<tr>
<td>AeroChamber Plus</td>
<td>Polycarbonate polyurethane</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Breath-A-Tech</td>
<td>Plastic</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Breathe Eazy</td>
<td>Polycarbonate polyurethane</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>DispozABLE</td>
<td>Cardboard</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>La Grande E-Chamber</td>
<td>Polycarbonate polyurethane</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>LiteAire</td>
<td>Cardboard</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>La Petite E-Chamber</td>
<td>Polycarbonate polyurethane</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>OptiChamber Diamond</td>
<td>Thermoplastic polymer</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Space Chamber</td>
<td>Polypropylene</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Volumatic</td>
<td>Plastic</td>
<td>Yes</td>
<td>Yes</td>
</tr>
</tbody>
</table>

* Before first use only, by either of these methods:

- Washing: disassemble (if necessary), wash in warm water and dishwashing detergent, then allow to air dry without rinsing or wiping.
- Actuating medicine: fire multiple (at least 10) actuations of medicine into the spacer, following manufacturer’s instructions. (This is an arbitrary number of actuations in the absence of evidence that would enable a precise guideline.)

Asset ID: 98

**How this recommendation was developed**

Consensus

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

- Berg, 1995²
- Brand et al. 2008¹
- Dompeling et al. 2001³
- National Asthma Council Australia, 2008⁴

When giving multiple puffs at a time via a spacer, fire one puff at a time into the spacer and ask the child to take 4–6 breaths in and out of spacer after each puff.

**How this recommendation was developed**

Consensus

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

For children taking inhaled corticosteroids, recommend:

- to rinse the mouth with water and spit after inhaling the last dose, to minimise the amount of medicine deposited in the oropharynx (particularly important if using a dry-powder inhaler)
• to use a spacer (if using a manually-actuated pressurised metered-dose inhaler).

How this recommendation was developed

Adapted from existing guidance
Based on reliable clinical practice guideline(s) or position statement(s):

• van Asperen *et al.* 2010

Consider using a nebuliser only if a child cannot be taught to inhale medicine from a spacer.

How this recommendation was developed

Adapted from existing guidance
Based on reliable clinical practice guideline(s) or position statement(s):

• Global Initiative for Asthma, 2009

More information

Correct use of inhaler devices

The majority of patients do not use inhaler devices correctly. Australian research studies have reported that only approximately 10% of patients use correct technique.\(^7\),\(^8\) High rates of incorrect inhaler use among children with asthma and adults with asthma or COPD have been reported,\(^9\),\(^10\),\(^11\),\(^12\),\(^13\) even among regular users.\(^14\) Regardless of the type of inhaler device prescribed, patients are unlikely to use inhalers correctly unless they receive clear instruction, including a physical demonstration, and have their inhaler technique checked regularly.\(^15\) Poor inhaler technique has been associated with worse outcomes in asthma and COPD. It can lead to poor asthma symptom control and overuse of relievers and preventers.\(^9\),\(^16\),\(^17\),\(^18\) In patients with asthma or COPD, incorrect technique is associated with a 50% increased risk of hospitalisation, increased emergency department visits and increased use of oral corticosteroids due to flare-ups.\(^14\) Correcting patients’ inhaler technique has been shown to improve asthma control, asthma-related quality of life and lung function.\(^19\),\(^20\)

Common errors and problems with inhaler technique

Common errors with manually actuated pressurised metered dose inhalers include:\(^15\)

• failing to shake the inhaler before actuating
• holding the inhaler in wrong position
• failing to exhale fully before actuating the inhaler
• actuating the inhaler too early or during exhalation (the medicine may be seen escaping from the top of the inhaler)
• actuating the inhaler too late while inhaling
• actuating more than once while inhaling
• inhaling too rapidly (this can be especially difficult for children to overcome)
• multiple actuations without shaking between doses.

Common errors for dry powder inhalers include:\(^15\)

• not keeping the device in the correct position while loading the dose (horizontal for *Accuhaler* and vertical for *Turbuhaler*)
• failing to exhale fully before inhaling
• failing to inhale completely
• inhaling too slowly and weakly
• exhaling into the device mouthpiece before or after inhaling
• failing to close the inhaler after use
• using past the expiry date or when empty.
Other common problems include:

- difficulty manipulating device due to problems with dexterity (e.g. osteoarthritis, stroke, muscle weakness)
- inability to seal the lips firmly around the mouthpiece of an inhaler or spacer
- inability to generate adequate inspiratory flow for the inhaler type
- failure to use a spacer when appropriate
- use of incorrect size mask
- inappropriate use of a mask with a spacer in older children.

How to improve patients’ inhaler technique

Patients’ inhaler technique can be improved by brief education, including a physical demonstration, from a health professional or other person trained in correct technique. The best way to train patients to use their inhalers correctly is one-to-one training by a healthcare professional (e.g. nurse, pharmacist, GP, specialist), that involves both verbal instruction and physical demonstration. Patients do not learn to use their inhalers properly just by reading the manufacturer’s leaflet. An effective method is to assess the individual’s technique by comparing with a checklist specific to the type of inhaler, and then, after training in correct technique, to provide written instructions about errors (e.g. a sticker attached to the device).

