The coughing child

Most children with recurrent cough can be divided into those with asthma and those with recurrent viral bronchitis, based on the presence or absence of wheeze. It is equally important to recognise a smaller group of children with less common causes of cough, as specific therapeutic interventions may be warranted.

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Cough is one of the most common and difficult to treat symptoms in childhood. The challenge is to ensure that the child with cough is neither under- nor overtreated.

Approximately 30% of children have a tendency to recurrent cough, particularly in the preschool years. This article examines:

- both recurrent cough and persistent cough – the latter arbitrarily defined as cough lasting more than three weeks
- recent epidemiological studies that suggest children who cough in the absence of wheeze appear to form a subgroup distinct from those with asthma, and thus require a separate management approach
- the less common causes of cough and how to identify and treat them.

Recent research findings

Does cough variant asthma exist?

There has been considerable debate about whether cough in the absence of wheeze should be labelled as 'asthma'. Much has been written regarding 'cough variant asthma' and there has been an increasing trend to treat all children with recurrent cough with asthma medications.

However, over the last five years, a number of epidemiological studies have been published which have highlighted important differences between children with recurrent cough alone

IN SUMMARY

- **There is increasing epidemiological evidence that children who cough in the absence of wheeze (recurrent viral bronchitis) are clinically distinct from children with asthma, and have increased cough receptor sensitivity.**
- **Children with recurrent viral bronchitis have a self-limiting illness that is usually unresponsive to asthma medication – this treatment should be ceased if there is no therapeutic response.**
- **Nedocromil sodium (Tilade) may be of some benefit in children with increased cough receptor sensitivity although trials to date have been limited to children with asthma who cough.**
- **Pertussis and mycoplasma should be considered in children presenting with persistent cough, particularly if there are specific clinical features suggestive of these infections.**
- **Foreign body inhalation is common in childhood and should be considered in any child with persistent respiratory symptoms, particularly if there are focal signs or radiological changes.**
- **A history of recurrent or persistent productive cough is suggestive of suppurative lung disease and requires further investigation.**
- **Cough may occur as a result of upper airway obstruction and improve following treatment of the upper airway pathology.**

and those with recurrent cough and wheeze. The most significant has been the Tucson Children's Respiratory Study which found that, compared with children with both recurrent cough and wheeze, children with cough alone were less likely to cough with exercise or be restricted in activity. They also had lung function and airway hyperresponsiveness comparable to controls and a better long term outcome (see the box on page 21).[1]

A cross sectional study conducted in Sydney of around 1200 school children between 6 and 12 years of age also identified a group of children with persistent cough in the absence of wheeze.2 Similar to the Tucson study, these children differed from children with wheeze, and the authors concluded that 'cough variant asthma is probably a misnomer for most children in the community who have persistent cough'.

Increased cough receptor sensitivity

A series of interesting studies performed at the Royal Children's Hospital in Melbourne has suggested that children with recurrent cough alone cough because of 'increased cough receptor sensitivity'.[3] A placebo controlled study of salbutamol and beclomethasone also failed to show any therapeutic response of cough to treatment – even in those children with evidence of airway hyperresponsiveness.[4]

Interestingly, viral infections appear to increase the cough sensitivity in these patients and hence the term 'recurrent viral bronchitis', which has often been used to label these children, would appear to be a valid one.

Nevertheless, there remains some overlap as increased cough receptor sensitivity has also been demonstrated in children with acute asthma who also cough.

Recurrent cough in childhood: what are the causes?

The common and less common causes of recurrent or persistent childhood cough are listed in Table 1.

