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PRACTICE

# Recurrent lower respiratory tract infections in children

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**What you need to know**

- Recurrent lower respiratory tract infection can be regarded as ≥3 annual episodes of documented bronchitis, bronchiolitis, or pneumonia and may merit further investigation for an underlying cause
- The normal duration of respiratory symptoms in children is longer than commonly believed: acute cough typically resolves within 25 days, the common cold by 15 days, and non-specific respiratory symptoms by 16 days
- Chronic wet-sounding cough every day for ≥4 weeks merits further investigation for lung disease
- Recurrent acute cough with cough-free periods of at least a week between bouts is probably due to viral colds
- A chest x ray is not usually required in children who seem generally well and have no worrying features on history and examination

Acute respiratory infections account for about a third of all paediatric consultations to primary care and 8-18% of acute hospital admissions in the UK.[1 2] Children, especially preschool children, may have up to 6-10 viral colds a year.[1 3] Parents often seek reassurance that all is well, or they may have concerns about a serious illness, sometimes prompted by the family history or a disturbing diagnosis in a friend's child (see Patient's perspective box). Sleep disturbance and the time carers may have to be away from work can lead to stress and impaired quality of life.

When consulting with families, distinguish children with recurrent self limiting or minor problems—the majority of cases—from those with a more serious underlying condition who may need investigation and treatment. Differentiate lower and upper respiratory tract infections, which may be difficult because symptoms and signs overlap and both may be present at the same time.[3 4] This article presents a practical approach to diagnosis and management of the otherwise apparently healthy child with recurrent lower respiratory tract infections. Acute respiratory infections and the management of children with known comorbidities, such as neurodisability, will not be covered. Recurrent upper respiratory tract infections have recently been discussed elsewhere.[5]

**Sources and selection criteria**

We searched the Cochrane Library, Medline, and Embase using the search terms "cough," "pneumonia," "recurrent," "respiratory," "infections," and "children." We included reviews, randomised controlled trials, and other types of experimental research in children between 0 and 18 years of age. Results were limited to English language material. No date limits were applied.

We also consulted evidence based reviews on recurrent respiratory infections and our personal archives of references.

## How common are they?

Children younger than 5 years old are worst affected by lower respiratory infections, with 704 000 deaths each year and more than 6 million disability-adjusted life years (DALYs) worldwide.[2] There is no consensus on how many episodes of lower respiratory infection are "too many" and require further investigation. Lack of consistent criteria makes study of the epidemiology problematic. Recurrent lower respiratory infection has been suggested as three or more annual episodes of bronchitis, bronchiolitis, or pneumonia.[6] Recurrent pneumonia is defined as two or more episodes of radiologically documented pneumonia in a single year or three or more episodes ever, with a normal chest x ray between episodes.[7]

In a cohort of 1360 children followed up until age 10 years, the incidence of recurrent lower respiratory infection (≥2 episodes of parental report of productive cough lasting for ≥5 days in the preceding 12 months) was 7.4%.[8] However, a productive sounding cough reported by parents may just be a sign of a viral cold. No community studies have reported the prevalence of recurrent pneumonia. In a retrospective chart review at the Toronto Hospital for Sick Children, 8% of over 2900 children admitted with a diagnostic coding of pneumonia had recurrent episodes; of whom less than 2% (42 children) had an underlying illness, such as reflux and aspiration, asthma, immune deficiency, congenital cardiac defects, and pulmonary abnormalities.[9]

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## What underlying causes should I consider?

Many children with recurrent lower respiratory infections are otherwise healthy, and no underlying cause is found, with perhaps environmental factors, such as passive exposure to tobacco or vape fumes, contributing to infection.[10] A child with intermittent wet cough may have viral colds, erroneously labelled "chest infection," with no documented lower respiratory infections.

*Persistent bacterial bronchitis* was the most common cause in a study systematically investigating 108 children with moist cough for more than three weeks.[11] This may be associated with bronchiectasis in a subgroup of children with *Haemophilus influenzae* infection or recurrent episodes,[12] and these children require particular attention. Persistent moist cough is a hallmark of bronchiectasis, and can be either idiopathic or due to disorders such as immunodeficiency, aspiration syndromes, cystic fibrosis, or primary ciliary dyskinesia.[13]