The National Asthma Council information paper on inhaler technique includes checklists for correct technique with all common inhaler types used in asthma or COPD.

Inhaler technique must be rechecked and training must be repeated regularly to help children and adults maintain correct technique.

Administration of inhaled medicines in children: 0–5 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.

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. 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.

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

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 firing the device. Note that breath-actuated pressurised metered-dose inhalers cannot be used with a spacer.

Even when using pressurised metered dose inhalers and spacers, drug delivery is very variable in young children. The inhaler design may improve spacer technique, but will not necessarily improve clinical outcomes. The amount of medicine delivered by inhaler devices to the lower airways varies from day to day in preschool children. This variation might explain fluctuations in effectiveness, even if the child’s parents have been trained to use the device correctly.

When administering salbutamol to relieve asthma symptoms in a preschool child, the standard recommendation is to shake the inhaler, fire one puff at a time into the spacer and have the child take 4–6 breaths in and out of the spacer (tidal breathing). 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.

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. 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.

**Administration of inhaled medicines in children: 6 years and over**

School-aged children (depending on the child’s age, ability, and with individualised training) can correctly 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). A pressurised metered-dose inhaler and spacer is an appropriate first choice for most children.

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

School-aged children are unlikely to use their inhaler device correctly without careful training.

**Preparation of new spacers before first use**

Electrostatic surface charge on new standard plastic spacers (e.g. Able Spacer Universal, Breath-A-Tech, Volumatic) reduces the proportion of medicine available for delivery to the airway. This charge can be reduced by washing the plastic spacer in dishwashing liquid and allowing it to air dry or drip-dry without wiping (i.e. suds intact).

Alternatively, priming the spacer by actuating the device several times into the spacer also overcomes the charge, but this wastes medicine. The optimal number of actuations for priming is not known and the findings of in vitro studies vary widely. One study (using older, CFC-based formulations of asthma medicines) reported that up to 40 actuations fired into a new plastic spacer overcame the effect of the electrostatic charge. Others have concluded that the electrostatic charge on plastic spacers does not reduce in vivo efficacy of bronchodilator therapy in children with asthma. The number of actuations necessary may be known when the results of recent studies become available.

When a new standard plastic spacer must be used immediately (e.g. for a person with asthma symptoms), patients, parents and carers should follow the manufacturer’s priming instructions. In hospitals and emergency departments, a new spacer that has not been pre-treated by washing can be primed using multiple (at least 10) puffs of salbutamol. (This is an arbitrary number of actuations in the absence of evidence that would enable a precise guideline.)

Disposable cardboard spacers and antistatic polymer spacers (e.g. Able A2A, AeroChamber Plus, Breathe Eazy, La Petit E-Chamber, La Grande E-Chamber, OptiChamber Diamond) do not have this problem.

**Note:** The term ‘priming’ is also used for the preparation process that is necessary for new pressurised metered-dose inhalers that have not been used for more than a week. This involves first actuating the inhaler into the air (away from the patient). Users should follow the manufacturer’s instructions for the particular brand of inhaler, which specify the number of actuations required.

**References**


Planning routine asthma review for children

Recommendations

As a general guide, review the child’s asthma:

- every 3–6 months when asthma is stable and well controlled
- 4 weeks after increasing the dose or number of medicines to regain control of partially or poorly controlled asthma
- 2–4 weeks after a visit to the emergency department or a hospital stay due to acute asthma.

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

<table>
<thead>
<tr>
<th>Good control</th>
<th>Partial control</th>
<th>Poor control</th>
</tr>
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<tbody>
<tr>
<td>All of:</td>
<td>Any of:</td>
<td>Either of:</td>
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<td>- Daytime symptoms(^{\dagger}) ≤2 days per week (lasting only a few minutes and rapidly relieved by rapid-acting bronchodilator)</td>
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<td>- Any limitation of activities(^{*})</td>
<td>- Any limitation of activities(^{*})</td>
</tr>
<tr>
<td>- No symptoms(^{\S}) during night or when wakes up</td>
<td>- Any symptoms during night or when wakes up(^{\ddagger\ddagger})</td>
<td>- ≥3 features of partial control within the same week</td>
</tr>
<tr>
<td>- Need for reliever(^{#}) ≤2 days per week</td>
<td>- Need for reliever(^{#}) &gt;2 days per week</td>
<td></td>
</tr>
</tbody>
</table>

\(^{\dagger}\) e.g. wheezing or breathing problems
\(^{\ddagger}\) child is fully active; runs and plays without symptoms
\(^{\S}\) including no coughing during sleep
\(^{\#}\) not including short-acting beta\(_2\) agonist 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
\(^{\ddagger\ddagger}\) e.g. waking with symptoms of wheezing or breathing problems

Note: 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.

