British Thoracic Society Clinical Statement on the Assessment and Management of Cough in Children

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On behalf of the British Thoracic Society

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Summary of clinical practice points

Definition

- Cough is both a symptom and a clinical sign and should be assessed systematically using history, examination and, where possible, direct or recorded observation of its characteristics.
- **Acute cough** is responsible for 25% of paediatric primary care appointments
- **Chronic cough** has an adverse on the quality of life of the child affected and their family

Classification

- **Classification by duration is fundamental:**
  - *Acute cough* (<4 weeks) is usually caused by a recent respiratory tract infection (RTI) and is self-limiting.
  - *Chronic cough* (>4 weeks) is more likely to be associated with an underlying respiratory disroder, though clinical context and red flag features are more important than duration alone.
- **Classification by aetiology improves diagnostic precision:**
  - *Specific cough* is attributable to a recognisable cause (e.g. asthma, cystic fibrosis, protracted bacterial bronchitis) based on identification of specific cough traits.
  - *Non-specific cough* has no identifiable specific cough traits.
- **Classification by acoustic quality provides diagnostic clues:**
  - A *wet cough* suggests airway secretions often associated with infection.
  - A *dry cough* suggests airway irritation/inflammation without excess secretions.
  - Distinctive sounds (e.g. barking, brassy, paroxysmal, honking) may indicate specific underlying disorders.

Clinical assessment

- A history, including environmental exposures, and clinical examination are key to establishing the underlying cause.
- Key aspects within history and examination (Table 2 and 3) help to identify possible diagnosis

Investigations and treatment principles (Figure 2 and 3)

- Although **acute cough** is most commonly caused a recent RTI, other causes such as inhaled foreign body need to be considered.
- In the absence of specific cough traits suggesting a non-viral cause, **acute cough** should be managed with reassurance and watchful waiting.
- In children with **chronic dry cough** and no specific cough traits, reduce exposure to airborne irritants and review after 4–8 weeks. Inhaled corticosteroids should only be used if there is objective evidence of asthma.
- In children with **chronic wet cough** and no specific cough traits, obtain sputum culture (if feasible) and initiate a 2–6 week course of antibiotics. Resolution of cough by two weeks supports a diagnosis of protracted bacterial bronchitis (PBB); if there is no improvement, further investigation for alternative causes of chronic wet cough is required.
- If specific cough traits are present, management should follow condition specific guidance

Indications for referral

- Urgent referral in the presence of red flags (Box 2 and 3)
- Diagnosis uncertainty, limited access to diagnostic tools
- Treatment failure
- Parent/carer or healthcare professional concern

Key message

Assessment of cough in children depends on careful clinical evaluation to identify the underlying cause. The vast majority of those with an acute cough only require reassurance. In contrast those with chronic cough are more likely to require investigation and treatment.

Introduction

Cough is a vital physiological reflex that aids the clearance of secretions and foreign material from the airways and helps prevent aspiration. It is therefore normal for children to cough. However, cough can also be a symptom of a serious or even life-threatening illness. Good clinical skills are required to determine whether an individual child needs investigation, or reassurance (the hardest diagnosis being 'normal child'). The differential diagnosis of cough encompasses virtually the whole of paediatric respiratory medicine and missing a diagnosis can have catastrophic long-term consequences. For example, untreated or misdiagnosed chronic wet cough can lead to bronchiectasis[1–3] meaning the progression to permanent lung damage could potentially have been prevented with earlier treatment.[4] The previous BTS guidelines[5] have been cited nearly 600 times but were published almost 20 years ago so there is an urgent need for an update that includes the latest evidence. The definitions used in the 2008 document no longer align with other major international guidelines.[6–8] Moreover, the long-term significance of chronic wet cough has been increasingly appreciated, as has the knowledge that isolated dry cough is not a form of asthma and will likely improve over time.

Scope

This clinical statement provides guidance and information for healthcare professionals and trainees involved in the care of children presenting with acute or chronic cough across all healthcare settings. It outlines the pathophysiology of cough, offers clear definitions of acute and chronic cough, and provides recommendations for appropriate investigations and management strategies. In addition, it identifies clinical features that should prompt referral to secondary or tertiary care. The treatments of the specific respiratory disorders causing chronic cough (see Table 4) are beyond the scope of this clinical statement, and should be determined in line with established, disease specific guidelines.

Methodology

The Clinical Statement Group (CSG) was jointly chaired by AG-L and FJG. Membership included paediatric respiratory consultants, a general paediatric consultant with respiratory interest, a general practitioner with respiratory interest, a paediatric respiratory specialist nurse, an advanced nurse/paramedic practitioner, a specialist respiratory physiotherapist, a paediatric respiratory trainee, and two parents of children affected by recurrent or chronic cough. The overall content reflects the scope approved by the BTS Standards of Care Committee (SOCC) and used the methodology described in the clinical statement production manual.[9] Following initial discussions, the clinical statement was divided into sections and allocated to subgroups who drafted the content. The individual sections, and later the document combined by FJG, were reviewed and edited by CSG members before being submitted to the BTS SOCC for review and approval and subsequently posted on the BTS website for public consultation and peer review.

Rationale for a separate statement on management of acute and chronic cough in children, distinct from the adult statement

The causes of cough in children differ significantly from those in adults, highlighting the need for separate statements .[5] Using a paediatric-specific, structured approach to the assessment of children with chronic cough improves clinical outcomes by promoting early diagnosis and treatment, as well as the timely referral of those requiring specialist input.[10,11] A number of key adult diagnoses have little or no relevance in paediatric practice:

- Cough hypersensitivity syndrome

Although some conditions increase cough receptor sensitivity in children, if the underlying condition is treated, the cough resolves. This suggests cough hypersensitivity in children is a consequence of an underlying condition rather than a disease itself.[12] The possibility that cough hypersensitivity syndrome develops in adulthood is supported by a lack of difference in the prevalence of Arnold's ear-cough reflex (initiation of cough via auricular branch of the vagus nerve when the external auditory meatus is mechanically simulated) between children with chronic cough and healthy controls. In adults it is more than ten times higher in those with chronic cough.[13]

- Gastroesophageal reflux (GOR)

The relationship between GOR and chronic cough in children is complex. When investigating children with chronic cough, GOR can be identified in up to a quarter of individuals[14] but the temporal relationship between GOR and cough is usually not causal[15] and is not responsive to treatment trials.[16] Children with chronic cough should therefore only be started on acid-suppressive therapy if they have clinical features of GOR such as recurrent regurgitation/dystonic neck posturing in infants, or heartburn/epigastric pain in older children.[17] The treatment should be discontinued if ineffective.