Common causes

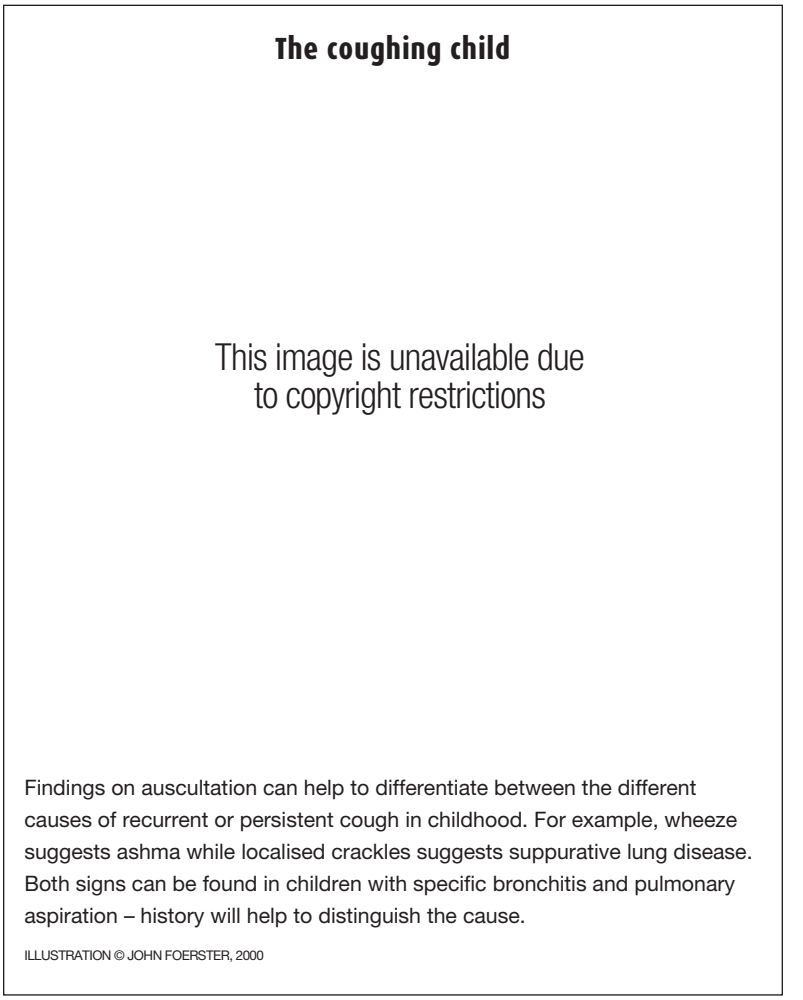
Asthma and recurrent viral bronchitis are the common causes of recurrent cough in childhood. Viral infections are the major precipitant of symptoms in both these conditions. Episodes may occur up to 12 times a year in preschoolers, often lasting up to three or four weeks, particularly in children with recurrent viral bronchitis where response to therapy is not dramatic. As highlighted above, the presence of wheeze would appear to be the most important distinguishing feature.

Less common causes

Specific bronchitis

Pertussis is still an underrecognised cause of persistent cough in both children and adults. Although classically associated with paroxysmal coughing with post-tussive flushing, vomiting and inspiratory whoop, the presentation may be more subtle in older and immunised children – immunisation should not exclude the diagnosis as efficacy is incomplete and wanes with time.

The coughing child



Findings on auscultation can help to differentiate between the different causes of recurrent or persistent cough in childhood. For example, wheeze suggests ashma while localised crackles suggests suppurative lung disease. Both signs can be found in children with specific bronchitis and pulmonary aspiration – history will help to distinguish the cause.

ILLUSTRATION © JOHN FOERSTER, 2000

Table 1. Causes of recurrent or persistent cough in childhood

Common causes

Asthma

Recurrent viral bronchitis

Less common causes

Specific bronchitis

- pertussis, mycoplasma, chlamydia, tuberculosis
- secondary bacterial bronchitis
- infantile bronchiolitis (viral, chlamydia, cytomegalovirus, ureaplasma)

Focal lesions of the tracheobronchial tree

- foreign body
- congenital airway abnormalities
- tumours

Suppurative lung disease

- cystic fibrosis
- immune deficiency
- primary ciliary dyskinesia
- retained foreign body
- postviral
- idiopathic

Pulmonary aspiration

- gastro-oesophageal reflux
- dysco-ordinate swallowing
- anatomical connections

Upper airway obstruction

- obstructive sleep apnoea
- allergic rhinitis

Smoking

Habit or psychogenic cough

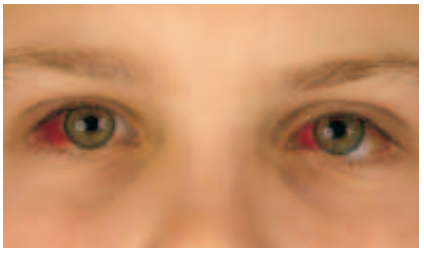


Figure 1. Pertussis. Conjunctival haemorrhages due to paroxysmal coughing in a child with pertussis.

Figure 1 shows conjunctival haemorrhages due to paroxysmal coughing in a child with pertussis.