Adapted from


Asset ID: 23
At each asthma review, assess recent asthma symptom control and future risk:

- recent asthma symptom control based on reported symptoms, limitation of daily activity and need for reliever medicine
- lung function using spirometry (for children old enough to perform the test)
- adherence to treatment
- inhaler technique
- whether the written asthma action plan is up to date
- modifiable environmental factors
- whether the child has any risk factors for poor asthma outcomes in future (e.g. persistent symptoms, difficult-to-control asthma due to severe disease or poor adherence, severe allergies such as food allergies or history of anaphylaxis, previous severe life-threatening acute asthma, history of sudden severe unpredictable asthma flare-ups, or significant psychosocial factors).

Note: Assessments can be made by asking the same questions at each visit, or using validated questionnaires.

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

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† e.g. wheezing or breathing problems
‡ child is fully active; runs and plays without symptoms
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* e.g. wheeze or breathlessness during exercise, vigorous play or laughing
†† e.g. waking with symptoms of wheezing or breathing problems

Note: 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.

Adapted from
Asset ID: 23
Table. Sample questions for reviewing asthma in children

- How many weeks does child’s reliever puffer last?
- How often does child wheeze, become short of breath or cough?
- Does child wake during the night due to wheezing, shortness of breath or coughing? (How many times per month?)
- How often does child need to take reliever puffer? (How many puffs?)
- Has child since last visit/ever needed to take oral corticosteroids? (How often and how much?)
- Does child take a preventer puffer? (What dose? How many puffs per day?)
- How often does child need new script for preventer medicine?
- Has child missed time from childcare, school and or sport due to asthma?
- How often does child get colds?
- Is child using other medicines for respiratory symptoms (e.g. oral or intranasal antihistamines, intranasal corticosteroids)
• How many weeks does child’s reliever puffer last?

• [Specify time period, e.g. In the last year/month/2 weeks] how many times has child visited GP/hospital emergency room for asthma symptoms?

Note: Questions are a guide. Wording will depend on who is reviewing the child’s asthma.

Asset ID: 29

How this recommendation was developed

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

Validated checklists or questionnaires can be used to assess recent asthma symptom control at each visit, e.g:

• Test for Respiratory and Asthma Control in Kids (TRACK) – suitable for children under 5 years
• Asthma Control Questionnaire (ACQ) – suitable for children aged 6–16 years.

How this recommendation was developed

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

If long-term treatment with high-dose inhaled corticosteroid is needed to control wheezing symptoms:

• refer for specialist assessment (e.g. paediatric respiratory physician or paediatrician)
• provide specific written advice (steroid alert card) for other health professionals such as emergency services (e.g. If child shows reduced consciousness, consider the possibility of adrenal insufficiency, check serum biochemistry, blood glucose level and serum cortisol urgently, and consider whether intramuscular hydrocortisone is indicated)
• warn parents that adrenal suppression is a possible side effect and advise them what to do if the child develops symptoms consistent with adrenal insufficiency, such as lethargy, vomiting, abdominal pain or seizures (e.g. go to the emergency department without delay, tell staff that the child is using regular high-dose medicine for asthma, and hand them the child’s steroid alert card).

Table. Definitions of ICS dose levels in children

<table>
<thead>
<tr>
<th>Inhaled corticosteroid</th>
<th>Daily dose (mcg)</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>Low</td>
</tr>
<tr>
<td>Beclometasone dipropionate †</td>
<td>100–200</td>
</tr>
<tr>
<td>Budesonide</td>
<td>200–400</td>
</tr>
<tr>
<td>Ciclesonide ‡</td>
<td>80–160</td>
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<td><strong>Fluticasone propionate</strong></td>
<td>100–200</td>
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† 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

Monitor linear growth (height and weight, accurately measured and plotted on a percentile chart) in children taking inhaled corticosteroids long term.

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

- van Asperen et al. 2010
- Zöllner et al. 2012
- Ahmet et al. 2011
- Priftis et al. 2008
- Macdessi et al. 2003

How this recommendation was developed
Adapted from existing guidance
Based on reliable clinical practice guideline(s) or position statement(s):

- van Asperen et al. 2010

More information

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 (e.g. flare-ups, 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)

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**Note:** 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.  

*Adapted from*  
Asset ID: 23

**Inhaled corticosteroids for children: adverse effects**

**Topical**

Hoarseness and pharyngeal candidiasis are not commonly reported among preschool children when using a metered-dose inhaler with spacer, or among school-aged children.  

Inhaled corticosteroids, particular dry-powder formulas with pH < 5.5, may dissolve tooth enamel in children.  

Topical effects can be reduced by use of spacer devices (which reduce oropharyngeal deposition), and by mouth-rinsing and spitting after use. Immediate quick mouth-rinsing removes more residual medicine in the mouth than delayed rinsing.  

