### Abbreviations

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>CFC</td>
<td>chlorofluorocarbon</td>
</tr>
<tr>
<td>COPD</td>
<td>chronic obstructive pulmonary disease</td>
</tr>
<tr>
<td>COX</td>
<td>cyclo-oxygenase</td>
</tr>
<tr>
<td>DXA</td>
<td>dual-energy X-ray absorptiometry</td>
</tr>
<tr>
<td>ED</td>
<td>emergency department</td>
</tr>
<tr>
<td>EIB</td>
<td>exercise-induced bronchoconstriction</td>
</tr>
<tr>
<td>FEV₁</td>
<td>forced expiratory volume over one second</td>
</tr>
<tr>
<td>FEV₆</td>
<td>forced expiratory volume over six seconds</td>
</tr>
<tr>
<td>FSANZ</td>
<td>Food Standards Australia and New Zealand</td>
</tr>
<tr>
<td>FVC</td>
<td>forced vital capacity</td>
</tr>
<tr>
<td>GORD</td>
<td>gastro-oesophageal reflux disease</td>
</tr>
<tr>
<td>HFA</td>
<td>formulated with hydrofluoralkane propellant</td>
</tr>
<tr>
<td>ICS</td>
<td>inhaled corticosteroid</td>
</tr>
<tr>
<td>ICU</td>
<td>intensive care unit</td>
</tr>
<tr>
<td>IgE</td>
<td>Immunoglobulin E</td>
</tr>
<tr>
<td>IL</td>
<td>interleukin</td>
</tr>
<tr>
<td>IU</td>
<td>international units</td>
</tr>
<tr>
<td>LABA</td>
<td>long-acting β₂-adrenergic receptor agonist</td>
</tr>
<tr>
<td>LAMA</td>
<td>long-acting muscarinic antagonist</td>
</tr>
</tbody>
</table>

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### Disclaimer

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Diagnosing asthma in children

Overview

A clinical definition of asthma in children

Asthma is defined clinically as the combination of variable respiratory symptoms (e.g. wheeze, shortness of breath, cough and chest tightness) and excessive variation in lung function, i.e. variation in expiratory airflow that is greater than that seen in healthy children (‘variable airflow limitation’).

See: A working definition of asthma

There is no single reliable test (‘gold standard’) and there are no standardised diagnostic criteria for asthma.

The diagnosis of asthma is based on:

- history
- physical examination
- considering other diagnoses
- clinical response to a treatment trial with an inhaled short-acting beta2 agonist reliever or preventer

Figure: Steps in the diagnosis of asthma in children aged 1-5 years

Please view and print this figure separately: http://www.asthmahandbook.org.au/figure/show/17

Figure. Steps in the diagnosis of asthma in children aged 6 years and over

Please view and print this figure separately: http://www.asthmahandbook.org.au/figure/show/121

Infants (age 0–12 months)

Asthma should not be diagnosed in infants aged less than 12 months old. Wheezing in this age group is most commonly due to acute viral bronchiolitis or to small and/or floppy airways. Infants with clinically significant wheezing should be referred to a paediatric respiratory physician or paediatrician.

Preschool wheeze (age 1–5 years)

Although many individuals later diagnosed with asthma first show respiratory symptoms by the age of 5 years, it is difficult to make the diagnosis of asthma with a high degree of certainty in children aged 1–5 years, because:

- episodic respiratory symptoms such as wheezing and cough are very common in children, particularly in children under 3 years
- objective lung function testing by spirometry is usually not feasible in this age group
- a high proportion of children who respond to bronchodilator treatment do not go on to have asthma in later childhood (e.g. by primary school age).

Children aged 6–11 years

In school-aged children able to perform spirometry, the diagnosis is supported by documentation of variable expiratory airflow limitation.

Adolescents

In older adolescents, the guidance on the diagnosis of asthma in adults generally applies.

See: Diagnosing asthma in adults

- A diagnosis of asthma should not be made if cough is the only or predominant respiratory symptom and there are no signs of airflow limitation (e.g. wheeze or breathlessness).
## Diagnosis: ages 1–5
Investigating wheeze and other asthma symptoms in preschool children, including history and physical examination, differential diagnosis, further investigations and treatment trials

http://www.asthmahandbook.org.au/diagnosis/children/1-5-years

## Diagnosis: age 6 and over
Investigating asthma symptoms in school-aged children, including history and physical examination, spirometry, differential diagnosis, further investigations and treatment trials

http://www.asthmahandbook.org.au/diagnosis/children/6-years-and-over
Figure: Steps in the diagnosis of asthma in children aged 1-5 years

**EPISODIC WHEEZING WITH INCREASED WORK OF Breathing**

**HISTORY AND PHYSICAL EXAMINATION**

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

Supports asthma diagnosis?

- Yes

**TREATMENT TRIAL**

- Trial reliever and/or preventer as indicated

Table: Classification of preschool wheeze and indications for initiating preventer treatment in children aged 1–5 years

See: Treatment trial for preschool wheeze

Clear response to treatment?

- Yes

**PROVISIONAL DIAGNOSIS OF ASTHMA**

- Manage according to frequency and severity of symptoms.

- Monitor and review response regularly.

**INVESTIGATIONS FOR SPECIFIC ALTERNATIVE DIAGNOSIS**

- Table: Findings that require investigation in children

- Table: Conditions that can be confused with asthma in children

Alternative diagnosis confirmed?

- No

- Yes

- No

- *---*
Figure. Steps in the diagnosis of asthma in children aged 6 years and over

**EPISODIC RESPIRATORY SYMPTOMS THAT SUGGEST ASTHMA**

**HISTORY AND PHYSICAL EXAMINATION**
- Table: Findings that increase or decrease the probability of asthma in children
  - **Supports asthma diagnosis?**

**TREATMENT TRIAL**
- Trial reliever and/or preventer as indicated
  - Table: Classification of asthma and indications for initiating preventer treatment in children aged 6 years and over.
  - See: Provisional diagnosis and treatment trial for asthma in a child aged 6 years or over
- **Clear response to treatment?**

**SPIROMETRY**
- FEV₁ before and 10-15 mins after bronchodilator
  - Reversible airflow limitation? (FEV₁ increase ≥12% from baseline)
  - **NO**

**INVESTIGATIONS FOR SPECIFIC ALTERNATIVE DIAGNOSIS**
- Table: Findings that require investigation in children
- Table: Conditions that can be confused with asthma in children
- **Alternative diagnosis confirmed?**

**FURTHER INVESTIGATIONS**
- Consider bronchial provocation test, cardiopulmonary exercise test and other tests as indicated
- **Supports asthma diagnosis?**

**CONSIDER ALTERNATIVE DIAGNOSES AND REFERRAL**

**ASTHMA NOT CONFIRMED**
- Monitor signs and symptoms and consider referral

**ASTHMA**
- Start asthma treatment and review response
## Diagnosis: ages 1–5

### In this section

<table>
<thead>
<tr>
<th><strong>History and physical examination</strong></th>
<th>Taking a history and performing physical examination for a wheezing child aged 1–5 years</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Differential diagnosis</strong></td>
<td>Considering alternative or comorbid conditions in wheezing in children aged 1–5 years</td>
</tr>
<tr>
<td><strong>Further investigations</strong></td>
<td>The role of further investigations for wheezing in children aged 1–5 years</td>
</tr>
<tr>
<td><strong>Treatment trial</strong></td>
<td>Conducting a treatment trial and reviewing effects in a wheezing child aged 1–5 years</td>
</tr>
</tbody>
</table>
History and physical examination for a wheezing child aged 1–5 years

**Recommendations**

Confirm that the breathing sounds described by parents/carers as ‘wheezing’ are actually wheeze:

- If possible, see the child during a bout of ‘wheezing’.
- Ask parents/carers to make an audio or video recording of noisy breathing (e.g. on phone).
- Show parents/carers a video of true wheezing and ask them whether signs match their child.

> Go to: Royal Children’s Hospital Melbourne’s [What is asthma](https://www.royalchildrens.org.au/what-is-asthma) video (see section on ‘What to look for’ from 2:52 to 3:52)

**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
- Global Initiative for Asthma (GINA), 2009
- Weinberger and Abu-Hasan, 2007

_Last reviewed version 2.0_

Ask about:

- current symptoms
- pattern of symptoms, including frequency and timing of wheezing episodes (whether they occur only when child has a viral cold, or are unrelated to colds, and whether child coughs or wheezes at other times, e.g. when playing or laughing)
- appearance of child’s chest during episodes of noisy breathing to identify chest recession (e.g. ask whether chest appears to be sucked inwards as child breathes in)
- whether child is generally alert, active, socially responsive, joins in play with other children
- home environment (e.g. exposure to smoke, pets)
- allergies, including atopic dermatitis (eczema) and allergic rhinitis (‘hay fever’)
- family history of asthma and allergies.

**How this recommendation was developed**

**Consensus**

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

_Last reviewed version 2.0_

Conduct a general physical examination, including:

- height and weight compared with normal range for age
- inspection of chest for deformity
- inspection of upper airway for signs of allergic rhinitis (e.g. swollen turbinates, transverse nasal crease, mouth breathing, darkness and swelling under eyes caused by sinus congestion) or polyps
- auscultation of chest
- inspection of fingers for clubbing (requires investigation)
- skin inspection for atopic dermatitis (eczema).
<table>
<thead>
<tr>
<th>Finding</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Persistent cough that is not associated with wheeze/breathlessness or systemic disease</td>
<td>Unlikely to be due to asthma</td>
</tr>
<tr>
<td>Onset of signs from birth or very early in life</td>
<td>Suggests cystic fibrosis, chronic lung disease of prematurity, primary ciliary dyskinesia, bronchopulmonary dysplasia, congenital abnormality</td>
</tr>
<tr>
<td>Family history of unusual chest disease</td>
<td>Should be enquired about before attributing all the signs and symptoms to asthma</td>
</tr>
<tr>
<td>Severe upper respiratory tract disease (e.g. severe rhinitis, enlarged tonsils and adenoids or nasal polyps)</td>
<td>Specialist assessment should be considered</td>
</tr>
<tr>
<td>Crepitations on chest auscultation that do not clear on coughing</td>
<td>Suggest a serious lower respiratory tract condition such as pneumonia, atelectasis, bronchiectasis</td>
</tr>
<tr>
<td>Unilateral wheeze</td>
<td>Suggests inhaled foreign body</td>
</tr>
<tr>
<td>Systemic symptoms (e.g. fever, weight loss, failure to thrive)</td>
<td>Suggest an alternative systemic disorder</td>
</tr>
<tr>
<td>Feeding difficulties, including choking or vomiting</td>
<td>Suggests aspiration – specialist assessment should be considered</td>
</tr>
<tr>
<td>Inspiratory upper airway noises (e.g. stridor, snoring)</td>
<td>Acute stridor suggests tracheobronchitis (croup)</td>
</tr>
<tr>
<td>Persistent voice abnormality</td>
<td>Suggests upper airway disorder</td>
</tr>
<tr>
<td>Finger clubbing</td>
<td>Suggests cystic fibrosis, bronchiectasis</td>
</tr>
<tr>
<td>Chronic (&gt;4 weeks) wet or productive cough</td>
<td>Suggests cystic fibrosis, bronchiectasis, chronic bronchitis, recurrent aspiration, immune abnormality, ciliary dyskinesia</td>
</tr>
<tr>
<td>Focal (localised) lung signs</td>
<td>Suggests pneumonia</td>
</tr>
<tr>
<td>Nasal polyps in child under 5 years old</td>
<td>Suggests cystic fibrosis</td>
</tr>
<tr>
<td>Severe chest deformity</td>
<td>Harrison’s Sulcus and Pectus Carinatum can be due to uncontrolled asthma, but severe deformity suggests an alternative diagnosis</td>
</tr>
<tr>
<td>Obvious breathing difficulty, especially at rest or at night</td>
<td>Specialist assessment should be considered</td>
</tr>
<tr>
<td>Recurrent pneumonia</td>
<td>Specialist assessment should be considered</td>
</tr>
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</table>
Identify any signs and symptoms that suggest an alternative diagnosis and which require investigation.

