

# Persistent cough in children

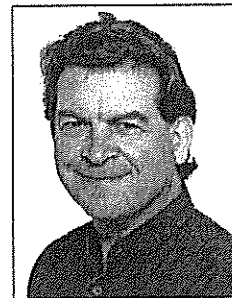
Philip K Pattemore

Correspondence to: philip.pattemore@otago.ac.nz

The mammalian cough reflex is designed to protect the lower airways and air-exchanging regions of the lung from infection and inhalation of foreign substances. Reptiles, who have no glottis to cough with, are prone to dying from pneumonic infection of their simple lungs. Cough is due to irritation of sensory nerve endings, particularly in the larynx, trachea and major bronchi. Cough receptors are sparse in the pharynx and epiglottis above the vocal cords and in the respiratory bronchioles and alveoli (Figure 1). Cough is not in itself a sign of airway obstruction.

Normal children wearing cough meters have been recorded as coughing 10–11 times per day, but rarely at night.<sup>1,2</sup> During respiratory infections, or in children presenting with recurrent cough, coughing may occur 60–100 times by day, and less often at night. Coughing at night is

*Philip Pattemore is Associate Professor of Paediatrics at Christchurch School of Medical and Health Sciences, University of Otago. He is a general and respiratory paediatrician with research, teaching and clinical interests in the epidemiology and management of childhood asthma, and in cystic fibrosis airway disease.*



often the main concern of parents. This is possibly because of the low ambient noise at night, a long spell in close proximity to the child, and the fact that the coughing disturbs the parent's sleep. Cough undergoes developmental changes and is weak in premature infants.<sup>3</sup>

Asthma clinically consists of intermittent episodes of intrathoracic airway obstruction manifest by expiratory wheezing (due to vibration

of partially collapsed airway walls), and shortness of breath. In an acute episode there will also be tachypnea, increased inspiratory effort, hyperexpansion, auscultatory wheeze, prolonged expiration, and decreased air entry. Cough may or may not be prominent. Very few children with asthma have cough as their predominant symptom but they will have wheeze and chest tightness as well. This is best categorised as 'cough-predominant asthma'.<sup>4</sup>

The important thing to note here is that recurrent or nocturnal cough in the absence of wheezing is (a) very common, particularly in pre-school children (b) very non-specific with a broad differential, and (c) unlikely to be due to asthma.<sup>5</sup> The term 'cough-variant asthma' should not be used in children.<sup>6</sup> Whether or not there is an entity of cough-variant asthma in adults is beyond the scope of this article.

In a child with recurrent or persistent cough the first important distinction to make clinically is between an irritating, dry cough (this refers to the absence of moist, rattly, or phlegmy sounds, rather than to being non-productive) and a moist or rattly cough. A moist cough may or may not be productive in school children. A guide to assessment and when to refer is shown in Table 1.

Figure 1. The anatomical localisation of signs and symptoms of airway irritation and obstruction.