**Systemic**

Systemic effects of inhaled corticosteroids in children depend on the dose, but clinically significant adverse effects are uncommon. The use of spacers and mouth rinsing will not reduce systemic effects, but may increase efficacy so that a lower dose is required.  

Short-term suppression of linear growth has been demonstrated in children, but only minimal long-term effects on growth or bone density have been reported. Some children may experience delay in the normal pubertal growth spurt due to asthma itself. Treatment beginning before puberty is associated with a small (mean approximately 1 cm) reduction in adult height.  

A research study using biochemical testing in a research setting showed that hypothalamic–pituitary–adrenal axis suppression may occur in up to two-thirds of children treated with inhaled corticosteroids, and may occur at even low doses. However, clinically cases are rare.
Cases of symptomatic, clinically significant adrenal insufficiency in children due to inhaled corticosteroid treatment have been reported, including cases in Australia. Most cases have involved children given more than 500 mcg per day fluticasone propionate.

The risk of hypothalamic–pituitary–adrenal axis suppression is higher among children receiving concomitant intranasal steroids and those with lower body mass index. Risk is lower in obese children.

There are no nationally accepted protocols for routine assessment of adrenal function because it has not yet been possible to identify precisely which children should be tested, to interpret test results reliably, to identify the appropriate interval for retesting, and because a clinical benefit has not been clearly demonstrated.

Go to: The Thoracic Society of Australia and New Zealand’s Position Statement: The role of corticosteroids in the management of childhood asthma

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† Dose equivalents for Qvar (TGA-registered CFC-free formulation of beclomethasone dipropionate)
‡ Ciclesonide is registered by the TGA for use in children aged 6 and over

Source
Asset ID: 21

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

Parents commonly underestimate the severity of their child’s asthma and overestimate asthma control.

Standardised questionnaires

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

Asthma Control Questionnaire (ACQ) for children aged 6 years and over (must be administered by a trained interviewer in children aged 6–10 years) – asks questions about symptoms, effect of asthma on activity and use of relievers during the previous week. A lower score indicates better asthma control.

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. 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 (about the child’s symptoms over the previous 4 weeks) and four for the child. A lower score indicates worse asthma control. Note: C-ACT is intended for US use.
**Measures of airway inflammation**

Measures of airway inflammation (e.g. sputum test, exhaled nitric oxide) are not used in clinical practice to guide treatment decisions. Tailoring the dose of inhaled corticosteroids based on exhaled nitric oxide appears to achieve only a small benefit in children, and may lead to higher doses.\(^{15}\)

**Correct use of inhaler devices**

The majority of patients do not use inhaler devices correctly. Australian research studies have reported that only approximately 10% of patients use correct technique.\(^{16,17}\)

High rates of incorrect inhaler use among children with asthma and adults with asthma or COPD have been reported,\(^{18,19,20,21,22}\) even among regular users.\(^{23}\) Regardless of the type of inhaler device prescribed, patients are unlikely to use inhalers correctly unless they receive clear instruction, including a physical demonstration, and have their inhaler technique checked regularly.\(^{24}\)

Poor inhaler technique has been associated with worse outcomes in asthma and COPD. It can lead to poor asthma symptom control and overuse of relievers and preventers.\(^{18,25,26,27}\) In patients with asthma or COPD, incorrect technique is associated with a 50% increased risk of hospitalisation, increased emergency department visits and increased use of oral corticosteroids due to flare-ups.\(^{23}\)

Correcting patients’ inhaler technique has been shown to improve asthma control, asthma-related quality of life and lung function.\(^{28,29}\)

**Common errors and problems with inhaler technique**

Common errors with manually actuated pressurised metered dose inhalers include:\(^{24}\)

- failing to shake the inhaler before actuating
- holding the inhaler in wrong position
- failing to exhale fully before actuating the inhaler
- actuating the inhaler too early or during exhalation (the medicine may be seen escaping from the top of the inhaler)
- actuating the inhaler too late while inhaling
- actuating more than once while inhaling
- inhaling too rapidly (this can be especially difficult for children to overcome)
- multiple actuations without shaking between doses.

Common errors for dry powder inhalers include:\(^{24}\)

- not keeping the device in the correct position while loading the dose (horizontal for Accuhaler and vertical for Turbuhaler)
- failing to exhale fully before inhaling
- failing to inhale completely
- inhaling too slowly and weakly
- exhaling into the device mouthpiece before or after inhaling
- failing to close the inhaler after use
- using past the expiry date or when empty.

Other common problems include:

- difficulty manipulating device due to problems with dexterity (e.g. osteoarthritis, stroke, muscle weakness)
- inability to seal the lips firmly around the mouthpiece of an inhaler or spacer
- inability to generate adequate inspiratory flow for the inhaler type
- failure to use a spacer when appropriate
- use of incorrect size mask
- inappropriate use of a mask with a spacer in older children.