**Table. Findings that require investigations in children**

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<tr>
<td>Finding</td>
<td>Notes</td>
</tr>
<tr>
<td>----------------------------------------------------</td>
<td>----------------------------------------------------------------------</td>
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<td>Obvious breathing difficulty, especially at rest or at night</td>
<td>Specialist assessment should be considered</td>
</tr>
<tr>
<td>Recurrent pneumonia</td>
<td>Specialist assessment should be considered</td>
</tr>
</tbody>
</table>

Asset ID: 59

faq

**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):

- Weinberger and Abu-Hasan, 2007
- Gibson et al. 2010

**More information**

**Definition of wheeze**

Wheeze is defined as a high-pitched sound coming from the chest during inspiration or expiration. It is a non-specific sign caused by turbulent air flow due to narrowing of intrathoracic airways and indicates expiratory airflow limitation, irrespective of the underlying mechanism (e.g. bronchoconstriction or secretions in the airway lumen).

Inspiratory sounds (e.g. rattling or stridor) should not be described as ‘wheeze’.

Various forms of noisy breathing, including wheezing, are common among babies and preschoolers. Noisy breathing is particularly common among infants under 6 months old, but only a small proportion have wheeze.

Parents and doctors sometimes use the word ‘wheeze’ to mean different things, including cough, gasp, a change in breathing rate or style of breathing. If based on parental report alone, children may be labelled as having wheeze when they do not have narrowed airways and expiratory flow limitation.

There are no validated questionnaire-based instruments to identify wheeze in preschoolers, so wheezing is best confirmed by listening with a stethoscope during an episode.

Reported noisy breathing that responds to bronchodilator therapy is likely to be genuine wheeze and to be caused, at least in part, by constriction of airway smooth muscle.
'Wheeze-detecting' devices

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

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

- Reliance on these devices could result in over- or under-treatment.

Significance of wheeze in children 1–5 years

Approximately one in three children has at least one episode of wheezing before their third birthday, and almost half of all children have at least one episode of wheezing by age 6 years.

Wheeze is the most common symptom associated with asthma in children aged 5 years and under. Among people with a diagnosis of asthma at any time in their life, approximately 80% will have shown signs of respiratory disease, such as wheezing, in the first years of life.

However, the presence of wheeze does not mean a child has asthma or will develop asthma:

- wheezing in infants up to 12 months old is most commonly due to acute viral bronchiolitis or to small and/or floppy airways
- wheezing in children aged 1–5 years is usually associated with viral upper respiratory tract infections, which recur frequently in this age group. Many children wheeze when they have viral respiratory infections, even if they do not have asthma
- among preschoolers with recurrent wheezing, only approximately one in three will have asthma at age 6 years
- wheezing can also be due to many conditions other than asthma, including anatomical abnormalities of the airways, cystic fibrosis, bronchomalacia.

Relationship of allergies to asthma

Asthma can be atopic or non-atopic. Atopic asthma, characterised by eosinophilic airway inflammation associated with sensitisation to aeroallergens (positive skin prick test or specific immunoglobulin E on serology) is the more common form in children.

The links between asthma and atopy are unclear. Many children with asthma are also atopic and have eczema, hay fever, or food allergies, but not all children with atopy develop asthma.

Eczema and allergic rhinitis are risk factors for developing asthma. Parental atopy has been identified as a risk factor for asthma in several studies, but the strength of the association differs between populations.

A family history of atopy or asthma, or a personal history of atopy are generally considered to increase the probability that wheezing in children is due to asthma.

The association between allergic rhinitis and asthma may reflect the common allergic causes of both conditions, rather than a causal link. However, few studies have examined interactions between genes and environment for asthma and for atopy in the same population, and there is not consistent evidence that similar gene–environment interactions are common to asthma and atopy.

See: Allergies and asthma

Wheezing phenotypes in preschool children

Longitudinal population-based cohort studies of preschool children with wheezing have identified various long-term patterns (wheezing phenotypes).

<table>
<thead>
<tr>
<th>Classification system/source</th>
<th>Phenotypes identified</th>
<th>Description</th>
</tr>
</thead>
</table>

Table. Systems for retrospectively classifying the duration of childhood wheeze
<table>
<thead>
<tr>
<th>Classification system/source</th>
<th>Phenotypes identified</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tucson Children’s Respiratory Study † ‡</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>Avon Longitudinal Study of Parents and Children §</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 Strongly associated with atopy (especially house mite, cat allergen, grass pollen)</td>
</tr>
<tr>
<td></td>
<td><strong>Persistent wheeze</strong></td>
<td>Wheezing mainly begins after 6 months and continues through to primary school Strongly associated with atopy</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
Early childhood wheezing phenotypes cannot be recognised or applied clinically, because they are recognised retrospectively. In an individual child with episodic wheeze, it is not possible to accurately predict epidemiological phenotype from clinical phenotype. Currently available tools for predicting whether a wheezing preschool child will have asthma at school age (e.g. the Asthma Predictive Index) have limited clinical value.

References

Differential diagnosis for wheezing in children aged 1–5 years

Recommendations

Consider features that increase or reduce the probability of asthma.

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

<table>
<thead>
<tr>
<th>Asthma more likely</th>
<th>Asthma less likely</th>
</tr>
</thead>
<tbody>
<tr>
<td>More than one of:</td>
<td>Any of:</td>
</tr>
<tr>
<td>• wheeze</td>
<td>• symptoms only occur when child has a cold, but not</td>
</tr>
<tr>
<td>• difficulty breathing</td>
<td>between colds</td>
</tr>
<tr>
<td>• feeling of tightness in the chest</td>
<td>isolated cough in the absence of wheeze or difficulty</td>
</tr>
<tr>
<td>• cough</td>
<td>breathing</td>
</tr>
<tr>
<td><strong>AND</strong></td>
<td>history of moist cough</td>
</tr>
<tr>
<td>Any of:</td>
<td>dizziness, light-headedness or peripheral tingling</td>
</tr>
<tr>
<td>• symptoms recur frequently</td>
<td>repeatedly normal physical examination of chest</td>
</tr>
<tr>
<td>• symptoms worse at night and in the early morning</td>
<td>when symptomatic</td>
</tr>
<tr>
<td>• symptoms triggered by exercise, exposure to pets,</td>
<td>normal spirometry when symptomatic (children old</td>
</tr>
<tr>
<td>cold air, damp air, emotions, laughing</td>
<td>enough to perform spirometry)</td>
</tr>
<tr>
<td>• symptoms occur when child doesn’t have a cold</td>
<td>no response to a trial of asthma treatment</td>
</tr>
<tr>
<td>• history of allergies (e.g. allergic rhinitis, atopic</td>
<td>clinical features that suggest an alternative diagnosis</td>
</tr>
<tr>
<td>dermatitis)</td>
<td></td>
</tr>
<tr>
<td>• family history of allergies</td>
<td></td>
</tr>
<tr>
<td>• family history of asthma</td>
<td></td>
</tr>
<tr>
<td>• widespread wheeze heard on auscultation</td>
<td></td>
</tr>
<tr>
<td>• symptoms respond to treatment trial of reliever, with</td>
<td></td>
</tr>
<tr>
<td>or without a preventer</td>
<td></td>
</tr>
<tr>
<td>• lung function measured by spirometry increases in</td>
<td></td>
</tr>
<tr>
<td>response to rapid-acting bronchodilator</td>
<td></td>
</tr>
<tr>
<td>• lung function measured by spirometry increases in</td>
<td></td>
</tr>
<tr>
<td>response to a treatment trial with inhaled corticosteroid (where indicated)</td>
<td></td>
</tr>
</tbody>
</table>

Sources

If cough is a prominent symptom, investigate according to the current *Australian Cough Guidelines*.

Consider alternative diagnoses and comorbidities, including:

- congenital conditions, e.g. structural airway problems (e.g. tracheomalacia, bronchopulmonary dysplasia, malformation causing narrowing of intrathoracic airways, vascular ring anomaly compressing bronchus, trachea--oesophageal fistula), cystic fibrosis, immune deficiency, primary ciliary dyskinesia, congenital heart disease
- infective conditions, e.g. bronchiolitis (infants < 12 months), laryngotracheobronchitis (croup), chronic rhinosinusitis, recurrent respiratory tract infections, chronic suppurative lung disease (consider protracted bacterial bronchitis or bronchiectasis as a cause)
- acquired conditions, e.g. inhaled foreign body, gastro-oesophageal reflux, recurrent aspiration, tumour or pulmonary oedema.

### Table. Conditions that can be confused with asthma in children

<table>
<thead>
<tr>
<th>Conditions characterised by cough</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pertussis (whooping cough)</td>
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<td>Cystic fibrosis</td>
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</tr>
<tr>
<td>Protracted bacterial bronchitis in young children</td>
</tr>
<tr>
<td>Habit-cough syndrome</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Conditions characterised by wheezing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Upper airway dysfunction</td>
</tr>
<tr>
<td>Inhaled foreign body causing partial airway obstruction</td>
</tr>
<tr>
<td>Tracheobronchomalacia</td>
</tr>
</tbody>
</table>
## Conditions characterised by cough

- Hyperventilation
- Anxiety
- Breathlessness on exertion due to poor cardiopulmonary fitness
- Upper airway dysfunction

## Conditions characterised by difficulty breathing

- Persistent cough that is not associated with wheeze/breathlessness or systemic disease
- Onset of signs from birth or very early in life
- Family history of unusual chest disease
- Severe upper respiratory tract disease (e.g. severe rhinitis, enlarged tonsils and adenoids or nasal polyps)
- Crepitations on chest auscultation that do not clear on coughing
- Unilateral wheeze
- Systemic symptoms (e.g. fever, weight loss, failure to thrive)
- Feeding difficulties, including choking or vomiting
- Inspiratory upper airway noises (e.g. stridor, snoring)
- Persistent voice abnormality
- Finger clubbing

### Source

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

Last reviewed version 2.0

Asset ID: 11

### Table. Findings that require investigations in children

<table>
<thead>
<tr>
<th>Finding</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Persistent cough that is not associated with wheeze/breathlessness or systemic disease</td>
<td>Unlikely to be due to asthma</td>
</tr>
<tr>
<td>Onset of signs from birth or very early in life</td>
<td>Suggests cystic fibrosis, chronic lung disease of prematurity, primary ciliary dyskinesia, bronchopulmonary dysplasia, congenital abnormality</td>
</tr>
<tr>
<td>Family history of unusual chest disease</td>
<td>Should be enquired about before attributing all the signs and symptoms to asthma</td>
</tr>
<tr>
<td>Severe upper respiratory tract disease (e.g. severe rhinitis, enlarged tonsils and adenoids or nasal polyps)</td>
<td>Specialist assessment should be considered</td>
</tr>
<tr>
<td>Crepitations on chest auscultation that do not clear on coughing</td>
<td>Suggest a serious lower respiratory tract condition such as pneumonia, atelectasis, bronchiectasis</td>
</tr>
<tr>
<td>Unilateral wheeze</td>
<td>Suggests inhaled foreign body</td>
</tr>
<tr>
<td>Systemic symptoms (e.g. fever, weight loss, failure to thrive)</td>
<td>Suggest an alternative systemic disorder</td>
</tr>
<tr>
<td>Feeding difficulties, including choking or vomiting</td>
<td>Suggests aspiration – specialist assessment should be considered</td>
</tr>
<tr>
<td>Inspiratory upper airway noises (e.g. stridor, snoring)</td>
<td>Acute stridor suggests tracheobronchitis (croup)</td>
</tr>
<tr>
<td>Persistent voice abnormality</td>
<td>Suggests upper airway disorder</td>
</tr>
<tr>
<td>Finger clubbing</td>
<td>Suggests cystic fibrosis, bronchiectasis</td>
</tr>
</tbody>
</table>
Finding | Notes
---|---
**Chronic (>4 weeks) wet or productive cough** | Suggests cystic fibrosis, bronchiectasis, chronic bronchitis, recurrent aspiration, immune abnormality, ciliary dyskinesia