- Post-nasal drip (PND)

It is unclear if PND causes cough in children. Furthermore, the criteria for the diagnosis of PND in children are unclear with uncertainty about whether it is a symptom or a clinical sign. Furthermore, cough in the presence of posterior pharyngeal secretions may be caused by co-existing airways pathology.[18]

- Cough variant asthma

Although cough is common in children with asthma, this is almost always associated with wheeze and the vast majority of children with isolated cough do not have asthma.[19–22]

The burden of cough on the child, their family and the healthcare system

Acute cough is responsible for around a quarter of primary care consultations in children.[23] These consultations are almost twice as common in those aged 0-4 years than 5-14 years, and slightly more prevalent in boys than girls (1.2 to 1).[24] The annual cost to the United Kingdon (UK) National Health Service (NHS) of acute cough in pre-school children in 2008 was estimated as £31M[25], based on inflation this suggests a cost in 2025 of £52M. A child with acute cough caused by a respiratory tract infection (RTI) is likely to have disturbed sleep, reduced oral intake and disturbance of play or other daily activities.[26] In a prospective study based in primary care, 52% of children with acute cough were absent from school/childcare for at least one day, resulting in time off work for 28% of mothers and 20% of fathers.[26] Chronic cough is also extremely burdensome for the child and their family. It affects all aspect of the child's life including their ability to sleep, play and attend school/nursery.[27] Parents repeatedly seek medical consultation with 80% of affected children having ≥5 doctor visits and 53% >10 doctor visits in the previous 12 months.[28] The parents of children with chronic cough have high levels of emotional distress caused by stress which improves when the child ceases coughing.[28]

Definition and Pathophysiology

Cough is a complex, protective airway reflex that functions to clear the respiratory tract of mucus, pathogens, and foreign matter.[29] While it serves an essential biological function, persistent or abnormal cough can signal disease, particularly in children.[30] The cough reflex arc is initiated by mechanical or chemical activation of cough receptors in the pharynx, larynx and proximal airways. This

produces a signal which is sent to the 'cough centre' in the medulla oblongata via afferent pathways in the vagus nerve. The brainstem then generates an efferent signal which travels via the vagus, phrenic and motor nerves to expiratory musculature to produce the cough.[29,31] The cough centre in the medulla oblongata can also be activated by a signal from the cerebral cortex allowing the voluntary initiation of cough.

The mechanical event of cough has three phases:[32]

1. Inspiratory Phase: A rapid inhalation takes place through a wide-open glottis. The size of the inhalation varies in relation to the stimulus and receptor type but can be up to vital capacity.
2. Compressive Phase: Glottis is closed and abdominal and respiratory muscles contract to increase the intrathoracic and intraabdominal pressure.
3. Expiratory Phase: Rapid glottis opening produces an explosive flow of air from the lungs removing airway secretions/debris and producing the characteristic cough sound.

Box 1: What is and isn't normal?

- Preschool children may have >10 URTIs per year causing acute cough.[33]
- A 'normal' cough resolves spontaneously within four weeks and is not associated with red flag features (e.g., weight loss, clubbing, haemoptysis, persistent wet cough).
- A chronic, unremitting cough, or cough with red flag symptoms, is not normal and warrants further evaluation.[34]

Classification of cough

Cough is a symptom but also an important clinical sign. Clinicians should determine the duration of the cough from the history and listen to the cough to categorise its acoustic quality. If the child does not cough during the consultation, parents should be requested to record the child's cough on a smart phone or recording device, if they have access to one.[35]

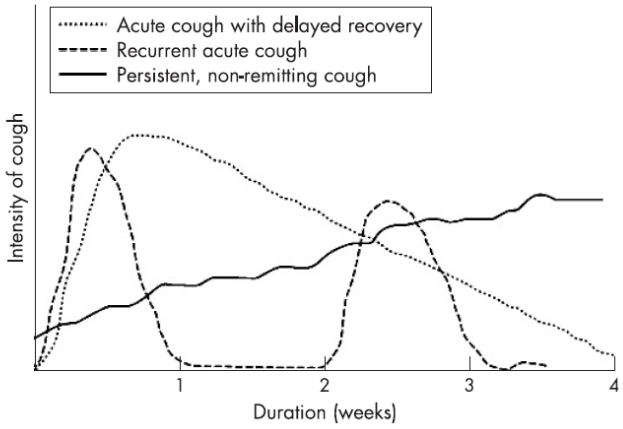
Classification by duration

The duration of cough is fundamental to its clinical assessment.

- **Acute Cough**: Lasts <4 weeks in children.
  A four-week cutoff is used as 80-90% of coughs in children associated with a recent RTI will resolve by this time point. Most such cases do not require further investigation or treatment.[36–38] Recurrent severe acute cough may warrant further investigation.
- **Chronic Cough**: Persisting, non-remitting cough lasting >4 weeks.
  The likelihood of a serious underlying respiratory disorder increases when the duration of a daily cough exceeds four weeks. When such children are assessed by a respiratory specialist, almost half are diagnosed with protracted bacterial bronchitis and a third with a new chronic lung disease such as asthma or bronchiectasis.[36] It is important to distinguish chronic cough from recurrent acute cough which can be difficult if the time between episodes is short. See Figure 1.

It is important to note the four-week cut-off is an arbitrary guide as to who needs investigation and there will be exceptions. For example, a child who has only been coughing for two weeks but is systemically unwell or has red flag features will need immediate investigation / treatment, whereas a child who has been coughing for six-weeks but the intensity is improving will only need a period of watchful waiting while their post-infective cough resolves.

Figure 1: Cough classification by duration according to the patterns of intensity vary over time[39]



Classification based on aetiology (by underlaying cause)

Aetiological classification improves diagnostic precision and management:

- **Specific Cough**: Attributable to a recognisable cause based on 'specific cough traits' identified in the history or examination. Causes include asthma, cystic fibrosis (CF), pertussis, primary ciliary dyskinesia (PCD) and recurrent / chronic pulmonary aspiration (R/CPA). See Tables 4 and 5.
- **Non-specific Cough**: No identifiable 'specific cough traits'.

Classification of cough by acoustic quality

The acoustic quality of a cough can suggest the location of the causative pathology within the respiratory tract and/or the underlying cause. See Table 1. A key point when differentiating between coughs, is whether it is wet or dry.[40,41] A wet cough implies excess airways secretions which can be caused by either increased production or impaired mucociliary clearance. Both parental and clinician report of wet cough correlates well with the volume of secretions seen at bronchoscopy.[42] It is important to remember a wet cough in a young child is unlikely to be productive, as they usually swallow, rather than expectorate sputum. Not all coughs are easily classified as wet or dry. In chronic infections such as pertussis, the cough changes between wet and dry during the different stages of the illness. In R/CPA the cough associated with episodes of aspiration is usually dry but becomes wet during a lower respiratory tract infection (LRTI). If a cough is variable i.e. sometimes wet and sometimes dry, it is considered wet.[43] Other acoustic qualities include a barking, croupy cough suggesting upper airway obstruction, a brassy cough suggesting airway malacia, paroxysmal cough with or without a whoop suggesting pertussis, a honking cough suggesting somatic cough disorder and a repetitive, throat-clearing cough suggesting tic cough.[44] See Table 1.

Table 1: The acoustic quality of a cough and associated significance

Acoustic Quality	**Potential Significance**
Wet	LRTI, PBB, CSLD, bronchiectasis.
Dry / non-productive	Viral URTI, post-infective cough, asthma*, inhaled irritants.
Barking or croupy,	Croup, inhaled foreign body, bacterial tracheitis
Brassy	Laryngo-tracheomalacia,
Paroxysmal or spasmodic	Pertussis, pertussis-like illness, inhaled foreign body.
Honking	Somatic cough syndrome.
Repetitive / throat-clearing	Tic cough.

*Asthma is unlikely to be the cause of chronic cough if not associated with wheeze.

CSLD: chronic suppurative lung disease, LRTI: lower respiratory tract infection, PBB: protracted bacterial bronchitis, URTI: upper respiratory tract infection.

Clinical assessment of the coughing child

A thorough history and physical examination are crucial first steps in the evaluation of a child with cough. The findings will guide the clinician as to what, if any, investigations are needed.

History

The first aspect of the history is to determine when the cough started and how the intensity has changed since that time. This will enable the differentiation between acute cough, recurrent acute cough and chronic cough.[23] See Figure 1. For acute cough, the history is also used to identify the likely cause and red flags highlighting those requiring urgent investigation, treatment, referral or admission. For chronic cough, the history is focused on trying to identify specific cough traits suggestive of a specific disorder. Key aspects for a cough history are detailed in Table 2.