**How to improve patients’ inhaler technique**

Patients’ inhaler technique can be improved by brief education, including a physical demonstration, from a health professional or other person trained in correct technique.\(^{24}\) The best way to train patients to use their inhalers correctly is one-to-one training by a healthcare professional (e.g. nurse, pharmacist, GP, specialist), that involves both verbal instruction and physical demonstration.\(^{30,31,32}\) Patients do not learn to use their inhalers properly just by reading the manufacturer’s leaflet.\(^{21}\) An effective method is to assess the individual’s technique by comparing with a checklist specific to the type of inhaler, and then, after training in correct technique, to provide written instructions about errors (e.g. a sticker attached to the device).\(^{16,29}\)
The National Asthma Council information paper on inhaler technique includes checklists for correct technique with all common inhaler types used in asthma or COPD.

Inhaler technique must be rechecked and training must be repeated regularly to help children and adults maintain correct technique.28, 18, 19

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

Steroid alert card

Written information (e.g. a steroid alert card) can be prepared for children receiving long-term high-dose inhaled corticosteroids. Parents can be instructed to present the card if the child ever needs to go to the emergency department (for any reason) or be admitted to hospital.

A steroid alert card should state that child has asthma and the inhaled corticosteroid dose.

References


Managing triggers in children

Recommendations

Advise parents/carers to ensure that children are not exposed to tobacco smoke. Explain that smoking outdoors near children still exposes children to smoke.

How this recommendation was developed

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

All health professionals should advise parents and household members about cessation options and support them to quit smoking.

How this recommendation was developed

Adapted from existing guidance
Based on reliable clinical practice guideline(s) or position statement(s):

- Zwar et al. 2011
- Aveyard et al. 2012

Identify allergens to which the child is sensitised and avoid allergic triggers, if possible.

Table. Summary of asthma triggers
Please view and print this figure separately: https://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).

More information

Asthma triggers in children: tobacco smoke
There is consistent, high-quality evidence that exposure to environmental tobacco smoke can both cause and worsen wheezing in preschool children.

See: Smoking and asthma
See: Asthma triggers

Asthma triggers in children: environmental allergens
There is insufficient evidence on which to base recommendations for the reduction of exposure to environmental allergens in the treatment of wheezing in preschool children.

See: Allergies and asthma
**Asthma triggers in children: respiratory tract infections**

The common cold is a frequent cause of asthma flare-ups in children. Children with asthma have a deficient immune response to rhinovirus infections, irrespective of whether they are atopic.  

Few studies have assessed clinical outcomes in children with acute asthma treated with antibiotics.  

Although upper respiratory tract bacterial infections are associated with increased levels of inflammatory cytokines in the airway, which may contribute to wheezing in children, there is insufficient evidence to determine whether antibiotic treatment improves short-term or long-term clinical outcomes.  

Macrolide antibiotics may have beneficial effects in asthma through mechanisms other than their antibacterial action, but their use in children has not been well investigated.  

*The Australian Immunisation Handbook* recommends annual influenza vaccine for children and adults with asthma that is severe enough to require frequent hospital visits and the use of multiple asthma medicines. It is also recommended for children aged 6 months–5 years (using specific brands registered for use in children). Pneumococcal vaccination is recommended for all children under 2 years.  

Asthma, atopic dermatitis (eczema) and allergic rhinitis (hay fever) are not contraindications to any vaccine, unless the child is receiving high-dose oral steroid therapy.  

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.  

To be effective, influenza vaccination must be given every year before the influenza season.  

There is no significant increase in asthma flare-ups immediately after vaccination with inactivated influenza vaccination.  

For information about immunisation, refer to the current version of *The Australian Immunisation Handbook*.  

**Note:** National immunisation guidelines include specific recommendations about influenza and pneumococcal vaccinations for Aboriginal and Torres Strait Islander children.  