**Focal (localised) lung signs** | Suggests pneumonia

**Nasal polyps in child under 5 years old** | Suggests cystic fibrosis

**Severe chest deformity** | Harrison’s Sulcus and Pectus Carinatum can be due to uncontrolled asthma, but severe deformity suggests an alternative diagnosis

**Obvious breathing difficulty, especially at rest or at night** | Specialist assessment should be considered

**Recurrent pneumonia** | Specialist assessment should be considered

---

**More information**

**Cough and asthma in children**

**Relationship of cough to asthma in children**
- Misdiagnosis of nonspecific cough as asthma can result in overtreatment in children.
- Cough can indicate the possibility of a serious underlying illness and warrant further assessment and investigations.3

**Table. Red flags for cough in children**

- Wet or productive cough lasting more than 4 weeks
- Obvious difficulty breathing, especially at rest or at night
- Systemic symptoms: fever, failure to thrive or poor growth velocity
- Feeding difficulties (including choking or vomiting)
- Recurrent pneumonia
- Inspiratory stridor (other than during acute tracheobronchitis)
- Abnormalities on respiratory examination
- Abnormal findings on chest X-ray
- ‘Clubbing’ of fingers
Chronic cough (cough lasting more than 4 weeks) without other features of asthma is unlikely to be due to asthma.3

Cough is a frequent symptom in children with asthma, but may have a different mechanism from other symptoms of asthma (e.g. wheeze, chest tightness or breathlessness). Children who have recurrent cough, but do not wheeze, are unlikely to have asthma.4 A very small minority of children with recurrent nocturnal cough, but no other asthma symptoms, may be considered to have a diagnosis of atypical asthma.4 This diagnosis should be only made in consultation with a paediatric respiratory physician.

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

- due to protracted bacterial bronchitis (resolves with 2–6 weeks' treatment with antibiotics)3
- post-viral (resolves with time)
- due to exposure to tobacco smoke and other pollutants.3

Frequency of cough reported by parents correlates poorly with frequency measured using diary cards or by audio recording monitors.5

0-5 years

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

- Recurrent cough in preschool children, in the absence of other signs, is most likely due to recurrent viral bronchitis. Cough due to viral infection is unresponsive to bronchodilators and preventers such as montelukast, cromones or inhaled corticosteroids.
- Children attending daycare or preschool can have a succession of viral infections that merge into each other,5 giving the false appearance of chronic cough (cough lasting more than 4 weeks).

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

6 years and over

Chronic cough may be due to asthma if the cough is episodic and associated with other features of asthma such as expiratory wheeze, exercise-related breathlessness, or airflow limitation objectively demonstrated by spirometry (particularly if responsive to a bronchodilator).3

Go to: Australian Cough Guidelines

Alternative diagnoses in children

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

- protracted bacterial bronchitis3,6
- habit-cough syndrome3
- upper airway dysfunction.7

Table. Conditions that can be confused with asthma in children

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</table>
### Conditions characterised by cough

- Habit-cough syndrome

### Conditions characterised by wheezing

- Upper airway dysfunction
- Inhaled foreign body causing partial airway obstruction
- Tracheobronchomalacia

### Conditions characterised by difficulty breathing

- Hyperventilation
- Anxiety
- Breathlessness on exertion due to poor cardiopulmonary fitness
- Upper airway dysfunction

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

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

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

**Asthma less likely**

Sources


Asset ID: 12

Go to: [Australian Cough Guidelines](https://www.ncbi.nlm.nih.gov/pubmed/16473813)

References


Further investigations for wheezing in children aged 1–5 years

Recommendations

Consider allergy tests (skin prick test or specific IgE assay) for common aeroallergens for children with recurrent wheezing when the results might guide you in (either of):

- assessing the prognosis (the presence of allergies in preschool children increases the probability that the child will have asthma at primary school age)
- managing symptoms (e.g. advising parents/carers about management if avoidable allergic triggers are identified).

Notes: Allergy tests are not essential in the diagnostic investigation of asthma in children. The finding of allergic sensitisation on skin-prick testing or specific IgE does not necessarily mean that it is clinically important.

How this recommendation was developed

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

Last reviewed version 2.0

Arrange chest X-ray if the child has unusual respiratory symptoms or if wheezing is localised. Routine chest X-ray is not otherwise recommended in the investigation of asthma symptoms in children.

How this recommendation was developed

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

Measurement of exhaled nitric oxide is not recommended as a diagnostic test for asthma in routine clinical practice.

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
- Dweik et al. 2011

Routine microbiological investigations are not recommended in the investigation of symptoms that suggest asthma.

How this recommendation was developed

Consensus
Based on clinical experience and expert opinion (informed by evidence, where available), with particular reference to the following source(s):
- Brand et al. 2008
Offer referral to a specialist for further assessment and investigation if the diagnosis is unclear or if a serious condition cannot be ruled out.

**How this recommendation was developed**

Consensus

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

### More information

**Relationship of allergies to asthma**

Asthma can be atopic or non-atopic. Atopic asthma, characterised by eosinophilic airway inflammation associated with sensitisation to aeroallergens (positive skin prick test or specific immunoglobulin E on serology) is the more common form in children. Atopic asthma, characterised by eosinophilic airway inflammation associated with sensitisation to aeroallergens (positive skin prick test or specific immunoglobulin E on serology) is the more common form in children. The links between asthma and atopy are unclear. Many children with asthma are also atopic and have eczema, hay fever, or food allergies, but not all children with atopy develop asthma.

Eczema and allergic rhinitis are risk factors for developing asthma. Parental atopy has been identified as a risk factor for asthma in several studies, but the strength of the association differs between populations. A family history of atopy or asthma, or a personal history of atopy are generally considered to increase the probability that wheezing in children is due to asthma. The association between allergic rhinitis and asthma may reflect the common allergic causes of both conditions, rather than a causal link. Few studies have examined interactions between genes and environment for asthma and for atopy in the same population, and there is not consistent evidence that similar gene–environment interactions are common to asthma and atopy.

See: Allergies and asthma

**Allergy tests in children**

**Skin-prick testing**

Allergy tests have a very limited role in the clinical investigation of asthma. They may be useful to guide management if the child is sensitised to aeroallergens that are avoidable (e.g. advise parents against getting a cat if skin-prick testing has shown that the child is sensitised to cat allergens, or advise parents that there is no need to remove a family pet if the child is not sensitised).

Skin-prick testing is the recommended test for allergies in children.

Risk factors for anaphylaxis during skin prick testing are thought to include asthma (particularly uncontrolled or unstable asthma), age less than 6 months, and widespread atopic dermatitis in children. As a precaution, the Australasian Society of Clinical Immunology and Allergy (ASCIA) advises that skin prick testing should be performed only in specialist practices for children under 2 years and children with severe or unstable asthma. ASCIA's manual on skin prick testing lists other risk factors.

Go to: Australasian Society of Clinical Immunology and Allergy Skin Prick Testing Working Party's Skin prick testing for the diagnosis of allergic disease. A manual for practitioners

**Total serum IgE testing**

In children aged 0–5 years, total serum immunoglobulin E measurement is a poor predictor of allergies or asthma.

**Specific serum IgE testing**

Among children aged 1–4 years attending primary care, those with raised specific IgE for inhaled allergens (e.g. house dust mite, cat dander) are two-to-three times more likely to have asthma at age 6 than non-sensitised children. Sensitisation to hen's egg at the age of 1 year (specific IgE) is a strong predictor of allergic sensitisation to inhaled allergens at age 3 years.

See: Allergies and asthma

**Further investigations in children aged 1–5 years**

In preschool children, further investigations (other than allergy tests) are not necessary and are generally not helpful.
Investigations in a preschool child may be justified in any of the following circumstances:

- symptoms are present from birth
- airway obstruction is abnormally severe
- recovery is very slow or incomplete (resulting in prolonged or repeated hospital admission in the first few years of life)
- episodes continue in the absence of a viral infection
- when parents are very anxious.

References


Treatment trial for preschool wheeze

Recommendations

For children over 12 months old with wheezing episodes that are associated with increased work of breathing (e.g. intercostal retraction), consider a trial of treatment with an inhaled short-acting beta2 agonist given as needed.

If the child is wheezing during the consultation, administer 2–4 puffs (200–400 microg) of salbutamol via spacer and mask. Note any response to treatment (improvement in work of breathing, respiratory rate, breath sounds or wheeze).

If there is a positive response:

- show parents/carers how to give salbutamol via a pressurised metered-dose inhaler plus spacer (older preschool children) or pressurised metered-dose inhaler plus spacer and mask (infants and children unable to use spacer alone)
- tell parents/carers to give 2–4 puffs (200–400 microg) when child wheezes, and repeat if wheezing recurs
- ask parents/carers to watch closely for whether child’s breathing improves (e.g. child stops showing signs of increased work of breathing) and report effects.

If the child is not wheezing during the consultation, show parents/carers how to administer salbutamol, and ask them to trial this treatment over 1–2 days, starting the next time wheezing occurs and to monitor the response.

- If child needs salbutamol again within 4 hours, or increased work of breathing does not respond to salbutamol, parents/carers should seek urgent medical attention (go to emergency department or call 000).

Notes:
If increased work of breathing resolves in response to inhaled bronchodilator (either during a treatment trial at home or observed in the clinic or hospital), consider whether preventer is indicated.

Table. Classification of preschool wheeze and indications for preventer treatment in children aged 1–5

<table>
<thead>
<tr>
<th>Severity of flare-ups</th>
<th>Frequency of symptoms</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Symptoms every 6 months or less</td>
</tr>
<tr>
<td>Mild flare-ups (managed with salbutamol in community)</td>
<td>Not indicated</td>
</tr>
<tr>
<td>Moderate–severe flare-ups (require ED care/oral corticosteroids)</td>
<td>Indicated</td>
</tr>
</tbody>
</table>
### Severity of flare-ups | Frequency of symptoms
---|---|---|---|---
Symptoms every 6 months or less | Symptoms every 3–4 months | Symptoms every 4–6 weeks | Symptoms at least once per week

*Life-threatening flare-ups (require hospitalisation or PICU)*
- Indicated
- Indicated
- Indicated
- Indicated

**PICU**: paediatric intensive care unit; **ED**: emergency department

**Indicated**: Prescribe preventer and monitor as a treatment trial. Discontinue if ineffective.

**Not indicated**: Preventer is unlikely to be beneficial.

**Consider prescribing preventer according to overall risk for severe flare-ups**

**Symptoms**: wheeze, cough or breathlessness. May be triggered by viral infection, exercise or inhaled allergens.

**Flare-up**: increase in symptoms from usual day-to-day symptoms (ranging from worsening asthma over a few days to an acute asthma episode).

**Preventer options**: an inhaled corticosteroid (low dose) or montelukast

[!] Advise parents/carers about potential adverse behavioural and/or neuropsychiatric effects of montelukast.

**Notes:**

Preventer medication is unlikely to be beneficial in a child whose symptoms do not generally respond to salbutamol.

In children taking preventer, symptoms should be managed with a short-acting inhaled beta<sub>2</sub> agonist reliever (e.g. when child shows difficulty breathing).

*Last reviewed version 2.0*

*Asset ID: 20*

The trial can be repeated if it is inconclusive.

**How this recommendation was developed**

**Consensus**

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

*Last reviewed version 2.0*

For children aged 12 months and over with a provisional diagnosis of asthma, consider a trial of preventer treatment, if indicated.