Environmental exposures

When evaluating a coughing child, clinicians should routinely assess environmental exposures due to their important role in the onset and persistence of respiratory symptoms. Key exposures include direct and second-hand tobacco smoke, e-cigarette vapour, indoor dampness/mould, household allergens, and outdoor or indoor air pollution.[45] Children are particularly susceptible to these factors due to their developing lungs, higher respiratory rates, and increased time spent in the home environment. Identifying and addressing such exposures is critical, as targeted mitigation can reduce symptom burden, prevent recurrent presentations, and support long-term respiratory health.[45]

Table 2: Key aspects of the history and their clinical significance.

	Key aspects of history	**Clinical Significance**
Age of onset	As neonate	Laryngeal cleft, H-type TOF, primary ciliary dyskinesia, cystic fibrosis
Type of onset	Sudden or associated with choking episode Preceded by coryzal illness	Inhaled foreign body Post-infective cough
Pattern of intensity	Gradually improving Acute episodes with periods of remission Worse at night or seasonal Absent when sleeping Suggestibility and distractibility	URTI / post-infective cough Recurrent acute cough Asthma Tic cough / somatic cough disorder Tic cough
Acoustic quality	Wet / dry / barking / croupy / brassy / paroxysmal / honking / throat clearing	See Table 1
Triggering factors	Cold air / exercise Feeding	Asthma* Laryngeal cleft, TOF, R/CPA, unsafe swallow
Alleviating factors	Bronchodilators Antibiotics	Asthma* Protracted bacterial bronchitis / bronchiectasis**
Associated symptoms	Fever, runny / blocked nose / sore throat Poor feeding, lethargy, or irritability Wheeze Failure to thrive / steatorrhoea Night sweats / weight loss / haemoptysis Chronic otitis media and/or rhinosinusitis	URTI Systemic infection Asthma* / bronchiolitis / bronchiolitis obliterans Cystic fibrosis Tuberculosis Primary ciliary dyskinesia
Past medical & surgical history	Severe, persistent, unusual or recurrent (SPUR) infections Rectal prolapse Neurodisability Previous TOF repair Neonatal respiratory distress	Immunodeficiency Cystic fibrosis R/CPA Swallowing incoordination causing R/CPA Primary ciliary dyskinesia
Medications	ACE inhibitors	May cause chronic cough
Immunisation status	Pertussis / influenza / pneumococcus / BCG	Increased risk if unvaccinated
Environmental exposures	Tobacco smoke / e-cigarette vapor	Worsen asthma, chronic cough, LRTIs

	Key aspects of history	Clinical Significance
	Ambient or household air pollution Allergens (pets / pollen / HDM / mould)	Worsen asthma, chronic cough, LRTIs Asthma*
Social & family history	Recent travel or tuberculosis exposure	Tuberculosis

*Asthma is unlikely to be the cause of chronic cough if not associated with wheeze.
** Bronchiectasis is a lung condition with multiple potential underlying causes and improvement with antibiotics reflects treatment of bronchiectasis-related infection rather than resolution of the underlying disorder
ACE: Angiotensin-converting enzyme, LRTI: HDM: House dust mite, Lower respiratory tract infection, R/CPA: recurrent or chronic pulmonary aspiration, TOF: Tracheoesophageal fistula, URTI: Upper respiratory tract infection,

Examination

All children with cough should have a full systemic examination, including assessment of their general health, nutritional status (including height and weight centiles / z scores) and examination of their upper and lower respiratory system.[46] In a child with acute cough, the aim of the examination is to identify the unwell and/or conditions requiring investigation or treatment.[47] For the child with chronic cough, the aim of the examination is to identify cough specific pointers which suggest an underlying respiratory disorder and to identify those who need to be referred to secondary or tertiary care. Key examination findings and their clinical significance are shown in Table 3.

Table 3: Key examination findings and their clinical significance

	Finding	Clinical Significance
General Appearance and observations	Lethargy, confusion, poor perfusion Elevated respiratory rate or heart rate Grunting Stridor, barking cough Pyrexia Nutritional status (height & weight percentiles / z scores)	Signs of severe illness / sepsis[48] Key signs of the 'unwell child' Sign of severe illness Upper airway obstruction, inhaled foreign body Infective cause Failure to thrive: cystic fibrosis, immunodeficiency, interstitial lung disease
Inspection	Digital clubbing Nasal flaring, tracheal tug, I/C or S/C recession Harrison sulci	CSLD, bronchiectasis, interstitial lung disease Signs of respiratory distress Chronic / recurrent respiratory distress
Palpation	Tracheal deviation Subcutaneous emphysema Asymmetrical chest expansion	Atelectasis, effusion, thoracic mass Air leak Pneumothorax, atelectasis, consolidation, effusion
Percussion	Dull Stony dull Hyperresonant	Consolidation, atelectasis Pleural effusion Pneumothorax, acute severe asthma
Auscultation	Decreased breath sounds Bilateral wheeze, polyphonic wheeze Unilateral wheeze, monophonic wheeze Coarse crackles Fine crackles	Consolidation, atelectasis, pneumothorax, effusion Asthma, bronchiolitis, bronchiolitis obliterans Inhaled foreign body, obstruction of main bronchi Bronchiolitis, LRTI Interstitial lung disease
Upper respiratory tract	Drooling or muffled voice Mucopurulent nasal discharge Nasal polyps Tonsillar exudates Chronic otitis media and/or rhinosinusitis	Epiglottitis, bacterial tracheitis URTI, acute or chronic rhinosinusitis Cystic fibrosis Tonsillitis Associated with primary ciliary dyskinesia
Extra-pulmonary	Conjunctivitis, coryza, rash Subconjunctival haemorrhages, petechiae Recurrent or severe infections Poor feeding, tachycardia, tachypnoea, sweating, oedema, hepatomegaly Dextrocardia	URTI Intense coughing (pertussis) Immunodeficiency Cardiac failure Associated with primary ciliary dyskinesia

CSLD: Chronic suppurative lung disease, I/C: intercostal, LRTI: Lower respiratory tract infection, S/C: Subcostal, URTI: Upper respiratory tract infection,

Investigations

Radiological

- Chest X-ray (CXR):

Most children with acute cough do not need a CXR. This includes those with uncomplicated community acquired pneumonia which is a clinical diagnosis.[49] A CXR should only be performed on a child with acute cough in the following circumstances:

1. Signs or symptoms suggesting inhaled foreign body.[50]
   Perform inspiratory and expiratory CXRs if the child is able to cooperate or bilateral decubitus views if not. A normal CXR does not exclude a foreign body.
2. Signs or symptoms suggesting pleural effusion / empyema.[51]
   If effusion confirmed, size and appropriateness for drainage to be informed by chest ultrasound scan.
3. Sign or symptoms suggesting a pneumothorax.[52]
4. A history of haemoptysis.[53]
   To aid the diagnosis of LRTI, tuberculosis, pulmonary oedema and malignancy.

In contrast to acute cough, all children with a chronic cough should have a CXR.[54]

- High resolution computerised tomography (HRCT):

Bronchiectasis is confirmed using HRCT images.[55] These are usually obtained using a multidetector CT (MDCT) scanner which acquires a high-resolution, volume dataset of the whole thorax in a single breath hold.[56] These data can then be reformatted into multiple thin axial slices (0.5mm) or 3D reconstructions. Due to the associated radiation dose,[57] the timing of the HRCT is a balance between making an early diagnosis, obtaining the best quality scan and limiting the need for a repeat. HRCT is also used to diagnose a wide range of other respiratory disorders including bronchiolitis obliterans (aided by expiratory images), childhood interstitial lung disease (chILD) and congenital lung abnormalities (may require contrast enhancement). See Chronic Cough Section. HRCT should only be performed in secondary or tertiary centres with paediatric radiographers and radiologists, to minimise radiation dose while maximising image quality.