Mycoplasma pneumoniae infection often presents with a bronchitic illness, which may be associated with basal crackles and associated radiological changes in the lower lobes. Although classically thought to be a disease of older children, mycoplasma is still relatively common in the preschool age group.

Chlamydia pneumoniae may also present with a bronchitic illness similar to mycoplasma, but is more difficult to confirm serologically at present.

Tuberculosis should be considered as a potential cause of persistent cough, particularly in at-risk groups from countries where TB is endemic.

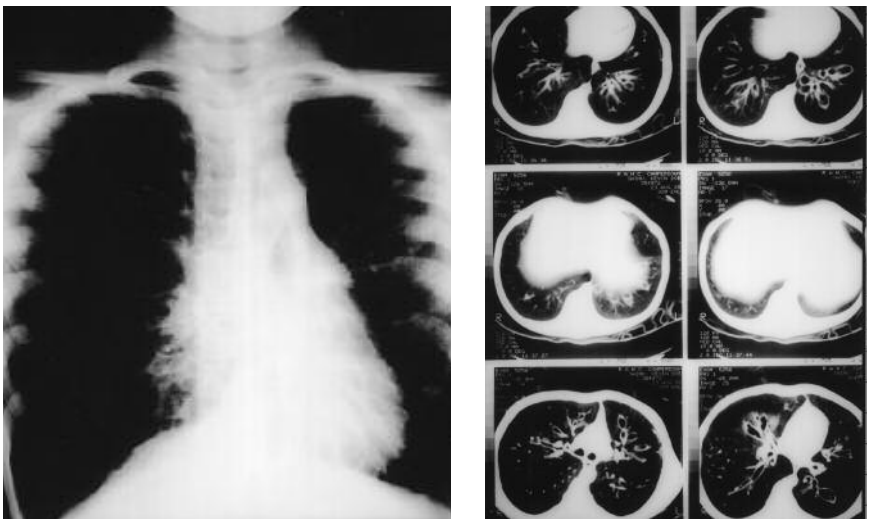
Secondary bacterial infection (nontypable *Haemophilus influenzae*, *Streptococcus pneumoniae* or *Moraxella catarrhalis*) occasionally complicates viral bronchitis. A more prolonged episode of bronchitis results, often associated with a more productive cough and occasionally radiological changes. Recurrent episodes should raise suspicion of suppurative lung disease.

Infantile bronchiolitis may often have persistent cough as a feature. This is most commonly associated with respiratory syncytial virus infection but other pathogens including cytomegalovirus, ureaplasma and *Chlamydia trachomatis* have also been implicated. Chlamydia is associated with conjunctival infection, mild respiratory distress and cough – often described as 'staccato' – starting a few weeks after birth.

Suppurative lung disease

The presence of suppurative lung disease should be suspected if a child presents with recurrent or persistent productive cough, particularly if associated with purulent sputum. There may be associated localised crackles on auscultation and finger clubbing may be present. Specific clinical features and a positive family history may help to differentiate the underlying disease process. Figures 2a and b show radiological findings.

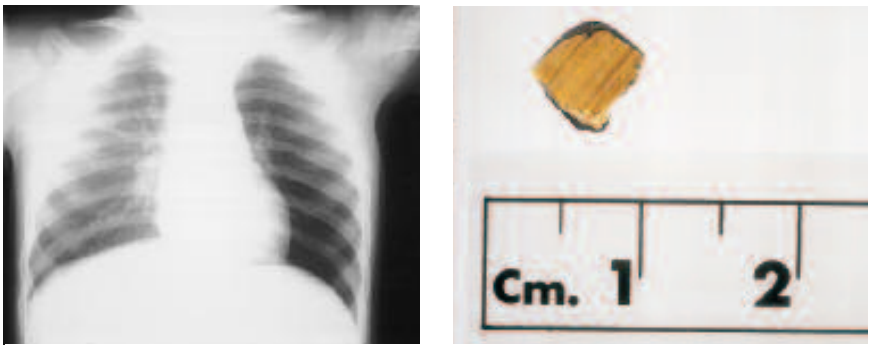
The presence of coexistent upper respiratory suppuration is suggestive of a more generalised process – cystic fibrosis, immune deficiency or primary ciliary dyskinesia. Accompanying symptoms of fat malabsorption should prompt a sweat test to exclude cystic fibrosis.



Figures 2a and b. Suppurative lung disease. a (left). Chest x-ray demonstrating hyperinflation and bronchial wall thickening ('tram tracking') in a child with a history of chronic productive cough. b (right). CT scan demonstrating bronchial dilatation confirming bronchiectasis in the same patient.