**Table. Classification of preschool wheeze and indications for preventer treatment in children aged 1–5**

<p>| Severity of flare-ups | Frequency of symptoms |
|---|---|---|---|---|
| Symptoms every 6 months or less | Symptoms every 3–4 months | Symptoms every 4–6 weeks | Symptoms at least once per week |
| <em>Mild flare-ups (managed with salbutamol in community)</em> | Not indicated | Not indicated | Consider | Indicated |</p>
<table>
<thead>
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<td>Indicated</td>
<td>Indicated</td>
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<td>Life-threatening flare-ups (require hospitalisation or PICU)</td>
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PICU: paediatric intensive care unit; ED: emergency department

Indicated: Prescribe preventer and monitor as a treatment trial. Discontinue if ineffective.

Not indicated: Preventer is unlikely to be beneficial

Consider prescribing preventer according to overall risk for severe flare-ups

Symptoms: wheeze, cough or breathlessness. May be triggered by viral infection, exercise or inhaled allergens

Flare-up: increase in symptoms from usual day-to-day symptoms (ranging from worsening asthma over a few days to an acute asthma episode)

Preventer options: an inhaled corticosteroid (low dose) or montelukast

[!] Advise parents/carers about potential adverse behavioural and/or neuropsychiatric effects of montelukast

Notes:

Preventer medication is unlikely to be beneficial in a child whose symptoms do not generally respond to salbutamol

In children taking preventer, symptoms should be managed with a short-acting inhaled beta₂ agonist reliever (e.g. when child shows difficulty breathing).

Last reviewed version 2.0

Asset ID: 20

How this recommendation was developed

Consensus

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

Last reviewed version 2.0

If wheezing accompanied by increased work of breathing is markedly reduced during a treatment trial with a preventer, then recurs when treatment is stopped, this supports a provisional diagnosis of asthma in a preschool child.

Note: If the diagnosis is in doubt, performing spirometry later, when the child is able, may be useful to confirm the diagnosis

How this recommendation was developed

Consensus

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

Last reviewed version 2.0
**Short-acting beta-2 agonist relievers for children: 1–5 years**

**Infants under 12 months**

In infants under 12 months, bronchiolitis is the most likely cause of acute respiratory distress. Bronchodilators are not recommended in children under 12 months old, consistent with current guidelines for the management of acute bronchiolitis.1

**Children aged 1–5 years**

Inhaled short-acting beta_{2} agonists are effective bronchodilators in children aged 1–5 years.2 Short-acting beta_{2} 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 beta_{2} agonists specifically in asthma.3 Studies conducted in emergency departments have shown that short-acting beta_{2} agonists are more effective than placebo in controlling acute wheeze in children under 2 years, but may not achieve clinically significant improvements.3

Inhaled short-acting beta_{2} agonists are generally well tolerated in children aged 1–5 years.2 Adverse effects can include muscle tremor, headache, palpitations and agitation. Muscle tremor and agitation are common with initial use of standard doses, but often settle over time. Serious adverse effects such as hypokalaemia have been reported at very high doses.2

Oral short-acting beta_{2} agonists are associated with adverse effects2 and should not be used for the treatment of asthma in any age group.

**Administration of inhaled medicines in children: 1-5 years**

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

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

**Types of inhalers suitable for preschool children**

Preschool children cannot use pressurised metered-dose inhalers properly unless a spacer is attached (with mask when necessary), because it is difficult for them to coordinate inspiratory effort with actuating the device.2 Note that breath-actuated pressurised metered-dose inhalers cannot be used with a spacer.

Dry-powder inhalers are usually ineffective for preschool children because they cannot generate sufficient inspiratory air flow.2 Drug delivery is very variable in young children with any type of inhaler, including pressurised metered dose inhalers and spacers.4 Filter studies have shown high day-to-day variability in delivered doses in preschool children.4 This variation might explain fluctuations in effectiveness, even if the child’s parents have been trained to use the device correctly.

<table>
<thead>
<tr>
<th>Table. Types of inhaler devices for delivering asthma and COPD medicines</th>
</tr>
</thead>
<tbody>
<tr>
<td>Please view and print this figure separately: <a href="http://www.asthmahandbook.org.au/table/show/75">http://www.asthmahandbook.org.au/table/show/75</a></td>
</tr>
</tbody>
</table>

**Pressurised metered-dose inhalers plus spacers for relievers**

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.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.5

When administering salbutamol to relieve asthma symptoms in a preschool child, the standard recommendation is to shake the inhaler, actuate one puff at a time into the spacer and have the child take 4–6 breaths in and out of the spacer (tidal breathing).6 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.7

**Face masks for infants**

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

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

Preparation of new spacers before first use
Spacers are made of plastic, antistatic polymer/polycarbonate polyurethane, or cardboard.

Plastic spacers (e.g. Breath-A-Tech, Volumatic)
Electrostatic surface charge on new spacers made of plastic (e.g. 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 rinsing or wiping. 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 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.)

Non-plastic spacers
Disposable cardboard spacers (e.g. DispozABLE, LiteAire) and polyurethane/antistatic polymer spacers (e.g. Able A2A, AeroChamber Plus, La Petite E-Chamber, La Grande E-Chamber) do not require preparation before first use.

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.

Wheezing phenotypes in preschool children
Longitudinal population-based cohort studies of preschool children with wheezing have identified various long-term patterns (wheezing phenotypes).

<table>
<thead>
<tr>
<th>Classification system/source</th>
<th>Phenotypes identified</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tucson Children's Respiratory Study † ‡</td>
<td>Transient wheeze</td>
<td>Wheezing commences before the age of 3 years and disappear by age 6 years</td>
</tr>
<tr>
<td></td>
<td>Persistent wheeze</td>
<td>Wheezing continues until up to or after age 6 years</td>
</tr>
<tr>
<td></td>
<td>Late-onset wheeze</td>
<td>Wheezing starts after age 3 years</td>
</tr>
</tbody>
</table>

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

Last reviewed version 2.0
<table>
<thead>
<tr>
<th>Classification system/source</th>
<th>Phenotypes identified</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Avon Longitudinal Study of Parents and Children §</td>
<td>Transient early wheeze</td>
<td>Wheezing mainly occurs before 18 months, then mainly disappears by age 3.5 years</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Not associated with hypersensitivity to airborne allergens</td>
</tr>
<tr>
<td></td>
<td>Prolonged early wheeze</td>
<td>Wheezing occurs mainly between age 6 months and 4.5 years, then mainly disappears before child’s 6th birthday</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Not associated with hypersensitivity to airborne allergens</td>
</tr>
<tr>
<td></td>
<td></td>
<td>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>Intermediate-onset wheeze</td>
<td>Wheezing begins sometime after age 18 months and before 3.5 years.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>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>Late-onset wheeze</td>
<td>Wheezing mainly begins after age 3.5 years</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Strongly associated with atopy (especially house mite, cat allergen, grass pollen)</td>
</tr>
<tr>
<td></td>
<td>Persistent wheeze</td>
<td>Wheezing mainly begins after 6 months and continues through to primary school</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Strongly associated with atopy</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**


Early childhood wheezing phenotypes cannot be recognised or applied clinically, because they are recognised retrospectively.² In an individual child with episodic wheeze, it is not possible to accurately predict epidemiological phenotype from clinical phenotype.² Currently available tools for predicting whether a wheezing preschool child will have asthma at school age (e.g. the Asthma Predictive Index¹²) have limited clinical value.¹³

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References


Diagnosis: age 6 and over

In this section

*History and physical examination*
Taking a history and performing physical examination for a wheezing child aged 6 years or over

*Lung function*
Assessing lung function in children 6 years and over
http://www.asthmahandbook.org.au/diagnosis/children/6-years-and-over/lung-function

*Differential diagnosis*
Considering alternative or comorbid conditions in children with asthma-like symptoms aged 6 years and over

*Further investigations*
The role of further investigations for asthma-like symptoms in children aged 6 years and over
http://www.asthmahandbook.org.au/diagnosis/children/6-years-and-over/further-investigations

*Treatment trial*
Making a provisional diagnosis of asthma and conducting a treatment trial for children aged 6 years and over
http://www.asthmahandbook.org.au/diagnosis/children/6-years-and-over/provisional-diagnosis
History and physical examination for a wheezing child aged 6 years or over

Recommendations

Ask about:

- current symptoms
- pattern of symptoms, including frequency and timing of wheezing episodes (whether they occur only when child has a viral cold, or are unrelated to colds, and whether child coughs or wheezes at other times, e.g. when playing or laughing)
- appearance of child’s chest during episodes of noisy breathing to identify chest recession (e.g. ask whether chest appears to be sucked inwards as child breathes in)
- whether child is generally alert, active, socially responsive, joins in play with other children
- home environment (e.g. exposure to smoke, pets)
- allergies, including atopic dermatitis (eczema) and allergic rhinitis ('hay fever')
- family history of asthma and allergies.

Conduct a general physical examination, including:

- height and weight compared with normal range for age
- inspection of chest for deformity
- inspection of upper airway for signs of allergic rhinitis (e.g. swollen turbinates, transverse nasal crease, mouth breathing, darkness and swelling under eyes caused by sinus congestion) or polyps
- auscultation of chest
- inspection of fingers for clubbing (requires investigation)
- skin inspection for atopic dermatitis (eczema).

Table. Findings that require investigations in children

<table>
<thead>
<tr>
<th>Finding</th>
<th>Notes</th>
</tr>
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<td>Unlikely to be due to asthma</td>
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<td>Onset of signs from birth or very early in life</td>
<td>Suggests cystic fibrosis, chronic lung disease of prematurity, primary ciliary dyskinesia, bronchopulmonary dysplasia, congenital abnormality</td>
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<td>Family history of unusual chest disease</td>
<td>Should be enquired about before attributing all the signs and symptoms to asthma</td>
</tr>
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<td>Finding</td>
<td>Notes</td>
</tr>
<tr>
<td>------------------------------------------------------------------------</td>
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</tr>
<tr>
<td>Severe upper respiratory tract disease (e.g. severe rhinitis, enlarged tonsils and adenoids or nasal polyps)</td>
<td>Specialist assessment should be considered</td>
</tr>
<tr>
<td>Crepitations on chest auscultation that do not clear on coughing</td>
<td>Suggest a serious lower respiratory tract condition such as pneumonia, atelectasis, bronchiectasis</td>
</tr>
<tr>
<td>Unilateral wheeze</td>
<td>Suggests inhaled foreign body</td>
</tr>
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<td>Systemic symptoms (e.g. fever, weight loss, failure to thrive)</td>
<td>Suggest an alternative systemic disorder</td>
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<td>Feeding difficulties, including choking or vomiting</td>
<td>Suggests aspiration – specialist assessment should be considered</td>
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<td>Recurrent pneumonia</td>
<td>Specialist assessment should be considered</td>
</tr>
</tbody>
</table>

Asset ID: 59

🔍 How this recommendation was developed

Consensus

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

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Identify any signs and symptoms that suggest an alternative diagnosis and which require investigation.

Table. Findings that require investigations in children
Finding Notes

Asset ID: 59

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):

- Weinberger and Abu-Hasan, 2007
- Gibson et al. 2010

More information

Definition of wheeze

Wheeze is defined as a high-pitched sound coming from the chest during inspiration or expiration. It is a non-specific sign caused by turbulent airflow due to narrowing of intrathoracic airways and indicates expiratory airflow limitation, irrespective of the underlying mechanism (e.g. bronchoconstriction or secretions in the airway lumen).

Inspiratory sounds (e.g. rattling or stridor) should not be described as ‘wheeze’.

Various forms of noisy breathing, including wheezing, are common among babies and preschoolers. Noisy breathing is particularly common among infants under 6 months old, but only a small proportion have wheeze.