Go to: *The Australian Immunisation Handbook*  

References


## Table. Summary of asthma triggers

<table>
<thead>
<tr>
<th>Avoidable triggers</th>
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</tr>
</thead>
<tbody>
<tr>
<td><strong>Always avoid</strong></td>
<td><strong>Do not avoid</strong></td>
</tr>
<tr>
<td>Cigarette smoke</td>
<td>Exercise</td>
</tr>
<tr>
<td></td>
<td>Laughter</td>
</tr>
<tr>
<td><strong>Avoid or reduce where possible</strong></td>
<td><strong>Manage</strong></td>
</tr>
<tr>
<td>Allergens (if person is sensitised and relevant avoidance strategies are practical and shown to be effective)</td>
<td>Respiratory tract infections</td>
</tr>
<tr>
<td>• Animal allergens (e.g. pets, animals in workplace)</td>
<td>Certain medicines</td>
</tr>
<tr>
<td>• Cockroaches</td>
<td>• Aspirin (when given for purpose of desensitisation)</td>
</tr>
<tr>
<td>• House dust mite</td>
<td>• Anticholinesterases and cholinergic agents</td>
</tr>
<tr>
<td>• Moulds</td>
<td><strong>Comorbid medical conditions</strong></td>
</tr>
<tr>
<td>• Occupational allergens</td>
<td>• Allergic rhinitis/rhinosinusitis</td>
</tr>
<tr>
<td>• Pollens</td>
<td>• Gastro-oesophageal reflux disease</td>
</tr>
<tr>
<td>• Thunderstorms (airborne pollens, moulds)</td>
<td>• Nasal polyposis</td>
</tr>
<tr>
<td><strong>Airborne/environmental irritants</strong></td>
<td>• Obesity</td>
</tr>
<tr>
<td>• Cold/dry air</td>
<td>• Upper airway dysfunction</td>
</tr>
<tr>
<td>• Fuel combustion (nitrogen dioxide-emitting gas heaters)</td>
<td><strong>Physiological and psychological changes</strong></td>
</tr>
<tr>
<td>• Home renovation materials</td>
<td>• Extreme emotions</td>
</tr>
<tr>
<td>• Household aerosols</td>
<td>• Hormonal changes (e.g. menstrual cycle)</td>
</tr>
<tr>
<td>• Moulds (airborne endotoxins)</td>
<td>• Pregnancy</td>
</tr>
<tr>
<td>• Occupational irritants</td>
<td>• Sexual activity</td>
</tr>
<tr>
<td>• Outdoor industrial and traffic pollution</td>
<td>• Echinacea</td>
</tr>
<tr>
<td>• Perfumes/scents/incense</td>
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</tbody>
</table>
### Avoidable triggers

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</thead>
<tbody>
<tr>
<td><strong>Dietary triggers</strong></td>
<td></td>
</tr>
<tr>
<td>• Food chemicals/additives (if person is intolerant)</td>
<td></td>
</tr>
<tr>
<td>• Thermal effects (e.g. cold drinks)</td>
<td></td>
</tr>
</tbody>
</table>

† Requires close specialist supervision. If indicated for acute cardiac events, must be given under specialist supervision and started at low dose.

[Back to top](#)

Asset ID: 52
Providing asthma management education for parents and children

Recommendations

Provide parents (and children, if old enough) with asthma education that includes information about asthma symptoms and signs, asthma medicines, and how to take inhaled medicines correctly.

Table. Childhood asthma education checklist

<table>
<thead>
<tr>
<th>Asthma symptoms and signs</th>
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<tr>
<td>- Explain that asthma is a long-term condition that is still there even when the child does not have current symptoms, and which involves abnormally sensitive or inflamed breathing tubes (airways) in the lungs.</td>
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<td>- Explain the causes of wheezing and breathlessness (narrowing of airways due to contraction of smooth muscle in airway wall, swelling of lining of airways, increased mucus secretion into airway).</td>
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<td>- Explain that the severity of a particular asthma flare-up (e.g. acute asthma causing a trip to the emergency department) is not the same as the severity of the child’s asthma overall.</td>
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<td>- Explain warning signs that mean the child needs to take reliever, needs a doctor, or needs emergency care.</td>
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<tr>
<td>- Mention some common factors that can trigger children’s asthma (e.g. colds, exercise, allergens, tobacco smoke). Provide advice on triggers that can be avoided.</td>
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</table>

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<th>Asthma medicines</th>
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<td>- Explain that relievers make the abnormally narrowed breathing tubes (airways) wider so it is easier to breathe.</td>
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<tr>
<td>- Explain that relievers should only be used when the child has symptoms, or before exercise if prescribed for exercise-induced bronchoconstriction.</td>
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<td>- Explain that relievers should not be used at other times ‘just in case’, and that using reliever too often is a sign that the child’s asthma is poorly controlled – the child may need regular medicine.</td>
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<td>- Explain that preventers (inhaled corticosteroids, montelukast, and combinations of inhaled corticosteroid and long-acting beta\textsubscript{2} agonist) work mainly by settling down the inflammation in the airways. Combination preventers (inhaled corticosteroid plus long-acting beta\textsubscript{2} agonist) also contain a second medicine that helps keep narrow airways open.</td>
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<tr>
<td>- Emphasise that preventers must be taken regularly to work properly.</td>
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<tr>
<td>- Explain the possible side effects of inhaled corticosteroids and how to minimise them (following directions closely, using a spacer, rinsing and spitting after use).</td>
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<tr>
<td>- Explain that other medicines are used during acute asthma (‘attacks’).</td>
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<tr>
<th>Inhaler devices</th>
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<tbody>
<tr>
<td>- Explain how to use a puffer and spacer or other inhaler device properly.</td>
</tr>
<tr>
<td>- Physically demonstrate how to use the device, provide training, then watch the child or parents perform each step.</td>
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<td>- Explain how to clean and care for inhalers and spacers.</td>
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<tr>
<th>Written asthma action plan</th>
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<tbody>
<tr>
<td>- Provide a written asthma action plan and explain how to use it</td>
</tr>
<tr>
<td>- Provide a plan for the child’s school or childcare centre</td>
</tr>
</tbody>
</table>

Note: for children with difficult-to-treat asthma or comorbid conditions, provide more detailed information.