Microbiological

- Viral molecular testing

The vast majority of children with a cough caused by a viral URTI or LRTI do not need viral molecular testing. However, if the child is unwell enough to require admission, this should be performed for the purposes of infection control, including SARS-CoV-2, influenza A&B, and respiratory syncytial virus (RSV).[58]

- Sputum microscopy, culture and sensitivity (MC&S)

Obtaining sputum from a child with a wet cough is difficult as most will swallow it rather than expectorating. In children with PBB, identifying the causative pathogen promotes antibiotic stewardship by enabling a narrow spectrum antibiotic to be prescribed.[59] In secondary and tertiary settings, obtaining a lower airway sample for MC&S, such as induced sputum, should be attempted prior to prescribing a prolonged antibiotic course.[60] Routinely obtaining a sputum sample (spontaneously expectorated or induced) is not recommended in children with acute LRTI.[61]

- Bordetella Pertussis

In a child with suspected whooping cough, early confirmation of the diagnosis helps control outbreaks, limit complications and enable notification to UK Health Security Agency (UKHSA). The optimal diagnostic test depends on the duration of cough:[62]

- <21 days: Culture and/or PCR of a nasopharyngeal swab or aspirate.
- >21 days: Serological testing of blood, or saliva for anti-pertussis toxin IgG

Bronchoscopy

- Rigid bronchoscopy

Rigid bronchoscopy is the gold-standard for foreign body removal[63] and for the identification of structural airway abnormalities such as laryngeal cleft and H-type tracheoesophageal fistula (TOF).[64]

- Flexible bronchoscopy:

Flexible bronchoscopy with bronchoalveolar lavage (FB-BAL) is an important investigation in children with chronic cough to obtain lower airway microbiological samples and diagnose airway abnormalities.[65] The potential advantages of FB-BAL need to be balanced against the burden for the child and their family.[66] In PBB, FB-BAL should be reserved for those with recurrent relapses and may not be necessary if an induced sputum is obtained in this patients' group.[60] When undertaking FB-BAL to obtain lower airway samples, sampling 6-lobes (including lingula) increases microbiological yield.[59,67,68] Various biochemical (pepsin or bile acids) and cytological (lipid-laden macrophages) BAL markers of aspiration have been investigated but none are used routinely.[69] Flexible bronchoscopy is also increasing being used for foreign body removal and has been shown to be safe and efficient, with a shorter procedure time and fewer complications.[70,71]

Impedance/pH study

Investigations for acidic and non-acidic reflux are not commonly necessary when investigating children with cough but may be used in selected patients. Combined oesophageal multichannel intraluminal impedance and pH (MII-pH) monitoring is the investigation of choice for diagnosing GOR and non-acid reflux (NAR). As reflux is common, its detection does not necessarily mean it is the cause of the cough.

Swallowing assessment

In children with suspected R/CPA, a videofluoroscopic swallowing study (VFSS) can be used to evaluate if a child can swallow safely.[72] This is normally requested after assessment by a speech and language therapist. Flexible endoscopic evaluation of swallow (FEES) is an alternative method to assess swallow.[73]

Asthma investigations

In a child with a clinical suspicion of asthma, the investigations should be undertaken as per the BTS/NICE/SIGN Joint Guideline on Asthma.[74] Objective tests to confirm the diagnosis in those ≥5 years include FeNO, spirometry with bronchodilator reversibility, total IgE, skin-prick tests and blood eosinophil count. In those <5 years old, if there is strong clinical suspicion of asthma, an 8-week trial of inhaled corticosteroid can be used.

CF investigations

Most children with CF in the UK are now identified by newborn screening. Quantitative pilocarpine iontophoresis with sweat chloride analysis and CFTR genetics are used to confirm the diagnosis and test older children with clinical suspicion of CF.[75,76] CF is diagnosed in those with a sweat chloride ≥60mmol/L and those with an intermediate sweat chloride (30-59mmol/L) but two disease causing CFTR variants. CF can also be diagnosed by nasal transepithelial voltage measurements in individuals with high clinical suspicion of CF but a normal (<30mmol/L) sweat chloride.[77]

PCD investigations

There is no single, gold-standard diagnostic test for PCD. Tests used to aid diagnosis include: ciliary beat pattern and frequency (measured using digital high-speed video), ciliary ultrastructure assessed using electron microscopy, ciliopathy mutation screening, and immunofluorescence[78,79] Nasal nitric oxide (nNO) concentrations are low in individuals with PCD[80], this together with symptom based scoring systems[81,82] can be used as a gateway to further testing

<u>When to refer</u>

Most children with cough present to primary care and are managed appropriately without the need for referral. Although referral pathways may show geographical variation and depend on the level of expertise of the healthcare professionals involved, the principles of referral from primary to secondary or secondary to tertiary care are:

1. When the diagnosis is in doubt, and the practitioner does not have the facilities to perform further testing.

2. When the progress of the disease is not as anticipated, or the treatment is not working.
3. When any party (professional or family) remains concerned.
4. If a child with a known diagnosis (e.g. cystic fibrosis) presents to a setting such as primary care in which otherwise unsupported management is inappropriate.

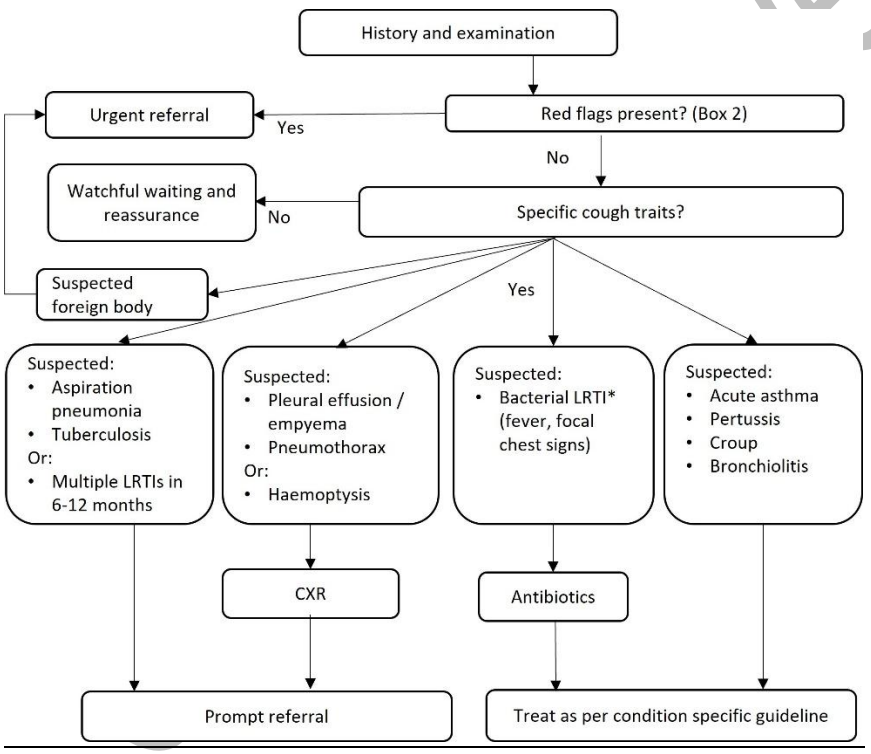
Specific guidance on when to refer children with acute and chronic cough is included in the relevant sections below.

Acute Cough

Structured Assessment

The majority of cases of acute cough are self-limiting but it can be a feature of a more significant condition requiring investigation and treatment such as inhaled foreign body or bacterial LRTI.[83] Occasionally, acute cough is a presenting symptom of a serious underlying disorder such as CF, immunodeficiency or PCD.[83] The structured assessment of the child with acute cough begins with a detailed history and systemic examination. The first aim is to identify children who require referral or admission as they are acutely unwell. The second aim is to identify those with specific cough traits suggesting a cause requiring investigation, treatment, referral or admission (see Table 4).