Parents and doctors sometimes use the word ‘wheeze’ to mean different things, including cough, gasp, a change in breathing rate or style of breathing. If based on parental report alone, children may be labelled as having wheeze when they do not have narrowed airways and expiratory airflow limitation.

There are no validated questionnaire-based instruments to identify wheeze in preschoolers, so wheezing is best confirmed by listening with a stethoscope during an episode.

Reported noisy breathing that responds to bronchodilator therapy is likely to be genuine wheeze and to be caused, at least in part, by constriction of airway smooth muscle.

Relationship of allergies to asthma

Asthma can be atopic or non-atopic. Atopic asthma, characterised by eosinophilic airway inflammation associated with sensitisation to aeroallergens (positive skin prick test or specific immunoglobulin E on serology) is the more common form in children.

The links between asthma and atopy are unclear. Many children with asthma are also atopic and have eczema, hay fever, or food allergies, but not all children with atopy develop asthma.

Eczema and allergic rhinitis are risk factors for developing asthma. Parental atopy has been identified as a risk factor for asthma in several studies, but the strength of the association differs between populations.

A family history of atopy or asthma, or a personal history of atopy are generally considered to increase the probability that wheezing in children is due to asthma.

The association between allergic rhinitis and asthma may reflect the common allergic causes of both conditions, rather than a causal link. However, few studies have examined interactions between genes and environment for asthma and for atopy in the same population, and there is not consistent evidence that similar gene–environment interactions are common to asthma and atopy.

See: Allergies and asthma

Diagnostic difficulties when investigating asthma-like symptoms in adolescents

Asthma is commonly misdiagnosed in young people presenting with exercise-related symptoms or cough. Conditions associated with
dyspnoea include hyperventilation, anxiety, and poor cardiopulmonary fitness.\textsuperscript{1} Both denial and overplay of symptoms has been observed among adolescents.\textsuperscript{13} Adolescents with new or re-emerging asthma symptoms may deny their symptoms.\textsuperscript{13} US data suggest that risk factors for undiagnosed asthma among adolescents include female sex, smoking (current smoking and exposure to others’ smoke), low socioeconomic status, family problems, low physical activity and high body mass.\textsuperscript{14}

**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.\textsuperscript{15}

When adolescents are accompanied by parents or carers, health care providers should consider seeing the adolescent alone for part of each consultation.\textsuperscript{15}

Health professionals should discuss confidentiality and its limits with adolescents.\textsuperscript{15} Adolescents are more willing to communicate honestly with healthcare professionals who discuss confidentiality with them.\textsuperscript{16}

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.\textsuperscript{15}

Go to: Royal Australasian College of Physicians’ Working with young people online resource (see Privacy and confidentiality in adolescent health care in Topic 2: Ethical and legal issues)

Go to: Australian Government Department of Human Services’ Financial and health support for young people webpage

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**Exercise-related symptoms in adolescents**

In adolescents, exercise-related wheezing and breathlessness are poor predictors of exercise-induced bronchoconstriction. Only a minority of adolescents referred for assessment of exercise-induced respiratory symptoms show objective evidence of exercise-induced bronchoconstriction.\textsuperscript{17}

For adolescents with exercise-related symptoms, common conditions that should be considered in the differential diagnosis include poor cardiopulmonary fitness, exercise-induced upper airway dysfunction and exercise-induced hyperventilation.\textsuperscript{13, 18}

In addition to spirometry, other objective tests (e.g. cardiopulmonary fitness testing, bronchial provocation tests) may be helpful to clarify the diagnosis and inform management.

Go to: Investigation and management of exercise-induced bronchoconstriction

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**References**


Assessing lung function in children 6 years and over

Recommendations

In children able to perform spirometry, measure bronchodilator reversibility by performing spirometry before and after giving inhaled rapid-onset beta2 agonist bronchodilator (e.g. 4 puffs of salbutamol 100 microg/actuation) by metered-dose inhaler and spacer.

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.

Airflow limitation is defined as reversible (i.e. bronchodilator response is clinically important) if FEV1 increases by $\geq 12\%$.

Operators who perform spirometry should receive comprehensive training to ensure good quality.

Operators who perform spirometry should receive comprehensive training to ensure good quality.

More information

Role of spirometry in the diagnosis of asthma in children

Generally, spirometry cannot be performed to acceptable standards in children younger than 4–5 years. Some older children cannot perform spirometry either. However, children who are unable to perform spirometry satisfactorily on their first visit are often able to perform the test correctly at the next visit.

Normal spirometry in a child, especially when asymptomatic, does not exclude the diagnosis of asthma. FEV1 is often normal in children with persistent asthma.

Reduced FEV1 alone does not indicate that a child has asthma, because it may be seen with other lung diseases (or be due to poor spirometric technique). However, reduced ratio of FEV1 to FVC for age indicates expiratory airflow limitation.

A significant increase in FEV1 ($\geq 12\%$ from baseline) after administering a bronchodilator (e.g. 2–4 puffs of salbutamol 100 microg/actuation) indicates that airflow limitation is reversible and supports the diagnosis of asthma. However, an absent response to bronchodilators does not exclude asthma.

In children with asthma, bronchodilator reversibility is also predictive of a good lung function response to inhaled corticosteroids.

- Go to: National Asthma Council Australia’s Spirometry Resources

Bronchial provocation (challenge) tests in children

How this recommendation was developed

Consensus

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

Last reviewed version 2.0

How this recommendation was developed

Consensus

Based on clinical experience and expert opinion (informed by evidence, where available).
Clinical assessment is more sensitive for confirming the diagnosis of asthma than tests for airway hyperresponsiveness. The main roles of bronchial provocation (challenge) tests of airway hyperresponsiveness (airway hyperreactivity) are to confirm or exclude asthma as the cause of current symptoms, including exercise-associated respiratory symptoms such as dyspnoea or noisy breathing.

Challenge tests are performed in accredited lung function testing laboratories. These tests are usually difficult to perform in children under 8 years of age because they involve repeated spirometry tests. If challenge testing is needed, consider referring to a paediatric respiratory physician for investigation, or discussing with a paediatric respiratory physician before selecting which test to order. Do not test during a respiratory infection, or initiate inhaled corticosteroid treatment a few weeks before challenge testing, because these could invalidate the result.

Bronchial provocation tests of airway hyperresponsiveness include:

- exercise challenge test
- mannitol challenge test
- methacholine challenge test

Roles of other lung function tests in diagnosing asthma in children

Peak expiratory flow meters in asthma diagnosis

Using a peak flow meter to measure peak expiratory flow in children does not reliably rule the diagnosis of asthma in or out.

Newer tests under investigation

Impulse oscillometry, tests of specific airways resistance, and measurements of residual volume are being investigated for use in asthma diagnosis and management, but their availability is mainly restricted to specialist and research centres.

References

Differential diagnosis for asthma-like symptoms in children aged 6 years and over

Recommendations

Consider features that increase or reduce the probability of asthma.

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

<table>
<thead>
<tr>
<th>Asthma more likely</th>
<th>Asthma less likely</th>
</tr>
</thead>
<tbody>
<tr>
<td>More than one of:</td>
<td>Any of:</td>
</tr>
<tr>
<td>• wheeze</td>
<td>• symptoms only occur when child has a cold, but not between colds</td>
</tr>
<tr>
<td>• difficulty breathing</td>
<td>• isolated cough in the absence of wheeze or difficulty breathing</td>
</tr>
<tr>
<td>• feeling of tightness in the chest</td>
<td>• history of moist cough</td>
</tr>
<tr>
<td>• cough</td>
<td>• dizziness, light-headedness or peripheral tingling</td>
</tr>
<tr>
<td><strong>AND</strong></td>
<td>• repeatedly normal physical examination of chest when symptomatic</td>
</tr>
<tr>
<td>Any of:</td>
<td>• normal spirometry when symptomatic (children old enough to perform spirometry)</td>
</tr>
<tr>
<td>• symptoms recur frequently</td>
<td>• no response to a trial of asthma treatment</td>
</tr>
<tr>
<td>• symptoms worse at night and in the early morning</td>
<td>• clinical features that suggest an alternative diagnosis</td>
</tr>
<tr>
<td>• symptoms triggered by exercise, exposure to pets,</td>
<td></td>
</tr>
<tr>
<td>cold air, damp air, emotions, laughing</td>
<td></td>
</tr>
<tr>
<td>• symptoms occur when child doesn’t have a cold</td>
<td></td>
</tr>
<tr>
<td>• history of allergies (e.g. allergic rhinitis, atopic</td>
<td></td>
</tr>
<tr>
<td>dermatitis)</td>
<td></td>
</tr>
<tr>
<td>• family history of allergies</td>
<td></td>
</tr>
<tr>
<td>• family history of asthma</td>
<td></td>
</tr>
<tr>
<td>• widespread wheeze heard on auscultation</td>
<td></td>
</tr>
<tr>
<td>• symptoms respond to treatment trial of reliever, with</td>
<td></td>
</tr>
<tr>
<td>or without a preventer</td>
<td></td>
</tr>
<tr>
<td>• lung function measured by spirometry increases in</td>
<td></td>
</tr>
<tr>
<td>response to rapid-acting bronchodilator</td>
<td></td>
</tr>
<tr>
<td>• lung function measured by spirometry increases in</td>
<td></td>
</tr>
<tr>
<td>response to a treatment trial with inhaled corticosteroid</td>
<td></td>
</tr>
<tr>
<td>(where indicated)</td>
<td></td>
</tr>
</tbody>
</table>

Sources
Do not assume that cough is due to asthma in the absence of wheezing or breathlessness. Misdiagnosis of asthma in a child with nonspecific cough can result in overtreatment in children.

If cough is a prominent symptom, investigate according to the current Australian Cough Guidelines.

Table. Conditions that can be confused with asthma in children

<table>
<thead>
<tr>
<th>Conditions characterised by cough</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pertussis (whooping cough)</td>
</tr>
<tr>
<td>Post-viral cough</td>
</tr>
<tr>
<td>Cystic fibrosis</td>
</tr>
</tbody>
</table>
Conditions characterised by cough

- Airway abnormalities (e.g. tracheobronchomalacia)
- Protracted bacterial bronchitis in young children
- Habit-cough syndrome

Conditions characterised by wheezing

- Upper airway dysfunction
- Inhaled foreign body causing partial airway obstruction
- Tracheobronchomalacia

Conditions characterised by difficulty breathing

- Hyperventilation
- Anxiety
- Breathlessness on exertion due to poor cardiopulmonary fitness
- Upper airway dysfunction

Source


Last reviewed version 2.0
Asset ID: 11

Table. Findings that require investigations in children

<table>
<thead>
<tr>
<th>Finding</th>
<th>Notes</th>
</tr>
</thead>
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<tr>
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<td>Family history of unusual chest disease</td>
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<tr>
<td>Severe upper respiratory tract disease (e.g. severe rhinitis, enlarged tonsils and adenoids or nasal polyps)</td>
<td>Specialist assessment should be considered</td>
</tr>
<tr>
<td>Crepitations on chest auscultation that do not clear on coughing</td>
<td>Suggest a serious lower respiratory tract condition such as pneumonia, atelectasis, bronchiectasis</td>
</tr>
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<td>Notes</td>
</tr>
<tr>
<td>------------------------------------------------------------------------</td>
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</tr>
<tr>
<td>Systemic symptoms (e.g. fever, weight loss, failure to thrive)</td>
<td>Suggest an alternative systemic disorder</td>
</tr>
<tr>
<td>Feeding difficulties, including choking or vomiting</td>
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<td>Finger clubbing</td>
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<tr>
<td>Recurrent pneumonia</td>
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</tr>
</tbody>
</table>

Asset ID: 59

How this recommendation was developed
Consensus
Based on clinical experience and expert opinion (informed by evidence, where available).
Last reviewed version 2.0

More information

Cough and asthma in children

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

Table. Red flags for cough in children

<table>
<thead>
<tr>
<th>Wet or productive cough lasting more than 4 weeks</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Obvious difficulty breathing, especially at rest or at night
Systemic symptoms: fever, failure to thrive or poor growth velocity
Feeding difficulties (including choking or vomiting)
Recurrent pneumonia
Inspiratory stridor (other than during acute tracheobronchitis)
Abnormalities on respiratory examination
Abnormal findings on chest X-ray
‘Clubbing’ of fingers

Chronic cough (cough lasting more than 4 weeks) without other features of asthma is unlikely to be due to asthma.³

Cough is a frequent symptom in children with asthma, but may have a different mechanism from other symptoms of asthma (e.g. wheeze, chest tightness or breathlessness). Children who have recurrent cough, but do not wheeze, are unlikely to have asthma.⁴ A very small minority of children with recurrent nocturnal cough, but no other asthma symptoms, may be considered to have a diagnosis of atypical asthma.⁴ This diagnosis should be only made in consultation with a paediatric respiratory physician.