Asset ID: 30

How this recommendation was developed

Consensus
Provide parents of wheezing preschool children with education that includes information on causes of wheeze, effective treatment options, and how to recognise warning signals.

How this recommendation was developed
Consensus
Based on clinical experience and expert opinion (informed by evidence, where available).

Provide training for children and parents on how to use inhaler devices correctly, including inhaler technique, care and cleaning of devices and spacers.

How this recommendation was developed
Consensus
Based on clinical experience and expert opinion (informed by evidence, where available).

Provide a written asthma action plan for all children with asthma, and train parents (and older children) how to follow it.

How this recommendation was developed
Consensus
Based on clinical experience and expert opinion (informed by evidence, where available).

Review the child’s written asthma action plan every 6 months, and whenever asthma control status changes significantly or medicines are changed or stopped.

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

How this recommendation was developed
Consensus
Based on clinical experience and expert opinion (informed by evidence, where available).

More information

Written asthma action plans for 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.¹ Symptom-based plans were more effective than peak flow-based plans for reducing the risk of acute care visits in children and adolescents.¹

Written asthma action plans that are based on symptoms appear to be more effective than action plans based on peak expiratory flow monitoring for children and adolescents.¹

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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**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 smartphone application
- 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)
- Children’s written asthma action plans.

Some written asthma action plans are available in community languages.

Software for developing electronic pictorial asthma action plans²³ is available online.

Go to: National Asthma Council Australia’s *Asthma Action Plan Library*

Download: Imperial College London’s *Electronic Asthma Action Plan (ZIP/9.9 MB)*

**Asthma education programs for parents and children**

Asthma education for children and/or caregivers reduces the risk of emergency department visit for asthma, compared with usual care.⁴
However, the most effective components of education have not been clearly identified. There have been relatively few Australian controlled trials assessing education programs.

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, or to identify which types of education is more effective.

All age groups

A systematic review 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.

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.

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. 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
- education programs are more likely to be effective if they involve multiple sessions, each longer than 20 minutes’ duration.

Adolescents

The school-based Adolescent Asthma Action (Triple A) program has been associated with improvement in quality of life and asthma knowledge. It is available in many Australian schools.

Go to: Adolescent Asthma Action (Triple A) program

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 can provide asthma education whenever the opportunity occurs.

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Emphasise that preventers must be taken regularly to work properly.
Explain the possible side effects of inhaled corticosteroids and how to minimise them (following directions closely, using a spacer, rinsing and spitting after use).
Explain that other medicines are used during acute asthma (‘attacks’).

**Inhaler devices**

- Explain how to use a puffer and spacer or other inhaler device properly.
- Physically demonstrate how to use the device, provide training, then watch the child or parents perform each step.
- Explain how to clean and care for inhalers and spacers.

**Written asthma action plan**

- Provide a written asthma action plan and explain how to use it
- Provide a plan for the child’s school or childcare centre

**Note:** for children with difficult-to-treat asthma or comorbid conditions, provide more detailed information.

**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](#)

**Administration of inhaled medicines in children: 0–5 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.

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. 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.

Dry-powder inhalers are usually ineffective for preschool children because they cannot generate sufficient inspiratory airflow.

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 firing the device. Note that breath-actuated pressurised metered-dose inhalers cannot be used with a spacer.

Even when using pressurised metered-dose inhalers and spacers, drug delivery is very variable in young children. The inhaler design may improve spacer technique, but will not necessarily improve clinical outcomes. The amount of medicine delivered by inhaler devices to the lower airways varies from day to day in preschool children. This variation might explain fluctuations in effectiveness, even if the child’s parents have been trained to use the device correctly.

When administering salbutamol to relieve asthma symptoms in a preschool child, the standard recommendation is to shake the inhaler, fire one puff at a time into the spacer and have the child take 4–6 breaths in and out of the spacer (tidal breathing). 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.

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. 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

Administration of inhaled medicines in children: 6 years and over

School-aged children (depending on the child's age, ability, and with individualised training) can correctly 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). A pressurised metered-dose inhaler and spacer is an appropriate first choice for most children.

Parents and children need training to use inhaler devices correctly, including inhaler technique, and care and cleaning of inhalers and spacers. School-aged children are unlikely to use their inhaler device correctly without careful training.

Correct use of inhaler devices

The majority of patients do not use inhaler devices correctly. Australian research studies have reported that only approximately 10% of patients use correct technique.

High rates of incorrect inhaler use among children with asthma and adults with asthma or COPD have been reported, regardless of the type of inhaler device prescribed, patients are unlikely to use inhalers correctly unless they receive clear instruction, including a physical demonstration, and have their inhaler technique checked regularly.