Figure 2: Structured assessment for the child with acute cough



CXR: Chest X-ray, LRTI: Lower respiratory tract infection, CAP: Community acquired pneumonia.
For Red Flags see Box 2.

Table 4: Causes of acute cough and associated 'specific cough traits'

DIAGNOSIS	COUGH NATURE	SPECIFIC COUGH TRAITS	
		History	Examination
Asthma exacerbation	Dry	Previous episodes, atopy	Wheeze, signs of respiratory distress
Aspiration pneumonia*	Wet +/- choking	Associated with feeding / meals, neurodisability	Normal / pyrexia / focal chest signs
Bronchiolitis	Variable	<1 year old, coryza, reduced feeding	Bilateral wheeze and crackles, signs of respiratory distress
CAP / LRTI (viral / bacterial / mixed)	Wet	Unwell, reduced appetite	Pyrexia, focal chest signs, signs of respiratory distress
Inhaled foreign body*	Choking / barking	Sudden onset, choking episode, relentless	Noisy breathing, unilateral chest signs
Laryngotracheobronchitis (croup)	Barking / croupy	Coryza, sore throat, hoarse voice	Pyrexia, stridor, signs of respiratory distress
Pertussis	Paroxysmal	Post-tussive vomiting, inspiratory whoop	Normal / sub-conjunctival haemorrhages
Tuberculosis*	Variable	TB contact / weight loss / night sweats / haemoptysis	Normal / focal chest signs/ weight loss
Viral URTI	Variable	Associated rhinorrhoea and sneezing	Normal / rhinitis / pharyngitis / lymphadenopathy

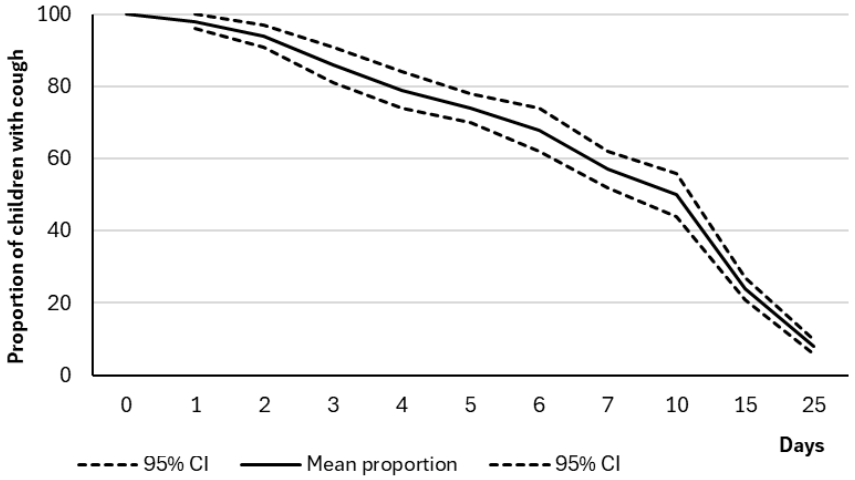
*Conditions likely to require referral to secondary/tertiary care for further investigation or management.
CAP: community acquired pneumonia, LRTI: Lower respiratory tract infection, TB: tuberculosis, URTI: upper respiratory tract infection, ↑WOB: increased work of breathing.

Management of acute cough

Watchful waiting and reassurance

A systematic review of acute cough in preschool children (five studies with 866 participants) found cough resolution occurred in 50% by day 10 and in 90% by day 25.[37] See Figure 2. A subsequent cohort study of 766 children (median age 2.3 years) presenting to the emergency department with an acute respiratory infection and cough (duration <28 days), reported cough resolution in 64% of children by day 14 and 82% by day 28.[36] As such, the vast majority of children with acute cough do not require any investigations or treatment. It is important this information is imparted to the family in a thoughtful and understanding way, as they often have genuine concerns about the consequences of their child's cough including fear of choking and long-term respiratory damage.[84]

Figure 2: Proportion of children with persisting cough, 1-25 days after presenting with acute cough.



Adapted from Thompson et al[37] which combines data from five studies[38,85–88] with a total of 866 preschool children. Duration of cough at presentation varied from 1 to 14 days.

Antibiotics for community acquired pneumonia (CAP)/LRTI

A key aspect when managing children with acute cough is to avoid unnecessary prescribing of antibiotics. When CAP/LRTI is suspected, antibiotics should be reserved for those with pyrexia and/or focal chest signs as this increases the risk of complications and re-consultation.[89] The BTS[49] and NICE[90] CAP guidelines both suggest oral amoxicillin as first-line treatment. The CAP-IT trial found 35-50mg/kg/d oral amoxicillin for three days was non inferior to 70-90mg/kg/d for seven days in preventing need for antibiotic re-treatment but children coughed for on average two days longer.[91] A macrolide should be prescribed for pneumonia caused by an atypical pathogen (e.g. *Mycoplasma pneumoniae*).

Treatment of Pertussis

If pertussis is confirmed or strongly suspected in a child coughing for <14 days who is not acutely unwell, a macrolide should be prescribed (3-5 days azithromycin or 7 days clarithromycin).[92] Children should stay off nursery/school until they have completed 48 hours of antibiotic treatment or for 14 days from onset of coughing if not treated. When recovered, any outstanding vaccinations should be offered. For a child with pertussis who has been coughing for <14 days, close contacts should be prescribed prophylaxis if they are vulnerable to severe complications or at increased risk of transmitting to those that are vulnerable.[93]

Over the counter (OTC) cough treatments

Multiple systemic reviews have failed to show any benefit from the use of over the counter cough treatments in children and report occasional instances of harm.[94–96] There is very weak evidence that honey may improve cough symptoms although a systematic review concluded there was no strong evidence for or against its use.[97]

When to refer

Although most cases of acute cough are self-limiting, it should not be forgotten that recurrent especially severe acute cough may be the harbinger of an underlying important diagnosis. Any child with acute cough who has red flags suggesting severe illness or an inhaled foreign body should be referred urgently for immediate assessment. Children with aspiration pneumonia, tuberculosis or multiple LRTIs (not URTIs) in the last 6-12 months should also be referred but the urgency of the referral will vary depending on the clinical state of the child and the medical history. Red flags for urgent referral of children with acute cough are shown in Box 2. There is no evidence base to guide how many severe episodes should prompt investigation / referral but we empirically suggest a child with ≥3 episodes in 12 months should be referred to a paediatrician with respiratory expertise for further investigation.

Box 2: Red flags for urgent referral in children with acute cough

- Lethargy or confusion
- Poor perfusion (capillary refill ≥2 seconds)
- Poor oral intake (<75% of normal intake) or clinical dehydration
- Stridor
- Increased WOB (intercostal / subcostal recession, nasal flaring, grunting)
- Tachycardia
- SpO_2 ≤92%
- Possible inhaled foreign body: Sudden onset choking, unilateral chest signs
- Possible aspiration pneumonia: Sudden onset cough with feeds / meals or after vomiting

SpO_2: oxygen saturation, WOB: work of breathing.

Causes of acute cough

Viral URTI

Viral URTIs are the commonest cause of acute cough with most healthy children experiencing multiple episodes each year.[34] Other symptoms include rhinorrhoea, sneezing, nasal congestion, sore throat and malaise.[98] The commonest causative pathogens are rhinovirus, coronavirus, influenza virus, parainfluenza virus and RSV. Although a quarter of children remain symptomatic after two weeks,[99] the vast majority or URTIs are self-limiting and require no specific investigations or treatment.[5,83,100–102]

CAP/LRTI

CAP is a clinical diagnosis based on the presence of persistent or recurrent fever >38.5°C, signs of respiratory distress and focal chest signs.[49] In children hospitalised with CAP, a respiratory virus is detected in 30-70%, atypical bacteria in 7-17% and pyogenic bacteria in 2-8%.[103] The commonest causative viruses are RSV, influenza and rhinovirus and the commonest bacteria are *Streptococcus pneumoniae*, *Haemophilus influenzae* and *Mycoplasma pneumoniae.*[104,105] It is not possible to reliably differentiate between viral, bacterial or mixed CAP based on history, examination or point of care tests.[44,84] For treatment see '*Antibiotics for community acquired pneumonia (CAP)/LRTI*' on P11.