In children with no abnormalities detected on physical examination, chest X-ray or spirometry, and no wheezing or breathlessness, chronic cough is most likely:³

- due to protracted bacterial bronchitis (resolves with 2–6 weeks' treatment with antibiotics)³
- post-viral (resolves with time)
- due to exposure to tobacco smoke and other pollutants.³

Frequency of cough reported by parents correlates poorly with frequency measured using diary cards or by audio recording monitors.⁵

0-5 years
Most cases of coughing in preschool children are not due to asthma:

- Recurrent cough in preschool children, in the absence of other signs, is most likely due to recurrent viral bronchitis. Cough due to viral infection is unresponsive to bronchodilators and preventers such as montelukast, cromones or inhaled corticosteroids.
- Children attending day care or preschool can have a succession of viral infections that merge into each other,⁵ giving the false appearance of chronic cough (cough lasting more than 4 weeks).

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

6 years and over
Chronic cough may be due to asthma if the cough is episodic and associated with other features of asthma such as expiratory wheeze, exercise-related breathlessness, or airflow limitation objectively demonstrated by spirometry (particularly if responsive to a bronchodilator).³

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

- protracted bacterial bronchitis³, ⁶
- habit-cough syndrome³
- upper airway dysfunction.⁷
### Table. Conditions that can be confused with asthma in children

<table>
<thead>
<tr>
<th>Conditions characterised by cough</th>
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</thead>
<tbody>
<tr>
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<td>Habit-cough syndrome</td>
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<td>Breathlessness on exertion due to poor cardiopulmonary fitness</td>
</tr>
<tr>
<td>Upper airway dysfunction</td>
</tr>
</tbody>
</table>

**Source**

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

Last reviewed version 2.0
Asset ID: 11

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

<table>
<thead>
<tr>
<th>Asthma more likely</th>
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</tr>
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<tbody>
<tr>
<td>More than one of:</td>
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<td>• wheeze</td>
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<td>• dizziness, light-headedness or peripheral tingling</td>
</tr>
<tr>
<td><strong>AND</strong></td>
<td></td>
</tr>
</tbody>
</table>
### Asthma more likely

- Any of:
  - symptoms recur frequently
  - symptoms worse at night and in the early morning
  - symptoms triggered by exercise, exposure to pets, cold air, damp air, emotions, laughing
  - symptoms occur when child doesn’t have a cold
  - history of allergies (e.g. allergic rhinitis, atopic dermatitis)
  - family history of allergies
  - family history of asthma
  - widespread wheeze heard on auscultation
  - symptoms respond to treatment trial of reliever, with or without a preventer
  - lung function measured by spirometry increases in response to rapid-acting bronchodilator
  - lung function measured by spirometry increases in response to a treatment trial with inhaled corticosteroid (where indicated)

### Asthma less likely

- repeatedly normal physical examination of chest when symptomatic
- normal spirometry when symptomatic (children old enough to perform spirometry)
- no response to a trial of asthma treatment
- clinical features that suggest an alternative diagnosis

### Sources


Asset ID: 12

### Go to: Australian Cough Guidelines

### Diagnostic difficulties when investigating asthma-like symptoms in adolescents

Asthma is commonly misdiagnosed in young people presenting with exercise-related symptoms or cough. Conditions associated with dyspnoea include hyperventilation, anxiety, and poor cardiopulmonary fitness.

Both denial and overplay of symptoms has been observed among adolescents. Adolescents with new or re-emerging asthma symptoms may deny their symptoms. US data suggest that risk factors for undiagnosed asthma among adolescents include female sex, smoking (current smoking and exposure to others' smoke), low socioeconomic status, family problems, low physical activity and high body mass.

### Exercise-related symptoms in adolescents

In adolescents, exercise-related wheezing and breathlessness are poor predictors of exercise-induced bronchoconstriction. Only a minority of adolescents referred for assessment of exercise-induced respiratory symptoms show objective evidence of exercise-induced bronchoconstriction.

For adolescents with exercise-related symptoms, common conditions that should be considered in the differential diagnosis include poor cardiopulmonary fitness, exercise-induced upper airway dysfunction and exercise-induced hyperventilation.

In addition to spirometry, other objective tests (e.g. cardiopulmonary fitness testing, bronchial provocation tests) may be helpful to
clarify the diagnosis and inform management.

► See: Investigation and management of exercise-induced bronchoconstriction

References

Further investigations for wheezing in children aged 6 years and over

Recommendations

Consider skin prick testing for common aeroallergens for children with recurrent wheezing when the results might guide you in managing symptoms (e.g. advising parents/carers about management if avoidable allergic triggers are identified).

Notes:
Allergy tests are not essential in the diagnostic investigation of asthma in children. The finding of allergic sensitisation on skin-prick testing or specific IgE does not necessarily mean that it is clinically important.
Blood test (immunoassay for allergen-specific immunoglobulin E) can be used if skin prick testing is unavailable, impractical or inappropriate.

How this recommendation was developed
Consensus
Based on clinical experience and expert opinion (informed by evidence, where available).
Last reviewed version 2.0

If the diagnosis is uncertain, consider arranging bronchial provocation (challenge) testing.

How this recommendation was developed
Consensus
Based on clinical experience and expert opinion (informed by evidence, where available).
Last reviewed version 2.0

Arrange chest X-ray if the child has unusual respiratory symptoms or if wheezing is localised. Routine chest X-ray is not otherwise recommended in the investigation of asthma symptoms in children.

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

Measurement of exhaled nitric oxide is not recommended as a diagnostic test for asthma in routine clinical practice.

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
- Dweik et al. 2011

Routine microbiological investigations are not recommended in the investigation of symptoms that suggest asthma.

How this recommendation was developed
Consensus
Offer referral to a specialist for further assessment and investigation if the diagnosis is unclear or if a serious condition cannot be ruled out.

More information

**Relationship of allergies to asthma**

Asthma can be atopic or non-atopic. Atopic asthma, characterised by eosinophilic airway inflammation associated with sensitisation to aeroallergens (positive skin prick test or specific immunoglobulin E on serology) is the more common form in children.3

The links between asthma and atopy are unclear.4 Many children with asthma are also atopic and have eczema, hay fever, or food allergies, but not all children with atopy develop asthma.4

Eczema and allergic rhinitis are risk factors for developing asthma.5, 6, 7, 8, 9, 10 Parental atopy has been identified as a risk factor for asthma in several studies, but the strength of the association differs between populations.11

A family history of atopy or asthma, or a personal history of atopy are generally considered to increase the probability that wheezing in children is due to asthma.

The association between allergic rhinitis and asthma may reflect the common allergic causes of both conditions, rather than a causal link.10 However, few studies have examined interactions between genes and environment for asthma and for atopy in the same population, and there is not consistent evidence that similar gene–environment interactions are common to asthma and atopy.4

➤ See: Allergies and asthma

**Allergy tests in children**

**Skin-prick testing**

Allergy tests have a very limited role in the clinical investigation of asthma. They may be useful to guide management if the child is sensitised to aeroallergens that are avoidable (e.g. advise parents against getting a cat if skin-prick testing has shown that the child is sensitised to cat allergens, or advise parents that there is no need to remove a family pet if the child is not sensitised).

Skin-prick testing is the recommended test for allergies in children.

Risk factors for anaphylaxis during skin prick testing are thought to include asthma (particularly uncontrolled or unstable asthma), age less than 6 months, and widespread atopic dermatitis in children.12 As a precaution, the Australasian Society of Clinical Immunology and Allergy (ASCIA) advises that skin prick testing should be performed only in specialist practices for children under 2 years and children with severe or unstable asthma.12 ASCIA’s manual on skin prick testing lists other risk factors.12

➤ Go to: Australasian Society of Clinical Immunology and Allergy Skin Prick Testing Working Party’s Skin prick testing for the diagnosis of allergic disease. A manual for practitioners

**Total serum IgE testing**

In children aged 0–5 years, total serum immunoglobulin E measurement is a poor predictor of allergies or asthma.1

**Specific serum IgE testing**

Among children aged 1–4 years attending primary care, those with raised specific IgE for inhaled allergens (e.g. house dust mite, cat dander) are two-to-three times more likely to have asthma at age 6 than non-sensitised children.1 Sensitisation to hen’s egg at the age of 1 year (specific IgE) is a strong predictor of allergic sensitisation to inhaled allergens at age 3 years.1
**Bronchial provocation (challenge) tests in children**

Clinical assessment is more sensitive for confirming the diagnosis of asthma than tests for airway hyperresponsiveness. The main roles of bronchial provocation (challenge) tests of airway hyperresponsiveness (airway hyperreactivity) are to confirm or exclude asthma as the cause of current symptoms, including exercise-associated respiratory symptoms such as dyspnoea or noisy breathing.13, 14

Challenge tests are performed in accredited lung function testing laboratories. These tests are usually difficult to perform in children under 8 years of age because they involve repeated spirometry tests.

If challenge testing is needed, consider referring to a paediatric respiratory physician for investigation, or discussing with a paediatric respiratory physician before selecting which test to order.

Do not test during a respiratory infection, or initiate inhaled corticosteroid treatment a few weeks before challenge testing, because these could invalidate the result.

Bronchial provocation tests of airway hyperresponsiveness include:

- exercise challenge test15
- mannitol challenge test16, 17
- methacholine challenge test.18, 19

**Roles of other lung function tests in diagnosing asthma in children**

**Peak expiratory flow meters in asthma diagnosis**

Using a peak flow meter to measure peak expiratory flow in children does not reliably rule the diagnosis of asthma in or out.

**Newer tests under investigation**

Impulse oscillometry, tests of specific airways resistance, and measurements of residual volume are being investigated for use in asthma diagnosis and management,20, 21 but their availability is mainly restricted to specialist and research centres.

*Last reviewed version 2.0*

**Cardiopulmonary exercise challenge test**

Cardiopulmonary exercise (stress) testing may be appropriate to assess cardiopulmonary fitness and identify respiratory or cardiac limitation of exercise in children presenting with exercise associated respiratory symptoms such as dyspnoea or noisy breathing.

**Further investigations in children**

**Microbiological investigation**

Microbiological investigations are not routinely recommended in children because the result does not alter management decisions, even though respiratory viruses can be identified.1

However, it may be useful to identify the virus in atypical cases (e.g. children with severe viral infections or *Mycoplasma* infections).

**Chest X-ray and other imaging technologies**

Chest X-ray should be ordered when a child’s symptoms and signs suggest an alternative diagnosis that can be identified or ruled out by X-ray.

A chest X-ray will neither establish nor rule out a diagnosis of asthma.1

**Exhaled nitric oxide testing**

The exhaled nitric oxide test is not currently available as a standard clinical test for the diagnosis of asthma and is mainly a research tool at present. Standardised reference values are available for children aged 4 years and older.1

**Induced sputum**

The sputum test for airway inflammation is not used in the diagnosis of asthma clinical practice.