Poor inhaler technique has been associated with worse outcomes in asthma and COPD. It can lead to poor asthma symptom control and overuse of relievers and preventers. Poor inhaler technique is associated with a 50% increased risk of hospitalisation, increased emergency department visits and increased use of oral corticosteroids due to flare-ups.

Correcting patients' inhaler technique has been shown to improve asthma control, asthma-related quality of life and lung function.

Common errors and problems with inhaler technique

Common errors with manually actuated pressurised metered dose inhalers include:

- failing to shake the inhaler before actuating
- holding the inhaler in wrong position
- failing to exhale fully before actuating the inhaler
- actuating the inhaler too early or during exhalation (the medicine may be seen escaping from the top of the inhaler)
- actuating the inhaler too late while inhaling
- actuating more than once while inhaling
- inhaling too rapidly (this can be especially difficult for children to overcome)
- multiple actuations without shaking between doses.

Common errors for dry powder inhalers include:

- not keeping the device in the correct position while loading the dose (horizontal for Accuhaler and vertical for Turbuhaler)
- failing to exhale fully before inhaling
- failing to inhale completely
- inhaling too slowly and weakly
- exhaling into the device mouthpiece before or after inhaling
- failing to close the inhaler after use
- using past the expiry date or when empty.
Other common problems include:

- difficulty manipulating device due to problems with dexterity (e.g. osteoarthritis, stroke, muscle weakness)
- inability to seal the lips firmly around the mouthpiece of an inhaler or spacer
- inability to generate adequate inspiratory flow for the inhaler type
- failure to use a spacer when appropriate
- use of incorrect size mask
- inappropriate use of a mask with a spacer in older children.

**How to improve patients’ inhaler technique**

Patients’ inhaler technique can be improved by brief education, including a physical demonstration, from a health professional or other person trained in correct technique. The best way to train patients to use their inhalers correctly is one-to-one training by a healthcare professional (e.g. nurse, pharmacist, GP, specialist), that involves both verbal instruction and physical demonstration. Patients do not learn to use their inhalers properly just by reading the manufacturer’s leaflet. An effective method is to assess the individual’s technique by comparing with a checklist specific to the type of inhaler, and then, after training in correct technique, to provide written instructions about errors (e.g. a sticker attached to the device).

The National Asthma Council information paper on inhaler technique includes checklists for correct technique with all common inhaler types used in asthma or COPD.

Inhaler technique must be rechecked and training must be repeated regularly to help children and adults maintain correct technique.

**Preparation of new spacers before first use**

Electrostatic surface charge on new standard plastic spacers (e.g. Able Spacer Universal, Breath-A-Tech, Volumatic) reduces the proportion of medicine available for delivery to the airway. This charge can be reduced by washing the plastic spacer in dishwashing liquid and allowing it to air dry or drip-dry without wiping (i.e. suds intact).

Alternatively, priming the spacer by actuating the device several times into the spacer also overcomes the charge, but this wastes medicine. The optimal number of actuations for priming is not known and the findings of in vitro studies vary widely. One study (using older, CFC-based formulations of asthma medicines) reported that up to 40 actuations fired into a new plastic spacer overcame the effect of the electrostatic charge. Others have concluded that the electrostatic charge on plastic spacers does not reduce in vivo efficacy of bronchodilator therapy in children with asthma.

Disposable cardboard spacers and antistatic polymer spacers (e.g. Able A2A, AeroChamber Plus, Breathe Eazy, La Petit E-Chamber, La Grande E-Chamber, OptiChamber Diamond) do not have this problem.

Note: The term ‘priming’ is also used for the preparation process that is necessary for new pressurised metered-dose inhalers that have not been used for more than a week. This involves first actuating the inhaler into the air (away from the patient). Users should follow the manufacturer’s instructions for the particular brand of inhaler, which specify the number of actuations required.

**‘Wheeze-detecting’ devices**

Some hand-held devices and smart phone applications are marketed for detecting and measuring wheeze by audio recording and analysis.

There is not enough evidence to recommend these devices and apps for use in monitoring asthma symptoms or asthma control in adults or children, or in distinguishing wheeze from other airway sounds in children.

- Over-reliance on these devices could result in over- or under-treatment.
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. Mechanisms may include effects of stress on the immune system 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. There is a complex interrelationship between:

- 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. A person’s level of health literacy is influenced by various factors including skills in reading, writing, numeracy, speaking, listening, cultural and conceptual knowledge. Inadequate health literacy is recognised as a risk factor for poorer health outcomes and less effective use of health care services. Poor health literacy has been associated with poor asthma control, poor knowledge of medications, and incorrect inhaler technique. 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. Studies assessing the association between parents’ health literacy and children’s asthma have reported inconsistent findings. Overall, there is not enough evidence to prove that low health literacy causes poor asthma control or inadequate self-management.

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

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

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

References