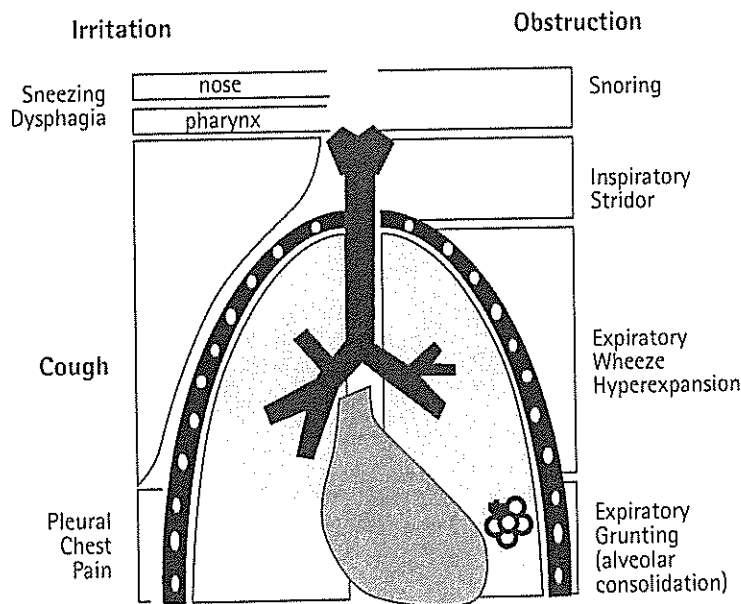


Table 1. Types of cough in children and diagnostic features

Type of cough	Trigger	Diurnal and seasonal pattern	Typical duration	Likely diagnosis	Recommended management
Dry, repeated	Repeated viral infections	Day and night. Mostly winter	2-4 weeks	Post-viral cough	Education and reassurance, simple measures. Avoid smoke exposure, discuss day care exposure
Dry (sometimes wet) paroxysmal attacks leading to red face, vomiting with or without apnoea or whoop. Undistressed in between attacks	Drinking, eating, movement, upset	Day and night. Any time of year	3-4 months gradual resolution, may relapse for brief periods with URTIs	Pertussis syndrome (may be pertussis, or other) Swabs are insensitive after 2 weeks	Infant, or child becoming apneic: Refer urgently (N.B. contagious). Others: Erythromycin in 1st 2 weeks. Education about time course and lack of treatment response, and reassurance
Dry throat-clearing or brief repeated	Before speaking or under stress	Day time; absent during sleep. Any season	Weeks-years	Psychogenic cough - habit or tic	Reassure regarding chest. Consider sources of stress. Refer to speech language therapy
Loud honking in adolescent	Situation specific, often at school. Repeatable on request	Day time; absent during sleep. Any season	Weeks-months	Psychogenic cough - contrived	Reassure regarding chest. Consider sources of stress or secondary gain. Refer to speech language therapy or behaviour modification
Dry or wet with associated wheeze	Night, exercise, cold air, allergens, URTIs	Day and night; may be seasonal	Weeks-years	Cough-predominant asthma	Treat asthma on the basis of controlling wheeze and/or shortness of breath. Reassure regarding cough - irritative, not a sign of obstruction
Dry, repeated	Tobacco smoke exposure without other obvious triggers	Day and night; any season	Years	Tobacco smoke exposure (passive smoker's cough)	Counsel regarding role of tobacco smoke and quitting. Re-evaluate after decreasing exposure
Dry, repeated	Multiple without obvious trigger	Day and night; any season	Years	Cough-receptor hypersensitivity	Should exclude foreign body or atelectasis with CXR. Consider referral for confirmation
Dry or wet, with vomiting and choking: developmental delay or swallowing difficulty	Reflux or night time	Night predominance; any season	Weeks-years	Aspiration of secretions or refluxed stomach contents	Chest x-ray and refer for barium swallow and consideration of other procedures
Wet, moist or rattly cough, with or without sputum, clubbing, crackles in chest, poor weight gain	Accentuated during activity or RTIs	Night, on waking, or day time with activity. Winter accentuation	>4 Weeks	Persistent bacterial bronchitis; Bronchiectasis; Cystic fibrosis (especially in Caucasians); Ciliary dyskinesia; TB (in contacts or refugees)	Refer for paediatric respiratory evaluation

Repeated or persistent dry coughing may be due to increased cough receptor sensitivity, exposure to irritants, or psychogenic.

### Increased cough receptor sensitivity

Coughing is very common for two to three weeks following a viral respiratory infection in many pre-schoolers and is often the last symptom to disappear. Prospective studies of coughing due to viral infections show that 50% last less than one week, 70–80% less than two weeks, and only 5% last more than four weeks.<sup>4</sup> From aged two to five children may have four to 10 episodes of respiratory infection per year, mostly during winter. Persistent coughing after each bout may thus blend seamlessly into the next infection and, although this may be reported as chronic coughing over three months, careful enquiry will reveal the repeated viral infection pattern. This is a protective reflex and can be regarded as helping to prevent atelectasis, stagnant secretions and bacterial pneumonia.

Increased cough receptor sensitivity is also characteristic of pertussis syndrome, in which the hyper-sensitivity is so extreme that attacks of coughing (often triggered by drinking or disturbance) occur without intervening breaths until red face, vomiting, and sometimes apnoea and cyanosis occur. A whoop on the following massive inspiration may or may not be present. Pertussis apnoea may be life-threatening in young infants who should be referred for urgent admission. In between these bouts the child usually looks and sounds entirely normal with no chest signs. The coughing bouts in whooping cough usually last for three to four months,<sup>7</sup> gradually decreasing unless re-stimulated by intercurrent viral infections. Pertussis syndrome is clinically diagnosed – it may be caused by *Bordetella pertussis*, adenovirus, *Mycoplasma pneumoniae* or other agents. Swabs for culture or PCR of *Bordetella pertussis* are insensitive after the first few weeks of illness. Erythromycin given in the first two

weeks of illness may shorten the period of infectivity but does not affect the course of the coughing.<sup>7</sup>

In some cases persistent atelectasis, or congenital narrowing of the airway (bronchomalacia) may result in persistent coughing. In cases of persistent dry cough, without an obviously recognisable cause, it is important to obtain a chest x-ray and consider paediatric specialist referral.