Focal lesions of the tracheobronchial tree

Focal lesions in the airway will usually present with focal signs and/or radiological abnormalities although sometimes these may be subtle (see Figure 3a). Inhaled foreign bodies may mimic any respiratory symptom and there is often no definite history of a choking episode preceding the onset of symptoms. Any suspicion of a focal lesion should prompt further investigation, usually including bronchoscopy. Figures 3b and 4 show examples of foreign bodies lodged in the left main bronchus and laryngeal inlet, respectively.



Figures 3a and b. Foreign body inhalation. a (left). Chest x-ray demonstrating evidence of air trapping in left lung suggestive of a foreign body in the left main bronchus. b (right). Block of wood removed from left main bronchus in same patient at bronchoscopy.

Pulmonary aspiration

Pulmonary aspiration is an important cause of cough during infancy or in children with neurodevelopmental problems. It may be related to gastro-oesophageal reflux and/or dysco-ordinate swallowing or rarely due to an anatomic connection (H-type tracheo-oesophageal fistula, laryngeal cleft).

Children usually present with either recurrent 'pneumonia' or persistent cough and/or wheeze, but occasionally respiratory involvement may be silent due to suppression of the cough reflex with chronic aspiration.

The role of gastro-oesophageal reflux in producing cough in older, otherwise healthy children, remains controversial. Specific paediatric studies are required to resolve this issue as studies to date have been limited to adult subjects.

Figure 4. 'Laryngosaurus rex'. A plastic dinosaur lodged in laryngeal inlet in a child presenting with recurrent 'croup'.

Figure 5. Obstructive tonsils. Tonsillar enlargement in a child presenting with symptoms of obstructive sleep apnoea.

Upper airway obstruction

There is now good evidence that upper airway disease may be associated with lower respiratory tract symptoms, such as cough, which resolve with treatment of the upper airway pathology (see Figure 5).

Smoking

Active smoking should be considered a potential cause of chronic cough in the adolescent age group.

The Tucson Children's Respiratory Study

The Tucson Children's Respiratory Study has been following a cohort of around 1000 children from birth, documenting the prevalence of, and risk factors for, acute and chronic respiratory illness in childhood.[1] At 6 years of age children could be divided into four groups:

- those with neither recurrent cough nor wheeze (61.8%)
- those with recurrent cough and wheeze (15.6%)
- those with recurrent cough in the absence of wheeze (11.8%)
- those with wheeze but no cough (10.8%).

Compared with children with recurrent cough and wheeze, those with recurrent cough alone were less likely to cough with exercise, be restricted in activity and to have been diagnosed with asthma. Interestingly, a history of nocturnal cough was not a differentiating feature.

The children with cough alone had a much lower prevalence of atopy on skin testing (36.7% *v*. 62.5%) and as a group had lung function and airway hyperresponsiveness which was no different to controls. In contrast, those who wheezed had lower lung function and an increased prevalence of airway hyperresponsiveness. The long term outcome between these two groups differed, with only 35% of those with cough alone still having recurrent cough at 11 years, compared with 65% of those with recurrent cough and wheeze.

Specific enquiries about smoking habits need to be made, preferably in the absence of parents.

Habit or psychogenic cough

Psychogenic cough usually has typical features that allow a primary diagnosis. These include the bizarre 'honking' nature of the cough and the absence of cough during sleep. There may be a preceding history of asthma or bronchitis but the nature of the presenting cough is usually different from the previous one.

Differential diagnosis

An approach to the differential diagnosis of recurrent or persistent cough is illustrated in Table 2.

Asthma v. viral bronchitis

In differentiating asthma from recurrent viral bronchitis, a history or physical finding of wheeze, particularly if bronchodilator responsive, is highly suggestive of asthma. A personal history or physical signs of other atopic disease, and/or a family history of asthma and/or atopy provides further supportive evidence; so does the presence of atopy (on skin testing) or reversible airway obstruction (in children more than 5 years of age who are able to perform reliable spirometry). However, there will inevitably be some overlap of these clinical features between groups and a trial of asthma treatment may be necessary to resolve the issue.