Inhaled foreign body

Inhaled foreign bodies are most prevalent in children aged 1-3 years, commonly impacting in the larynx or right main bronchus.[63] This causes acute cough which classically starts abruptly with a choking episode and may be associated with stridor or unilateral wheezing. Severe cases can be life threatening. If the foreign body is not removed it can cause chronic cough, atelectasis, abscesses, and cavities.

Pertussis (whooping cough)

Pertussis is a highly contagious infection caused by *Bordetella pertussis* that is implicated in up to 20% of children coughing for >2 weeks.[106] The initial 'catarrhal' phase lasts 1-2 weeks causing mild URTI symptoms. The 'paroxysmal' stage follows, characterised by bouts of coughing sometimes accompanied by an inspiratory whoop (commoner in younger children).[107] This can lead to hypoxia, apnoea and respiratory failure, as well as subconjunctival and intracranial haemorrhages.[108] A gradual transition to the "convalescent" stage follows after 1 to 2 months, characterised by the cough improving over several weeks.[109] Pertussis should be notified to the UKHSA Health Protection Team. Details of testing for pertussis are on P8 and for treatment and prophylaxis of pertussis are on P10.

Bronchiolitis

Bronchiolitis is an acute viral LRTI that currently is most commonly caused by RSV, although this may change in the future with maternal immunisation in pregnancy and the use of RSV monoclonal antibody in high risk infants. It affects infants <1 year old and is the commonest reason for infants to be admitted to hospital.[110] The usual presentation is with a short history of coryza, pyrexia, cough and reduced feeding. Severely affected infants, particularly those <3 months old may have apnoeas. Increased WOB, bilateral crackles and expiratory wheeze are the classical examination findings. Treatment is supportive and includes ensuring adequate hydration and oxygenation.[110]

Aspiration pneumonia

Aspiration pneumonia refers to a LRTI caused by the inhalation of food, liquid, saliva or stomach contents into the airway. Most children admitted to hospital with aspiration pneumonia have underlying medical diagnoses such as neurodisability.[69,111]

Croup

Viral laryngotracheobronchitis (croup) is a common URTI in children. Although usually self-limiting, it can be life-threatening. The infection causes subglottic, upper airway inflammation and obstruction

resulting in a hoarse voice, a barking/croupy cough, stridor and increased WOB. These symptoms are often preceded by a short history of cough, coryzal symptoms and pharyngitis. A single dose of oral dexamethasone is the mainstay of treatment although oral prednisolone and nebulised budesonide are also effective.[110]

Asthma exacerbation

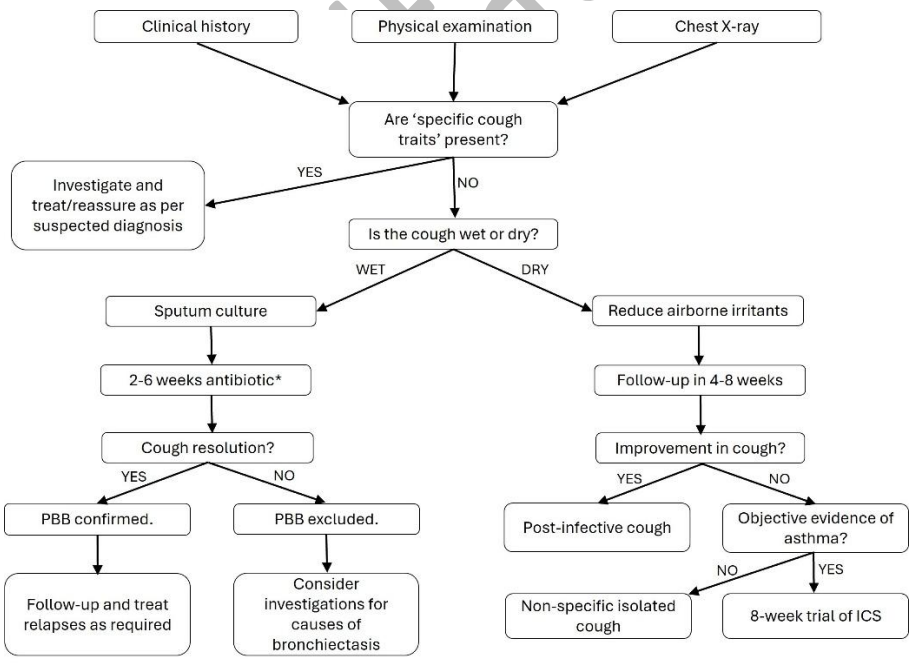
Whilst exacerbations of asthma can be associated with an acute dry cough, the most common symptoms are expiratory wheeze and signs of respiratory distress. Isolated cough is rarely a sign of asthma. Triggers include URTI/LRTI, aeroallergens, environmental exposures, emotion, and non-adherence with preventive therapy. Treatment includes inhaled bronchodilators and corticosteroids.[113]

Chronic Cough

Structured Assessment

The structured assessment of the child with chronic cough also starts with a detailed history, thorough examination and when possible, a chest radiograph. This allows identification of specific cough traits (see Table 5) indicating a specific respiratory diagnosis.[114] These diagnoses include the causes of bronchiectasis / chronic suppurative lung disease (CSLD), infections such as pertussis / tuberculosis and asthma. If suspected, these diagnoses should be confirmed with appropriate investigations and treatment. Some causes of chronic cough and their specific cough traits are shown in Table 4. A child with a chronic wet cough but no specific cough traits should be prescribed a course of an appropriate oral antibiotic to confirm or exclude protracted bacterial bronchitis (PBB).[115] If the cough does not resolve, investigations for the causes of bronchiectasis / chronic suppurative lung disease should be considered. For children with chronic dry cough but no specific cough traits, a period of observation will enable post-infective and non-specific isolated cough to be differentiated. See Figure 1.

Figure 3: A structured assessment for a child with chronic cough



If a cough is sometimes wet and sometimes dry, it is considered wet.
CXR: Chest x-ray, PBB: Protracted bacterial bronchitis. *A 4-6 week course should be used when prescribing in secondary / tertiary care with a review at 2 weeks, but a 2-week course may be appropriate for first episode, when prescribing in primary care or when sputum culture not possible.