**White cell count**

Blood eosinophil level is a component of the Asthma Predictive Index.22 However, this test is not routinely
recommended because the Asthma Predictive Index has limited clinical value in predicting whether a wheezing preschool child will have asthma at school age.\textsuperscript{1, 23}

**Invasive tests**

Airway wall biopsy and bronchoalveolar lavage are invasive investigations. These should only be used in unusual cases, and must be performed in specialised centres.\textsuperscript{1}

## References


2. Dweik RA, Boggs PB, Erzurum SC,\textit{ et al.} An Official ATS Clinical Practice Guideline: Interpretation of Exhaled Nitric Oxide Levels (FeNO) for Clinical Applications.\textit{ Am J Respir Crit Care Med}. 2011; 184: 602-615. Available from: \url{http://ajrccm.atsjournals.org/content/184/5/602.long}


**Provisional diagnosis and treatment trial for asthma in a child aged 6 years and over**

**Recommendations**

A provisional diagnosis of asthma can be made if the child has (all of):

- wheezing accompanied by breathing difficulty or cough
- other features that increase the probability of asthma such as a history of allergic rhinitis, atopic dermatitis or a strong family history of asthma and allergies
- no signs or symptoms that suggest a serious alternative diagnosis
- clinically important response to bronchodilator demonstrated on spirometry performed before and after short-acting beta$_2$ agonist (if child is able to perform spirometry).

**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.

Airflow limitation is defined as reversible (i.e. bronchodilator response is clinically important) if FEV$_1$ increases by $\geq 12\%$.

If spirometry does not demonstrate a clinically important response to bronchodilator, the test can be repeated when the child has symptoms.

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

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</tr>
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</tr>
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<td></td>
</tr>
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Sources


Asset ID: 12

Table. Conditions that can be confused with asthma in children

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<td>Anxiety</td>
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<td>Breathlessness on exertion due to poor cardiopulmonary fitness</td>
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<tr>
<td>Upper airway dysfunction</td>
</tr>
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</table>
Table. Findings that require investigations in children

<table>
<thead>
<tr>
<th>Finding</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Persistent cough that is not associated with wheeze/breathlessness or systemic disease</td>
<td>Unlikely to be due to asthma</td>
</tr>
<tr>
<td>Onset of signs from birth or very early in life</td>
<td>Suggests cystic fibrosis, chronic lung disease of prematurity, primary ciliary dyskinesia, bronchopulmonary dysplasia, congenital abnormality</td>
</tr>
<tr>
<td>Family history of unusual chest disease</td>
<td>Should be enquired about before attributing all the signs and symptoms to asthma</td>
</tr>
<tr>
<td>Severe upper respiratory tract disease (e.g. severe rhinitis, enlarged tonsils and adenoids or nasal polyps)</td>
<td>Specialist assessment should be considered</td>
</tr>
<tr>
<td>Crepitations on chest auscultation that do not clear on coughing</td>
<td>Suggest a serious lower respiratory tract condition such as pneumonia, atelectasis, bronchiectasis</td>
</tr>
<tr>
<td>Unilateral wheeze</td>
<td>Suggests inhaled foreign body</td>
</tr>
<tr>
<td>Systemic symptoms (e.g. fever, weight loss, failure to thrive)</td>
<td>Suggest an alternative systemic disorder</td>
</tr>
<tr>
<td>Feeding difficulties, including choking or vomiting</td>
<td>Suggests aspiration – specialist assessment should be considered</td>
</tr>
<tr>
<td>Inspiratory upper airway noises (e.g. stridor, snoring)</td>
<td>Acute stridor suggests tracheobronchitis (croup)</td>
</tr>
<tr>
<td>Persistent voice abnormality</td>
<td>Suggests upper airway disorder</td>
</tr>
<tr>
<td>Finger clubbing</td>
<td>Suggests cystic fibrosis, bronchiectasis</td>
</tr>
<tr>
<td>Chronic (&gt;4 weeks) wet or productive cough</td>
<td>Suggests cystic fibrosis, bronchiectasis, chronic bronchitis, recurrent aspiration, immune abnormality, ciliary dyskinesia</td>
</tr>
<tr>
<td>Focal (localised) lung signs</td>
<td>Suggests pneumonia</td>
</tr>
<tr>
<td>Nasal polyps in child under 5 years old</td>
<td>Suggests cystic fibrosis</td>
</tr>
<tr>
<td>Severe chest deformity</td>
<td>Harrison’s Sulcus and Pectus Carinatum can be due to uncontrolled asthma, but severe deformity suggests an alternative diagnosis</td>
</tr>
<tr>
<td>Finding</td>
<td>Notes</td>
</tr>
<tr>
<td>---------------------------------------</td>
<td>--------------------------------------------</td>
</tr>
<tr>
<td>Obvious breathing difficulty, especially at rest or at night</td>
<td>Specialist assessment should be considered</td>
</tr>
<tr>
<td>Recurrent pneumonia</td>
<td>Specialist assessment should be considered</td>
</tr>
</tbody>
</table>

Assess and record frequency and severity of symptoms, including flare-ups.

![How this recommendation was developed](Consensus)

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

Trial treatment with short-acting beta$_2$ agonist reliever as needed, or with regular preventer (and reliever as needed), as indicated.

Table. Classification of asthma and indications for initiating preventer treatment in children aged 6 - 11

<table>
<thead>
<tr>
<th>Severity of flare-ups</th>
<th>Average frequency of flare-ups and symptoms between flare-ups</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Infrequent intermittent Flare-ups every 6 weeks or less and no symptoms between flare-ups</td>
</tr>
<tr>
<td>Mild flare-ups (almost always managed with</td>
<td>Not indicated</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>
**Table. Definitions of ICS dose levels in children**

<table>
<thead>
<tr>
<th>Inhaled corticosteroid</th>
<th>Daily dose (microg)</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

Last reviewed version 2.0
Asset ID: 21
Assess response after 4–6 weeks and review before prescribing long term. At this follow-up, discontinue if ineffective. See: Reviewing initial treatment in children aged 6 years and over

How this recommendation was developed
Consensus
Based on clinical experience and expert opinion (informed by evidence, where available).
Last reviewed version 2.0

If cough does not respond to a treatment trial with a preventer, cease treatment instead of increasing the dose.

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

Repeat the treatment trial if the effect on symptoms is unclear.

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

More information

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

Table. Classification of preschool wheeze and indications for preventer treatment in children aged 1–5

<table>
<thead>
<tr>
<th>Severity of flare-ups</th>
<th>Frequency of symptoms</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Symptoms every 6 months or less</td>
</tr>
<tr>
<td>Mild flare-ups (managed with salbutamol in community)</td>
<td>Not indicated</td>
</tr>
<tr>
<td>Moderate–severe flare-ups (require ED care/oral corticosteroids)</td>
<td>Indicated</td>
</tr>
</tbody>
</table>
## Severity of flare-ups

<table>
<thead>
<tr>
<th>Frequency of symptoms</th>
<th>Symptoms every 6 months or less</th>
<th>Symptoms every 3–4 months</th>
<th>Symptoms every 4–6 weeks</th>
<th>Symptoms at least once per week</th>
</tr>
</thead>
<tbody>
<tr>
<td>Life-threatening flare-ups</td>
<td>Indicated</td>
<td>Indicated</td>
<td>Indicated</td>
<td>Indicated</td>
</tr>
<tr>
<td>(require hospitalisation or PICU)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

PICU: paediatric intensive care unit; ED: emergency department

Indicated: Prescribe preventer and monitor as a treatment trial. Discontinue if ineffective.

Not indicated: Preventer is unlikely to be beneficial

Consider prescribing preventer according to overall risk for severe flare-ups

**Symptoms**: wheeze, cough or breathlessness. May be triggered by viral infection, exercise or inhaled allergens

**Flare-up**: Increase in symptoms from usual day-to-day symptoms (ranging from worsening asthma over a few days to an acute asthma episode)

Preventer options: an inhaled corticosteroid (low dose) or montelukast

[!] Advise parents/carers about potential adverse behavioural and/or neuropsychiatric effects of montelukast

**Notes:**

Preventer medication is unlikely to be beneficial in a child whose symptoms do not generally respond to salbutamol

In children taking preventer, symptoms should be managed with a short-acting inhaled beta₂ agonist reliever (e.g. when child shows difficulty breathing).

*Last reviewed version 2.0*

**Asset ID: 20**

### 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**

<table>
<thead>
<tr>
<th>Mild</th>
<th>FEV₁ ≥80% predicted and at least one of:</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>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Moderate</th>
<th>Any of:</th>
</tr>
</thead>
<tbody>
<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>
</tbody>
</table>
Category | Pattern and intensity of symptoms (when not taking regular treatment)
---|---
| | • Symptoms sometimes restrict activity or sleep

Severe | Any of:
---|---
| | • FEV\(_1\) ≤ 60% predicted\(\dagger\)
| | • Daytime symptoms\(\dagger\) continual
| | • Night-time symptoms\(\dagger\) frequent
| | • Flare-ups frequent
| | • Symptoms frequently restrict activity or sleep

\(\dagger\) 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.

\(\dagger\) 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

### Table. Classification of asthma and indications for initiating preventer treatment in children aged 6–11

<table>
<thead>
<tr>
<th>Severity of flare-ups</th>
<th>Average frequency of flare-ups and symptoms between flare-ups</th>
</tr>
</thead>
</table>
| | Infrequent intermittent Flare-ups every 6 weeks or less and no symptoms between flare-ups | Frequent intermittent Flare-ups more than once every 6 weeks and no symptoms between flare-ups | Persistent Between flare-ups (any of):
| | | | • Daytime symptoms\(\dagger\) more than once per week
| | | | • Night-time symptoms\(\dagger\) more than twice per month
| | | | • Symptoms restrict activity or sleep

| Mild flare-ups (almost always managed with salbutamol in) | Not indicated | Consider | Indicated
|---|---|---|---|
Moderate–severe flare-ups
(>2 in past year requiring ED or oral corticosteroids)
Consider Indicated Indicated

Life-threatening flare-ups
(require hospitalisation or PICU)
Indicated Indicated Indicated

Preventer should be started as a treatment trial. Assess response after 4–6 weeks and review before prescribing long term.
ED: emergency department
Indicated:Prescribe preventer and monitor as a treatment trial. At follow-up, discontinue if ineffective
Not indicated: Preventer is unlikely to be beneficial
Consider prescribing preventer according to overall risk for severe flare-ups
‡ 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/carers and health professionals to prevent a serious outcome such as hospitalisation or death from asthma).

Cough and asthma in children

Relationship of cough to asthma in children
• Misdiagnosis of nonspecific cough as asthma can result in overtreatment in children.
• Cough can indicate the possibility of a serious underlying illness and warrant further assessment and investigations.¹

Table. Red flags for cough in children

- Wet or productive cough lasting more than 4 weeks
- Obvious difficulty breathing, especially at rest or at night
- Systemic symptoms: fever, failure to thrive or poor growth velocity
- Feeding difficulties (including choking or vomiting)
- Recurrent pneumonia
- Inspiratory stridor (other than during acute tracheobronchitis)
- Abnormalities on respiratory examination
- Abnormal findings on chest X-ray
- ‘Clubbing’ of fingers
Chronic cough (cough lasting more than 4 weeks) without other features of asthma is unlikely to be due to asthma.¹

Cough is a frequent symptom in children with asthma, but may have a different mechanism from other symptoms of asthma (e.g. wheeze, chest tightness or breathlessness). Children who have recurrent cough, but do not wheeze, are unlikely to have asthma.² A very small minority of children with recurrent nocturnal cough, but no other asthma symptoms, may be considered to have a diagnosis of atypical asthma.² This diagnosis should be only made in consultation with a paediatric respiratory physician.