Less common causes

The recognition of one of the less com-

Table 2. Differential diagnosis of recurrent or persistent cough

Diagnosis	History	Examination	Chest x-ray	Spirometry (if appropriate)
Asthma	Wheeze, atopy, family history of asthma and/or atopy	Wheeze, atopic disease	Normal or mild hyperinflation	Reversible airways obstruction
Recurrent bronchitis	Predominantly viral-associated, no wheeze or atopy	Clear chest	Normal with or without increased bronchial markings	Normal
Specific bronchitis	Specific features related to aetiology	Clear chest or focal crackles with or without wheeze	Normal or focal abnormalities	May be abnormal
Suppurative lung disease	Productive cough, specific features related to aetiology	Clear chest or focal crackles with or without clubbing	Normal progressing to bronchial wall thickening and dilatation	May be abnormal
Focal lesions	Specific features related to aetiology	Focal signs (decreased air entry, crackles or wheeze)	Focal air trapping, specific abnormality	May be abnormal
Pulmonary aspiration	Cough related to feeding, vomiting	Focal or generalised crackles with or without wheeze	Patchy collapse or consolidation (especially right upper lobe in infancy)	May be abnormal
Upper airway obstruction	Associated snoring and nasal blockage	Allergic rhinitis, nasal obstruction, large tonsils	Normal	Usually normal, may be reversible airway obstruction (coexistent asthma)
Psychogenic cough	Honking cough that is absent during sleep	Normal	Normal	Normal

mon causes of cough depends very much on clinical suspicion based on the specific symptoms and signs outlined earlier.

A chest x-ray is the most useful initial investigation and an abnormal x-ray (particularly if focal and persistent) is an indication for further investigation and/or referral for specialist consultation. Further investigations might include:

- culture, serology and Mantoux testing for specific pathogens
- further radiological procedures, such as lateral airways x-rays, computed tomography, barium swallow
- pulmonary function tests
- specific investigations for suppurative lung disease such as a sweat test, tests of immune function and ciliary studies
- bronchoscopy.

Management

Cough remains a very frustrating symptom for children, their parents and the doctor. In many cases, however, it is a self-limiting symptom; it is important to avoid overtreating cough with unnecessary and ineffective therapies, as described below.

General measures

Parental reassurance

Parents need to be reassured that cough is an important protective reflex which will not damage the heart or lungs. A simple explanation of the cough reflex often helps them understand the benefits of the cough and why it may be more harmful to suppress it (e.g. 'cough is a primitive reflex that can be triggered by a variety of physical and chemical stimuli and results in a complex co-ordinated process').

Parents also need to distinguish respiratory distress associated with the cough from respiratory distress associated with airway obstruction that persists between coughing bouts.

Parents who smoke should be advised of the potentially harmful effects to their child and be encouraged to quit.

Warming the air

Although not formally studied, warming the air at night may help to reduce irritation of the airway by cold night air. There is also no definite evidence that humidification is of benefit; further, steam inhalations may be potentially harmful by increasing the risk of scalds from boiling water.

Table 3. Antibiotics for specific or secondary bacterial bronchitis

Organism	Antibiotic	Total daily dose	Doses per day	Treatment duration
• *Bordatella pertussis* • *Mycoplasma pneumoniae*	• Erythromycin (EES, Emu-V, E-mycin, Eryc, Erythrocin Oral, Ilosone)	50 mg/kg	bd – qid	10 – 14 days
	• Roxithromycin* (Biaxsig, Rulide)	5–8 mg/kg	bd	10 – 14 days
• Pneumococcus • *Haemophilus influenzae*†	• Amoxycillin†† (Alphamox, Amohexal, Amoxil Oral, Bgramin, Cilamox, Moxacin Oral, SBPA Amoxycillin)	50 mg/kg	tds	2 – 3 weeks
	• Amoxycillin plus potassium clavulanate (Augmentin, Ausclav, Clamoxyl)	50 mg/kg	tds	2 – 3 weeks
	• Roxithromycin§	5–8 mg/kg	bd	2 – 3 weeks
	• Cefaclor (Ceclor, Keflor, Vercef)	40 mg/kg	bd	2 – 3 weeks
	• Trimethoprim–sulfamethoxazole (Bactrim, Cosig Forte, Resprim, SBPA Sulfamethoxazole and Trimethoprim, Septrin)	40/8 mg/kg	bd	2 – 3 weeks
• *Moraxella catarrhalis*	• Erythromycin	50 mg/kg	bd – qid	2 – 3 weeks
	• Roxithromycin	5–8 mg/kg	bd	2 – 3 weeks
	• Amoxycillin plus potassium clavulanate	50 mg/kg	tds	2 – 3 weeks

* Only *in vitro* data currently available for pertussis
† Empiric treatment of bacterial bronchitis should cover both pneumococcus and *Haemophilus influenzae*
‡ Amoxycillin not appropriate for β-lactamase positive *Haemophilus influenzae*
§ Pneumococcal resistance has been reported and *Haemophilus influenzae* only partially sensitive.