Table 5: Causes of chronic cough and associated specific cough traits

DIAGNOSIS	COUGH NATURE	SPECIFIC COUGH TRAIT		DIAGNOSTIC TEST
		History	Examination	
Cystic fibrosis*	Wet	Steatorrhoea, recurrent LRTIs, nasal polyps, rectal prolapse, haemoptysis[116]	FTT, inspiratory crackles, finger clubbing	Sweat test CFTR genetics
Primary ciliary dyskinesia*	Wet	Neonatal onset, chronic sinusitis, otitis media with effusion, recurrent LRTIs[81,82]	Dextrocardia / situs inversus, inspiratory crackles, digital clubbing	nNO, ciliary structure and function, ciliopathy genetics
Inborn error of immunity / Primary immunodeficiency*	Wet	Severe, persistent, unusual or recurrent infections, chronic diarrhoea, parental consanguinity [117]	FTT	FBC, immunoglobulins, functional Ab's
Airway malacia	Dry	Brassy, barking or croupy cough. Worse with URTI / LRTI, exertion or feeding[118]	Stridor, signs of respiratory distress	Bronchoscopy
Asthma	Dry	Wheeze and breathlessness associated with allergies and family history[119]	Nil when well, wheeze with exacerbations	FeNO, eosinophil count, bronchodilator reversibility or serial PEFR
ChILD*	Dry	Shortness of breath, hypoxia[120]	Fine crackles, hypoxia, tachypnoea, signs of respiratory distress	HRCT chest, genetic tests
Prolonged post-infective cough	Dry	Viral URTI within 6-8 weeks, cough slowly improving[121]	Normal	Not needed
Somatic cough syndrome*	Dry	Bizarre honking or barking cough, settles when asleep, may increase when observed[122]	Normal	Not needed
Tic cough	Dry	Frequent throat-clearing cough, settles when asleep, may increase when observed[122]	Normal	Not needed
Non-acidic reflux	Variable	Chronic, variable cough, GOR symptoms non-responsive to PPI[123]	Often normal, feature of LRTI	MII-pH
Pertussis	Variable	Paroxysms of coughing, post-tussive vomiting, inspiratory 'whoop'[106]	Often normal, subconjunctival haemorrhage, hypoxia	Culture/PCR of per-nasal swab
Recurrent / chronic pulmonary aspiration*	Variable	Relentless cough with neonatal onset, choking / spluttering with feeds, previous thoracic surgery, recurrent LRTIs[43]	Often normal, features of LRTI	VFSS, FEES
Retained inhaled foreign body*	Variable	Acute onset with choking, relentless cough, recurrent LRTIs[43]	Stridor, unilateral respiratory signs	Inspiratory & expiratory CXR, bronchoscopy
Tuberculosis*	Variable	Weight loss, night sweats, haemoptysis[124]	Often normal, features of LRTI	CXR, culture/PCR of sputum, gastric lavage or BAL

*Conditions likely to require referral to secondary/tertiary care for further investigation or management.
ChILD: childhood interstitial lung disease, FEES: fibreoptic endoscopic evaluation of swallowing, FTT: failure to thrive, GOR: gastro-oesophageal reflux, LRTI: lower respiratory tract infection, MII-pH: multichannel intraluminal impedance and pH monitoring, nNO: nasal nitric oxide, PCR: polymerase chain reaction, PEFT: peak expiratory flow rate, VFSS: videofluoroscopic swallow study.

Treatment

Chronic wet cough with no specific cough traits

In a child with a chronic wet cough but no specific cough traits, a two-week antibiotic course is long enough to confirm PBB and extending beyond this duration does not increase the rate of cough resolution.[125] However, in children whose cough does resolve with two-weeks of antibiotic and therefore have PBB, extending the antibiotic duration to 4-6 weeks reduces the risk of PBB

relapse.[126,127] A two week course is therefore suggested for the first episode, or if sputum culture is not possible. A 4-6 weeks course is recommended when prescribing in secondary/tertiary care. Antibiotic choice should be guided by a respiratory sample from the lower airway. If this is not available, co-amoxiclav is the first line choice.

Chronic dry cough with no specific cough traits

The commonest causes of chronic dry cough in children with no specific cough traits are post-infective and non-specific isolated cough, both of which usually resolve over time without the need for treatment. Identification and avoidance of cough triggers or exacerbating factors such as tobacco smoke and e-cigarette vapor may expedite cough resolution.[128] Treatment with inhaled corticosteroids should only be used if there is objective evidence of asthma.[74,119] In children with non-specific isolated cough, management should include addressing child and parental stress and concerns.[129]

Airway clearance

Airway clearance techniques (ACTs), including those that incorporate relevant devices, are a key management approach for children with chronic wet cough of various origin [130] Similar to the adult population[131], the approach uses the concept of treatable traits and although it lacks strong evidence due to inherent challenges in relevant studies, most clinicians consider ACTs a vital part of clinical care.[132] Having access to physiotherapists with relevant paediatric experience and being taught ACTs were also identified as management priorities in a European Lung Foundation (ELF) survey for paediatric bronchiectasis.[133] Importantly, there is no strong evidence in favour of a specific ACT so patient or family preference should be considered as key to adherence. Implementing ACTs should be tailored to the child's age and the underlying condition. The ACT needs to be taught by a trained professional and adapted according to the child's response and clinical progression. Nebulised hypertonic saline is the most widely used mucoactive agent. This stimulates coughing and reduces secretion viscosity thereby aiding expectoration, but supportive evidence regarding outcomes is scarce[134] and an RCT in adults with bronchiectasis questioned its effectiveness.[135]

When to refer

In addition to the general guidance regarding referrals given on P8, children with a chronic specific cough such as those highlighted with asterisk in Table 4 are likely to require referral to secondary or tertiary care for investigation or management. Red flags for urgent referral of children with chronic cough are shown in Box 3.

Box 3: Red flags for urgent referral in children with chronic cough

- Symptoms from first days of life
- Haemoptysis
- Coughing or choking when eating/drinking
- Chronic or recurrent otitis media
- Chronic diarrhoea / steatorrhoea
- Severe, persistent, unusual or recurrent infections
- Weight loss / failure to thrive / faltering growth
- Digital clubbing
- Nasal polpys
- Persistent crackles on auscultation
- Persistent chest x-ray changes
- Persisting fever
- Signs of cardiac disease / failure

Longterm outcomes for children with non-specific cough

Whilst most preschool children with chronic wet cough will become asymptomatic, some are still coughing many years later. One study which prospectively followed-up 166 children diagnosed with PBB, found the mean number of PBB episodes fell consistently over the subsequent five years as did the percentage of children with recurrent PBB. However, 68% had ongoing/intermittent respiratory

symptoms at five years.[136] A second study obtained symptom questionnaires from 120 children (median age of 6.8 years) who presented at <3 years of age with recurrent episodic or chronic wet cough.[137] At follow-up, 57% of children were symptom free, 32% had mild symptoms and 11% severe symptoms. Of those who had initially been diagnosed with PBB, 67% were symptom-free at follow-up, 25% had mild symptoms and 8% had severe symptoms.[137] A third study performed a clinical assessment and lung function on 62 children, 8 years after were diagnosed with PBB. At follow-up 18% had a chronic wet cough in the last 12 months and 13% had an abnormal FEV_1.[138] Bronchiectasis has been confirmed in 8-10% of children previously diagnosed with PBB.[136,139]

Causes of Chronic Wet Cough

Protracted bacterial bronchitis

PBB is a chronic endobronchial bacterial infection and the commonest cause of chronic wet cough in young children from developed countries.[65] The diagnostic criteria are: 1) chronic wet cough; 2) absence of specific cough traits suggesting another respiratory diagnosis; 3) cough resolution with an appropriate oral antibiotic.[140] The identification of the causative pathogen from a lower airway sample is not part of the diagnostic criteria but when available, promotes antibiotic stewardship.[141] By definition, cough in PBB resolves with antibiotics but relapses are frequent and recurrent PBB (>3/year) is associated with an increased likelihood of a future bronchiectasis diagnosis.[139,142] As PBB is a diagnosis of exclusion, an alternative, specific cause such as bronchiectasis or immunodeficiency should be considered particularly in recurrent PBB.[143] For treatment see '*Chronic wet cough with no specific cough traits*' on P14-16.

Bronchiectasis and CSLD

Recurrent PBB and failure of a chronic wet cough to respond to four weeks of antibiotic are risk factors for bronchiectasis.[139,144] The diagnosis of bronchiectasis in children is based on the presence of a clinical syndrome (chronic or recurrent acute wet cough, sometimes with coarse crackles and digital clubbing), confirmed by a broncho-arterial ratio [BAR] >0.80 on HRCT.[55] This is lower than the cutoff used in adults (>1.0) as BAR increases with age.[145] The change from a normal to dilated airway happens over time due to an ongoing or recurrent lung insults, such as infection or aspiration[143] and the longer the insult is present, the more severe the bronchiectasis.[146] The development of bronchiectasis therefore manifests as a clinical continuum with early features indistinguishable from PBB, progressing to CSLD in which the clinical syndrome of bronchiectasis is present without airway dilation, and eventually to bronchiectasis.[142] Interventions to remove or treat the insult, can halt or reverse the progression towards fixed dilated airways.[147,148] Manging treatable insults such as infection and aspiration is therefore key to preventing long term morbidity. When bronchiectasis is confirmed, the potential causes (see Table 1) need to be excluded.