In some children increased cough receptor sensitivity appears to be constitutional and is repeatedly demonstrated on capsaicin challenge testing.<sup>8</sup> Some children with this condition are atopic, but the coughing does not reliably respond to anti-asthma medication such as inhaled steroids.<sup>4</sup>

### Management

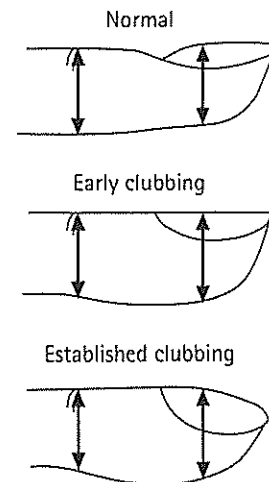
Specific treatment of dry protracted coughing is not available at this point.<sup>9</sup> Symptomatic treatment of the cough itself with asthma medications, cough suppressants and antibiotics is unhelpful,<sup>10</sup> associated with adverse effects, and not necessary.<sup>11</sup> Supportive management is important, however, to stop a frustrating search for a cure on the part of the parents. This primarily involves reassurance about the aetiology, natural history, and the absence of signs of serious underlying disease. In my experience reassurance is more effective after doing a thorough examination of the child and in some cases a chest x-ray (to check for unexpected findings such as a foreign body, or atelectasis). On occasions specialist referral is appropriate for reassurance. Reassurance is often all that is necessary to take the pressure and focus off a child's coughing. Other simple measures such as a glass of water beside the bed or school desk, or lemon and honey sips, may be helpful as temporary relievers. Offering to re-check the child after some weeks is also helpful.

### Extrapulmonary irritants

The most common irritant in the childhood environment is tobacco smoke – children exposed at home cough more, but also get two to four times as

many respiratory infections (ears, nose, throat, bronchial and pneumonic).<sup>7</sup>

Figure 2. The distinction of normal and clubbed fingers. Note that the earliest signs are increased AP diameter compared to the distal IP joint and flattening of the nail angle. Fluctuance is too subjective to be used as a marker. Curvature without the other features is called beaking and may be familial.



many respiratory infections (ears, nose, throat, bronchial and pneumonic).

In children with swallowing problems, for instance due to cerebral palsy, or oesophageal disease, reflux or secretions with aspiration at night may cause a dry or moist cough depending on the amount of aspiration and the development of chronic infection. However aspiration is extremely uncommon in neurodevelopmentally normal children with simple gastro-oesophageal reflux.

A foreign body in the chest may cause cough or wheeze or both. A history of a choking episode should be sought but its absence does not exclude a foreign body. A chest x-ray may identify persisting pulmonary problems. Paediatric respiratory referral should be made if foreign body or aspiration lung disease is suspected or likely.

Cough may be associated with nasal disease but the cough is not due to post-nasal drip.<sup>12</sup> Nasal secretions track to the pharynx and oesophagus rather than the airway. Throat clearing (rather than true cough) occurs when there are a lot of secretions in the pharynx. However airway disease often affects both the nasal and tracheo-bronchial epithelium (viral infections, allergic rhini-

tis, CF, bronchiectasis, ciliary dyskinesia) and the irritation of bronchial epithelium does cause coughing.

### Psychogenic cough

Psychogenic cough<sup>13</sup> can be of two main types. In the first, a dry cough or throat clearing is a habit or tic, occurring before speaking or under stress. The cough may have first started with a respiratory infection. The cough is usually brief and frequent, easily noticed during a consultation. In the second, an adolescent produces a loud 'honking' cough that is disruptive and occurs in particular situations, such as the classroom, but can be readily demonstrated to the doctor on demand. In both types of psychogenic cough, coughing is absent when the child is truly asleep (but may occur when lying awake in bed). Identification of stresses and triggers at school or at home is the principal investigation ('Let's see what situations make your coughing worse...we may be able to help you deal with the situations that make your coughing worse'), and often vocal re-training by speech language therapists or behaviour modification is necessary.<sup>14</sup>

### Moist cough

A persistent or recurrent moist, rattly, or productive cough that lasts beyond the time course of a usual viral respiratory infection (four weeks) is of significant concern. Whereas sometimes this is just the tail end of the infection, it may alternatively reflect low-grade secondary bacterial infection with organisms such as non-typable *Haemophilus influenzae* and *Streptococcus pneumoniae* – referred to sometimes as persistent bacterial bronchitis<sup>15</sup> or protracted bronchitis. Many paediatricians believe this may be a reflection of airway damage presaging the development of bronchiectasis. Hence antibiotic treatment of a moist cough lasting more than four weeks is recommended (14 days of amoxicillin-clavulanic acid, macrolide or cotrimoxazole). Signs of clubbing and poor growth should be sought and, in older children who can produce spu-