In children with no abnormalities detected on physical examination, chest X-ray or spirometry, and no wheezing or breathlessness, chronic cough is most likely:¹
- due to protracted bacterial bronchitis (resolves with 2–6 weeks' treatment with antibiotics)¹
- post-viral (resolves with time)
- due to exposure to tobacco smoke and other pollutants.¹

Frequency of cough reported by parents correlates poorly with frequency measured using diary cards or by audio recording monitors.³

### 0-5 years

Most cases of coughing in preschool children are not due to asthma:
- Recurrent cough in preschool children, in the absence of other signs, is most likely due to recurrent viral bronchitis. Cough due to viral infection is unresponsive to bronchodilators and preventers such as montelukast, cromones or inhaled corticosteroids.
- Children attending day care or preschool can have a succession of viral infections that merge into each other,³ giving the false appearance of chronic cough (cough lasting more than 4 weeks).

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

### 6 years and over

Chronic cough may be due to asthma if the cough is episodic and associated with other features of asthma such as expiratory wheeze, exercise-related breathlessness, or airflow limitation objectively demonstrated by spirometry (particularly if responsive to a bronchodilator).¹

<table>
<thead>
<tr>
<th>Table. Definition of levels of recent asthma symptom control in children (regardless of current treatment regimen)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Good control</strong></td>
</tr>
<tr>
<td>All of:</td>
</tr>
<tr>
<td>• Daytime symptoms† ≤ 2 days per week (lasting only a few minutes)</td>
</tr>
</tbody>
</table>

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Go to: [Australian Cough Guidelines](#)
### Inhaled corticosteroids for children: efficacy

**Role in treatment asthma in children**

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.\(^8\) Overall, inhaled corticosteroids seem to be more effective in older children and those with more severe disease.\(^9\)

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.\(^9\)

Current evidence does not support planned seasonal use of inhaled corticosteroids in children not taking preventer at other times.\(^10\)

**Children aged 1–5 years**

**Intermittent wheeze/asthma**

In preschool children who only have wheezing episodes with viral respiratory infections, 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.\(^8,11\) Inhaled corticosteroid treatment does not reduce these children's risk of developing persistent wheeze by age 6 years.\(^12\)

**Persistent wheeze/asthma**

In preschool children who have episodes of wheezing from time to time, but also cough and wheezes at other times when they do not
have a viral cold (e.g. when cries, plays or laughs), regular inhaled corticosteroids are moderately effective in controlling symptoms, though less effective than in older children. When 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 spontaneous resolution of symptoms. However, this can be clarified by stopping inhaled corticosteroid treatment, monitoring symptoms, and re-starting.

In infants and preschoolers with persistent wheezing or asthma of at least 6 months’ duration, regular treatment with inhaled corticosteroids improves wheezing, asthma symptoms and lung function, and reduces flare-ups.

**Children aged 6 years and over**

Most clinical trials of regular inhaled corticosteroid treatment in children have been conducted among children with asthma symptoms every week or more often (‘persistent asthma’). Beclometasone dipropionate, budesonide, ciclesonide and fluticasone propionate have all been shown to be effective in children. There have been relatively fewer studies of ciclesonide in children, but, overall, randomised clinical trials show that it is equally effective as budesonide or fluticasone propionate in improving asthma symptoms and reducing flare-ups.

In a study of school-aged children with more than 2 days per week with symptoms, night waking more than twice per month due to asthma symptoms, or needing regular preventer, regular low-dose daily inhaled corticosteroid treatment reduced the rate of flare-ups that require treatment with oral corticosteroids, compared with no regular preventer treatment and as-needed short-acting beta2agonist for wheezing episodes.

In a study of children aged 4–11 years with asthma diagnosed within the previous 2 years and symptoms more than weekly in the previous 3 months, regular preventer was associated with a reduction in serious flare-ups, school absence due to asthma, an increase in symptom-free days, and improved lung function, compared with placebo.

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:

- as a first-choice preventer for children with asthma symptoms at least daily or night-time symptoms at least twice per week between flare-ups
- as an alternative to cromones (nedocromil or sodium cromoglycate) or montelukast in children with any daytime or night-time symptoms between flare-ups, or those with flare-ups every 6 weeks or more.

**Doses**

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

- budesonide up to 400 microg/day
- beclometasone (Qvar) up to 200 microg/day
- ciclesonide up to 160 microg/day
- fluticasone propionate up to 200 microg/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 microg/day fluticasone propionate, while the risk of adrenal suppression increases exponentially at doses above 500 microg/day. Therefore (based on theoretical equivalents between different agents), upper limits of daily doses for children are:

- budesonide 800 microg/day
- beclometasone dipropionate [Qvar] 400 microg/day
- ciclesonide 320 microg/day
- fluticasone propionate 500 microg/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. Fluticasone propionate is only approved for twice-daily dosing, but the other inhaled corticosteroids are approved for once daily dosing. Ciclesonide is effective when given once daily.

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

### Definitions of ICS dose levels in children

<table>
<thead>
<tr>
<th>Inhaled corticosteroid</th>
<th>Daily dose (microg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Budesonide</td>
<td>400 microg/day</td>
</tr>
<tr>
<td>Beclometasone (Qvar)</td>
<td>200 microg/day</td>
</tr>
<tr>
<td>Ciclesonide</td>
<td>160 microg/day</td>
</tr>
<tr>
<td>Fluticasone propionate</td>
<td>200 microg/day</td>
</tr>
<tr>
<td></td>
<td>800 microg/day</td>
</tr>
<tr>
<td></td>
<td>400 microg/day</td>
</tr>
<tr>
<td></td>
<td>320 microg/day</td>
</tr>
<tr>
<td></td>
<td>500 microg/day</td>
</tr>
<tr>
<td></td>
<td>Low</td>
</tr>
<tr>
<td>----------------------</td>
<td>--------------</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

Montelukast for children: efficacy

- Montelukast use has been associated with behavioural and/or neuropsychiatric adverse effects, including suicidality.

  ► Go to: [TGA alert](http://www.tga.gov.au/alert)

Overview
Montelukast is a leukotriene receptor antagonist preventer. It is registered by the TGA for the treatment of asthma in children aged 2 years and older, and for the symptomatic treatment of allergic rhinitis.¹⁸

Montelukast can be used as an alternative to inhaled corticosteroids or as an add-on treatment in a child already taking regular inhaled corticosteroids.

However, it is not effective for all children. Overall, only approximately 20–30% of children will respond to montelukast treatment. The effect is thought to depend mainly on the child's genotype.¹⁹, ²⁰, ²¹ Clinically, it is not possible to predict accurately which children will benefit most from montelukast treatment.

**Montelukast as first-line preventer in children aged 2–5 years**

Viral-induced wheezing

Overall, regular maintenance montelukast treatment does not reduce the risk of wheezing episodes requiring oral corticosteroid treatment among preschool children who only have wheezing episodes when they have viral upper respiratory tract infections.²²

However, montelukast may be effective for some children. Some randomised controlled trials have reported a reduction the risk of flare-ups in preschool children with intermittent asthma/wheeze,²³, ²⁴ while others have not.²⁵

Persistent asthma or wheezing

A systematic review comparing montelukast with inhaled corticosteroids in preschoolers with asthma or recurrent wheezing requiring daily preventer treatment²⁶ reported that inhaled corticosteroids appeared to achieve better symptom control and reduce flare-ups (including severe flare-ups requiring treatment with systemic corticosteroids). However, results were inconsistent and meta-analysis was not possible due to heterogeneity of outcomes measured in available clinical trials.²⁶

Some preschool children with persistent asthma/wheeze respond to montelukast. A crossover study in preschool children with persistent asthma/wheeze reported that some children showed their best response to montelukast, while most responded better to regular inhaled corticosteroids.²⁷ Predictors of a better response to inhaled corticosteroids than montelukast were aeroallergen hypersensitivity and blood eosinophilia (eosinophil counts ≥ 300/μL).²⁷ However, routine blood eosinophil count is not feasible or recommended for this purpose.

**Montelukast as first-line preventer children aged 6 years and over**
In school-aged children with persistent asthma, inhaled corticosteroids are more effective overall than montelukast in improving lung function and controlling asthma symptoms. However, symptoms will respond to a treatment trial of montelukast in approximately one-quarter to one-third of children, and some may benefit more than from an inhaled corticosteroid. More severe asthma and markers of allergic inflammation may predict a better response to inhaled corticosteroids.

**Montelukast as add-on treatment**

A systematic review of studies in children over 6 years and adolescents with mild-to-moderate persistent asthma found that the addition of montelukast to inhaled corticosteroids did reduce flare-ups requiring oral corticosteroids or hospital admissions for asthma, compared with the same or an increased dose.

In a study comparing step-up treatments in children with asthma symptoms uncontrolled by low-dose inhaled corticosteroids, the addition of a long-acting beta2 agonist was effective in more children than either montelukast or increasing the dose of inhaled corticosteroid for controlling asthma symptoms and preventing flare-ups requiring systemic corticosteroids. However, some studies in school-aged children with persistent asthma already taking regular inhaled corticosteroids have reported that add-on montelukast reduced the risk of flare-ups and exercise-induced asthma symptoms. Not all children will respond.

In a small study in children with persistent asthma already taking regular inhaled corticosteroids who were homozygous for the Arg16 genotype, montelukast was more effective as an add-on therapy than long-acting beta2 agonist in reducing symptoms, reliever use and days absent from school due to asthma, depending on the child’s beta receptor genotype. However, children were given inhaled corticosteroid and long-acting beta2 agonists in separate inhalers, which is known to be associated with increased risks.

However, genotyping it is not currently feasible in clinical practice. In practice, a treatment trial of 4–6 weeks can determine which preventer is suitable for controlling a child’s asthma symptoms, but longer treatment may be required to evaluate effect on flare-ups, because flare-ups may be independent of symptom control.

**Exercise-induced symptoms**

In school-aged children who experience exercise-induced symptoms despite taking regular inhaled corticosteroids, the addition of montelukast is effective in controlling symptoms, but not all children experience a response.

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

**Short-term use in the management of flare-ups**

Some, but not all studies suggest that a short course of montelukast, introduced at the first signs of an upper respiratory tract infection, may be effective in controlling flare-ups. An Australian study reported that this strategy could achieve a small reduction in symptoms, school absence and medical consultations in preschool and school-aged children with episodic wheeze.

However, the evidence is inconsistent, with some studies showing no benefit. The findings of one study suggested that whether or not intermittent montelukast is effective in wheezing children aged 5 years and under depends on genotype.

Montelukast is not TGA-approved or PBS-subsidised for intermittent use.

**Note:** PBS status as at March 2019: Montelukast is not subsidised by the PBS for adolescents 15 years and over.
Administration of inhaled medicines in children: 6 years and over

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

School-aged children (depending on the child’s age, ability, and with individualised training) can learn to use a range of inhaler types, including manually actuated pressurised metered-dose inhalers with spacers, breath-actuated pressurised metered-dose inhalers (e.g., Autohaler), and dry-powder inhalers (e.g., Accuhaler, Turbuhaler).42, 43, 44, 45, 46

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

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

A pressurised metered-dose inhaler and spacer is an appropriate first choice for most children.44

School-aged children are unlikely to use their inhaler device correctly without careful training and repeated checking.47

Correct use of inhaler devices

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

Most patients with asthma or COPD do not use their inhalers properly,48, 49,50, 51 and most have not had their technique checked or corrected by a health professional.

Incorrect inhaler technique when using maintenance treatments increases the risk of severe flare-ups and hospitalisation for people with asthma or COPD.48, 49, 52, 53, 54, 55

Poor asthma symptom control is often due to incorrect inhaler technique.56, 57

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

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

References


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57. Hardwell, A., Barber, V., Hargadon, T., et al. Technique training does not improve the ability of most patients to use pressurised metered-dose inhalers (pMDIs), *Prim Care Respir J.* 2011; 20: 92-6. Available from: [http://www.nature.com/articles/pcrj201088](http://www.nature.com/articles/pcrj201088)