Causes of Chronic Dry Cough

Airway malacia

Airway malacia refers to the excessive collapsibility of the large airways due to laxity of the posterior tracheal wall or weakness in the airway cartilage.[149] Congenital airway malacia (prevalence ≈1 in 2100 children) can occur in isolation or be associated with conditions such as tracheal-oesophageal fistula or mucopolysaccharidoses.[150] Causes of acquired airway malacia include trauma, external compression, prolonged positive pressure ventilation, and inflammation.[150] Chronic cough, typically described as brassy or barking is present in up to 80%, wheeze or stridor may also be present.[151,152] Diagnosis is based on >50% expiratory reduction in the cross-sectional airway diameter seen at bronchoscopy.[118] End-inspiratory HRCT images paired with either end-expiratory or dynamic expiratory HRCT images can also aid diagnosis.[118] The severity ranges from mild, only causing an

intermittent cough, to severe, with life-threatening episodes of respiratory arrest. In most children, treatment is not needed as symptoms improve with age due to airway growth and strengthening.[150] As severity increases, prophylactic antibiotics and chest physiotherapy may be used to prevent recurrent LRTIs and positive end expiratory pressure delivered by non-invasive ventilation or tracheostomy to prevent airway collapse. Aortopexy or airway stenting may be considered in the most severe cases but are limited to specialist centres.[118]

Asthma

Although cough is common in children with asthma, this is usually associated with wheeze and the vast majority of children with isolated cough do not have asthma.[19–21] Inhaled corticosteroids (ICS) should only be prescribed to children aged 5-16 years with dry chronic cough if there is objective evidence of asthma from FeNO, blood eosinophil count, bronchodilator reversibility or serial peak expiratory flow measurements.[74]

Childhood Interstitial lung disease (chILD)

ChILD is a rare (4.4-8.2 cases per million per year) but likely under-estimated group of non-specific disorders affecting the lung interstitium, alveoli, or small airways.[153–155] The underlying cause can be genetic, inflammatory, environmental, related to systemic disease or unknown.[156] Neonatal chILD classically presents with unexplained respiratory distress progressing to respiratory failure.[157] Later clinical presentations develop insidiously or after a viral illness include dyspnoea, chronic dry cough (up to 75% of patients) and failure to thrive.[158] Examination findings include hypoxia, tachypnoea, increased WOB, fine crackles, and pulmonary hypertension.[159] The diagnosis is usually based on HRCT or genetic testing, with lung biopsy reserved for inconclusive cases. Management is challenging, with little evidence to inform clinical decisions. Corticosteroids are often tried, with variable effectiveness. More targeted treatments like antifibrotic agents, JAK inhibitors, and gene or cell-based therapies are emerging.[160] In the most severe cases, lung transplantation may be considered.[161]

Prolonged post-infective cough

Post-infective cough is the commonest cause of chronic cough in children and refers to a persistent dry cough which lingers after other symptoms of the causative RTI have resolved.[8,162] This happens in 10-20% of coughs caused by an acute RTI in children.[37,38] The cough reduces in frequency and severity over time, so treatment is not required. However, it is important to monitor for 'cough specific pointers' suggestive of an alternative diagnosis such as PBB, asthma or bronchiectasis.

Tic cough and somatic cough disorder

Tic cough (previously called habit cough) and somatic cough (previously called psychogenic cough) are distinct entities but both are highly disruptive, crucially both are absent during sleep and occur in children without underlying respiratory pathology.[122] Tic cough is a persistent, throat-clearing, dry cough that classically develops after a LRTI. Its core features are suppressibility, distractibility, suggestibility, variability, and the presence of a premonitory sensation.[163] Somatic cough syndrome describes a loud, honking or barking cough that reflects the 'transfer of psychologic distress into a physical symptom'.[122] In conditions, investigations are normal and should be avoided when possible. Management is non-pharmacological and focuses on breaking the subconscious cycle with reassurance and suggestion therapy.[164–166] Psychology input may be required in somatic cough disorder.[122]

Non-specific, isolated cough

Children with a chronic dry cough, no specific cough traits, no improvement during a prolonged period of observation and no objective evidence of asthma, should be labelled with non-specific isolated cough. This is not a diagnosis in itself and may be caused by a specific but as yet unidentified cause.[5] No medication has been shown to be beneficial for these children. Follow-up is needed, to identify those who develop specific cough traits, suggesting a respiratory disorder.[30]

Causes of Chronic Variable Cough

Recurrent / Chronic Pulmonary Aspiration (R/CPA)

R/CPA is the repeated passage of food, drink, gastric refluxate or saliva into the subglottic airways.[167] Chronic cough is the commonest symptom in children with R/CPA, whether or not they have bronchiectasis. Aspiration is silent (no associated cough) in up to 28% of children with neurodisability but may be suggested by wet/gurgly speech, rattly chest after feeds and recurrent LRTIs. Bronchiectasis is highly prevalent, can develop rapidly but can also be reversed with early identification and aggressive management of aspiration.[168] The cause of R/CPA can be structural, dynamic or GOR with aspiration. Structural causes include congenital anomalies such as laryngeal cleft and 'H' type tracheoesophageal fistula (TOF). The commonest dynamic cause is swallowing incoordination. This is commonest in children with neurodisability but can also occur after TOF repair or tracheostomy insertion. In children with neurodisability, R/CPA may be compounded by co-existent GOR +/- impaired laryngeal sensation (ILS) which is a failure to recognize food, saliva, or gastroesophageal reflux in the larynx.[169] They are also at risk of salivary aspiration causing aspiration symptoms that persist despite cessation of oral feeding treatment / exclusion of GOR.

Tuberculosis

Tuberculosis (TB) should be considered in the differential diagnosis for child with chronic cough, especially in areas where it is prevalent. The additional symptoms suggestive of active TB infection are night sweats and weight loss. If suspected, pulmonary TB is confirmed by culture/PCR of early morning gastric aspirate, sputum (spontaneously expectorated or induced) or BAL sample.[124] Tuberculin skin test and interferon-gamma release assay (IGRA) do not differentiate between latent or active TB infection.

Gastro-oesophageal relux (GOR) and non-acidic reflux (NAR)

GOR alone should not be accepted as the cause of isolated chronic cough in otherwise healthy children. In children with chronic cough and no overt regurgitation, international guidelines recommend only investigating / treating GOR if one or more of the following are present: unexplained feeding difficulties (refusing to feed, gagging or choking), distressed behaviour, faltering growth, hoarseness or a single episode of pneumonia.[17,170] In children with neurodisablity, the co-existence of swallowing dysfunction and GOR can result in R/CPA.[171] In contrast to acid reflux, there is some evidence that non-acid reflux (NAR), defined as reflux with pH >4.0 causes chronic cough, worsens other respiratory diseases and causes pulmonary aspiration.[123,172]

Summary

The assessment of cough, whether acute or chronic, relies on clinical skills to identify the few children who require investigation or treatment; the vast majority require only reassurance. The differential diagnosis is very different from that in adults. Investigation pathways in those children in whom cough portends a serious illness should be carefully focused. In particular, chronic wet cough of >4 weeks duration may lead on to bronchiectasis and mandated aggressive investigation and management to prevent chronic airflow obstruction and infection.

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