Table 2. The desktop guide to evaluating cough in children

<b>Background to consider</b>
<i>The child</i>
<ul style="list-style-type: none"> <li>• Always chesty or unwell</li> <li>• Hypotonia, difficulties with secretions, swallowing or airway protection (e.g. Down's syndrome, muscular dystrophy, oesophageal surgery)</li> </ul>
<i>The environment and contacts</i>
<ul style="list-style-type: none"> <li>• Passive smoke exposure</li> <li>• Exposure to other children at home or in day care / pre-school</li> <li>• Refugee / immigrant from high risk country, contact with TB</li> <li>• Contact with whooping cough</li> </ul>
<b>Symptoms to enquire for</b>
<ul style="list-style-type: none"> <li>• Character of cough and associated symptoms (vomiting, choking, wheeze, apnoea)</li> <li>• Onset, time course and time of day / season of cough</li> <li>• Has there been a significant choking episode?</li> <li>• Triggers of coughing (drinking, lying down, exercise, allergens, school class)</li> </ul>
<b>Signs to look for</b>
<ul style="list-style-type: none"> <li>• Respiratory distress</li> <li>• Noisy breathing (see Figure 1)</li> <li>• Growth and development</li> <li>• Clubbing (see Figure 2)</li> <li>• Chest deformity</li> <li>• Wheeze or crackles – generalised or localised</li> </ul>
<b>Reassure when cough is benign or due to pertussis syndrome after 1 year old</b>
<ul style="list-style-type: none"> <li>• Otherwise well child</li> <li>• Coughing is always dry, triggered by repeated viral infections, or clearly paroxysmal with red face, vomiting (N.B. refer acutely if the paroxysms cause significant apnoea)</li> <li>• Cough did not start with choking on food or other item</li> <li>• Chest x-ray is clear</li> </ul>
<b>Investigations to consider if any cough is persistent &gt;4 weeks</b>
<ul style="list-style-type: none"> <li>• Chest x-ray</li> <li>• Spirometry in older child</li> <li>• Sputum microbiology in older child if productive</li> <li>• Sources of stress in situational cough</li> <li>• Mantoux test in refugee / immigrant from high risk country / TB contact</li> </ul>
<b>Referral to paediatrician recommended</b>
<ol style="list-style-type: none"> <li>1. Any cough started with an episode of choking on food or other item</li> <li>2. Cough lasts &gt;4 weeks AND any of the following:               <ol style="list-style-type: none"> <li>(a) Moist or productive cough does not respond to antibiotics within two weeks, relapses immediately on stopping antibiotics, or undergoes repeated prolonged cycles for more than three months</li> <li>(b) Nocturnal only cough is associated with vomiting and choking, or occurs in a child with neurodevelopmental or oesophageal problems (other than simple reflux)</li> <li>(c) Child is chronically unwell or has poor weight gain</li> <li>(d) Fingernails are clubbed</li> <li>(e) There are persistent asymmetrical added sounds in the chest: wheeze (in spite of bronchodilators) or crackles (in spite of antibiotics)</li> <li>(f) There are significant x-ray findings</li> <li>(g) Mantoux is greater than 5mm</li> </ol> </li> </ol>

tum, sputum culture is helpful. A chest x-ray should be considered. Paediatric specialist evaluation for suppurative lung disease is recommended for children with moist cough who:

- have only partial response to an antibiotic regime as above
- have moist cough for longer than three months
- have repeated protracted spells of moist cough
- have clubbing or poor growth.

Sometimes children with established bronchiectasis or cystic fibrosis present with repeated episodes such as this (although they may have been treated for asthma for a long time before this is recognised).

Rarely, asthma in children may present with coughing, however signs of airway obstruction, such as wheezing are also present, if not as prominent.

How did the idea of 'cough-variant asthma' become so widespread? In the early 1980s there was growing concern about asthma – asthma prevalence and hospitalisations seemed to be rising in children and epidemics of asthma deaths had been documented in adults. It was widely believed that asthma was being under-diagnosed and under-treated in children. At the same time, a handful of small studies

seemed to indicate that some children and adults with persistent night cough had developed wheeze months to years later and one study showed that such coughing responded to theophylline. Very quickly the idea grew that this was the 'dark matter' of asthma, the hidden, under-diagnosed cases, and this partly explained the rise in prevalence of doctor-diagnosed asthma.<sup>16</sup> Studies of cough and cough receptors in the 1990s,<sup>17,18</sup> cast serious doubt on the entity of 'cough-variant asthma' and we now know that theophylline has some cough-suppressing effects. However the notion that these children have asthma has been extremely persistent and difficult to unseat.