Chest physiotherapy

Percussion, postural drainage and other forms of chest physiotherapy are only useful if normal clearance mechanisms are ineffective – for example, in lobar collapse, suppurative lung disease and neuromuscular disorders.

Cough suppressants

The role of cough suppressants remains controversial. They are contraindicated in suppurative lung disease in which cough is required for removal of sputum.

If a child has a dry irritating cough that is keeping him or her awake at night, a trial of cough suppressants may be indicated. A decision regarding ongoing treatment will depend on response (as cough suppressants are often ineffective) and side effects.

Expectorants and mucolytics

There is little evidence to support the use of these agents in children with cough, even in those with suppurative lung disease.

Specific treatment

Asthma medications

Despite a carefully taken history, physical examination and investigations, it may not be possible to definitely exclude a diagnosis of asthma. In this situation, a trial of asthma treatment may help to reveal the cause of the cough.

Although cough is often less responsive to bronchodilators than wheeze, a trial is justified because some children seem to obtain significant relief. In some children, ipratropium bromide (Atrovent, DBL Ipratropium, Ipratrin) appears to be more effective than β_2-agonists, possibly because of additional effects on mucous secretion due to its anticholinergic action.

A trial of regular preventive therapy may be warranted if the cough is frequent or persistent, particularly when there is significant lifestyle disruption. Sodium cromoglycate (Intal) or nedocromil sodium (Tilade) should be trialled initially, preferably via a spacer device. There is some evidence that nedocromil sodium may directly suppress cough by affecting cough receptors. Therefore, it may be useful in children with increased cough receptor sensitivity; however, trials to date have been limited to children with asthma and cough, where it has been shown to be beneficial.

If the child is unresponsive to sodium cromoglycate or nedocromil sodium, low dose inhaled corticosteroids can also be trialled. However, if the child is unresponsive after four to six weeks of treatment, it is unlikely that higher doses will be beneficial and treatment should be discontinued.

Some children are responsive to short courses of oral steroids during acute episodes but again, unless there is clear benefit, this should not be repeated.

In the situation where wheeze is an accompanying symptom and an asthma diagnosis is clearer, asthma medications should be used according to the severity of the asthma.

This assessment of severity and the subsequent assessment of control should be based primarily on wheeze, given the fact that even in children with asthma, cough, particularly during the acute episode, may reflect cough receptor sensitivity rather than the degree of airway obstruction.

Antibiotics

Antibiotics are indicated for the treatment of specific bronchitis (e.g. mycoplasma, chlamydia, pertussis) or where a secondary bacterial bronchitis is suspected, including in patients with suppurative lung disease.

The choice of antibiotic will depend on the likely organism, ideally confirmed by culture or serology (Table 3). In general, prolonged courses of antibiotics – for two to three weeks – are indicated to ensure eradication of the organism.

Upper airway obstruction

Treatment of allergic rhinitis with topical nasal steroids has been shown to improve both nasal obstruction and cough.

Relief of obstructive sleep apnoea by tonsillectomy and adenoidectomy or continuous positive airway pressure has also been shown to improve cough.

Other specific treatment

Other therapies directed at the specific cause include:

- bronchoscopy for removal of foreign body
- surgery for focal airway abnormalities
- antireflux therapy and/or surgery for pulmonary aspiration
- relaxation therapy or psychotherapy for psychogenic cough.

When to refer

Referral for specialist consultation should be considered when:

- clinical features suggest suppurative lung disease or an unusual cause of cough that requires further investigation
- foreign body inhalation is suspected
- localised chest signs or radiological abnormalities persist
- the response to treatment is suboptimal
- the level of treatment required to maintain symptom control is of concern.

Conclusion

Managing the coughing child is a difficult and often frustrating challenge. It is important to recognise that in many situations cough is a self-limiting symptom that is often unresponsive to therapeutic intervention. On the other hand, it may indicate an important underlying disorder that requires diagnosis and treatment. The challenge is to ensure the child with cough is neither under- nor overtreated. MT

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Further reading

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