Coughing is an important reflex in protecting the airways, but it may become over-active. Alternatively it may be a sign of noxious environmental exposure, psychological stress, or serious chest disease. The initial evaluation is largely clinical, but may take significant interview and observation time.

### Competing interest

The author has, in the past five years, received funding to attend symposia from companies that have an interest in medications for asthma, which is dealt with in this paper.

## Key Points

- Persistent cough without wheeze is not a sign of asthma in children.
- Persistent cough is usefully categorised as dry or moist.
- Chest x-ray (and spirometry in older children) is recommended in children with protracted dry or moist cough lasting greater than four weeks.
- Well children with typical viral initiation of dry cough or pertussis syndrome, and normal chest x-ray, do not benefit from medications, but lots of reassurance is necessary for parents.
- Children with moist cough lasting greater than four weeks should have a trial of two weeks of appropriate antibiotics.
- Children with persistent cough should be referred for paediatric evaluation if there is suspicion of foreign material in the airway, suppurative lung disease or TB, or the diagnosis is otherwise not clear.

## References

1. Chang AB, Phelan PD, Robertson CF, Newman RG, Sawyer SM. Frequency and perception of cough severity. *Journal of paediatrics and child health* 2001 Apr; 37(2):142-5.
2. Munyard P, Bush A. How much coughing is normal? *Archives of disease in childhood* 1996 Jun; 74(6):531-4.
3. Chang AB, Widdicombe JG. Cough throughout life: children, adults and the senile. *Pulmonary pharmacology & therapeutics* 2007; 20(4):371-82.
4. Landau LI. Acute and chronic cough. *Paediatric Respiratory Reviews* 2006; 7 Suppl 1:S64-7.
5. van Asperen PP. Cough and asthma. *Paediatric Respiratory Reviews* 2006 Mar; 7(1):26-30.
6. Chang AB, Landau LI, Van Asperen PP, Glasgow NJ, Robertson CF, Marchant JM, et al. Cough in children: definitions and clinical evaluation. *The Medical Journal of Australia* 2006 Apr 17; 184(8):398-403.
7. Harnden A, Grant C, Harrison T, Perera R, Brueggemann AB, Mayon-White R, et al. Whooping cough in school age children with persistent cough: prospective cohort study in primary care. *BMJ (Clinical research ed.)* 2006 Jul 22; 333(7560):174-7.
8. Chang AB, Masters IB. Treatment of chronic cough in children. *New Ethical Journal* 2002(July):60-6.
9. Belvisi MG, Geppetti P. Cough. 7: Current and future drugs for the treatment of chronic cough. *Thorax*. 2004 May; 59(5):438-40.
10. Paul JM, Yoder KE, Crowell KR, Shaffer ML, McMillan HS, Carlson LC, et al. Effect of dextromethorphan, diphenhydramine, and placebo on nocturnal cough and sleep quality for coughing children and their parents. *Pediatrics* 2004 Jul; 114(1):e85-90.
11. Thomson F, Masters IB, Chang AB. Persistent cough in children and the overuse of medications. *Journal of Paediatrics and Child Health* 2002 Dec; 38(6):578-81.
12. Kemp A. Does post-nasal drip cause cough in childhood? *Paediatric Respiratory Reviews* 2006 Mar; 7(1):31-5.
13. Fitzgerald DA, Kozłowska K. Habit cough: assessment and management. *Paediatric Respiratory Reviews* 2006 Mar; 7(1):21-5.
14. Faught J, Fitzgerald DA. Habit cough and effective therapy. *Journal of Paediatrics and Child Health* 2004 Jul; 40(7):399-400.
15. Donnelly D, Critchlow A, Everard ML. Outcomes in children treated for persistent bacterial bronchitis. *Thorax* 2007 Jan; 62(1):80-4.
16. Kelly YJ, Brabin BJ, Milligan PJ, Reid JA, Heaf D, Pearson MG. Clinical significance of cough and wheeze in the diagnosis of asthma. *Archives of Disease in Childhood* 1996 Dec; 75(6):489-93.
17. Ninan TK, Macdonald L, Russell G. Persistent nocturnal cough in childhood: a population based study. *Archives of Disease in Childhood* 1995 Nov; 73(5):403-7.
18. Chang AB, Phelan PD, Sawyer SM, Robertson CF. Airway hyperresponsiveness and cough-receptor sensitivity in children with recurrent cough. *American Journal of Respiratory and Critical Care Medicine* 1997 Jun; 155(6):1935-9.