*Tuberculosis*—Chronic cough associated with fever, weight loss, fatigue, and increased sweating should raise the suspicion of tuberculosis.[14] A systematic review of 52 studies in adults and children showed there could be a delay of up to several months between the onset of symptoms and the diagnosis of tuberculosis.[15 16] Not all children with tuberculosis present with characteristic symptoms, however, and further investigation is needed particularly in areas with a high burden of tuberculosis.[17]

*Pertussis*—In a prospective UK cohort study of 172 primary school children with a cough lasting 14 days or more, over a third had pertussis irrespective of immunisation status; these children were also more likely to be coughing for months after the initial illness.[18]

*Asthma*—Parents of children with isolated, recurrent, or chronic cough or other non-specific respiratory complaints may worry that their child has asthma. Although cough-variant asthma does exist, it is rare, especially in children who are not atopic.[19] An isolated cough is not usually a manifestation of underlying asthma.[20] The National Institute for Health and Care Excellence (NICE) guidelines on asthma[21] stress the importance of objective measurements such as spirometry and measurement of exhaled nitric oxide to diagnose asthma, reiterated in the recent *Lancet* commission on airway diseases.[22] Unfortunately, neglect of objective measurements leads to asthma being overdiagnosed.[23-25]

*Foreign body*—Ask about this specifically, since the history may not be volunteered.[26] If a foreign body is suspected, particularly a button battery, refer immediately to secondary care.

## How do patients present?

"My child has frequent chest infections" and "My child is always unwell due to chest infections" are common parental reports in primary care. Recurrent cough, often associated with signs of a viral cold, is the usual presentation. Rarely, children present with a history of early and severe recurrent respiratory symptoms suggesting a serious underlying condition. In a study evaluating 70 children with recurrent pneumonia in a low and middle income setting, the median age at presentation was 4 years and 9 months, but about a third of children had onset of symptoms before 3 months of age. The main symptoms were cough (100%), breathlessness (63%), and wheezing (46%), together with fever (86%) and failure to thrive (22%; much rarer in a developed world setting, where it should lead to a diagnostic work-up for an underlying condition).[27]

## How to make a diagnosis?

History and physical examination have a key role in the diagnostic approach, and clinical judgement is vital. Table 1 lists specific features in the history and physical examination that may suggest an underlying condition, although the predictive values of most of them are not known. Because it is treatable, it is particularly important not to miss bronchiectasis; diagnostic clues are given in box 1. A suggested diagnostic approach to children with recurrent lower respiratory infections is shown in figure 1.

**Box 1: Red flag features that should prompt suspicion of bronchiectasis**

**History**

- Recurrent or chronic moist or productive cough for 4-8 weeks (guidelines vary)
- Atypical "asthma" that does not respond to therapy
- Prior infection with known predisposing organism (such as *Bordetella pertussis*, adenovirus types 7, 14, 21)
- Recurrent or non-resolving pneumonia (probably a secondary care presentation)

**Physical examination**

- Digital clubbing (often overlooked in children)
- Palpable chest secretions on coughing or forced expiratory manoeuvre, persisting over time
- Persistent crackles on auscultation

**Investigation**

- Positive sputum culture for an unusual organism (such as *Staphylococcus aureus*, *Pseudomonas aeruginosa*)
- Recurrent or persistent radiographical changes
- Any evidence of localised bronchial obstruction, such as focal reduction in breath sounds or atelectasis on chest radiograph

## History

Clinicians should ascertain if the history is truly consistent with a lower respiratory infection or has been mislabelled as "chest infection."[28] Ask about

- Frequency of episodes, including seasonal pattern
- Duration—The normal duration of respiratory infections should be considered
  - A recent systematic review of 23 trials and 25 observational studies reported that the duration of symptoms in children with respiratory infections was consistently longer than believed: in 90% of children (n=700) acute cough was resolved by 25 days, symptoms of the common cold by 15 days, and non-specific respiratory symptoms by 16 days (n=5427 children).[29]
- Type of cough
  - Isolated dry cough in an otherwise well child is highly unlikely to suggest a serious underlying condition.[20]
  - A long history of moist (productive sounding) cough is common; young children rarely expectorate sputum. Distinguish recurrent wet cough (with intermittent cough-free periods) from continuous daily wet cough for several weeks. An intermittent cough is usually secondary to a series of viral colds. There are usually at least a few symptom-free days between colds. This scenario needs only reassurance, since natural resolution is the rule.
  - Any daily, chronic, productive-sounding cough should raise the suspicion of an underlying cause, especially if the child is ill or has other worrying features.[30] British

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Thoracic Society guidelines define chronic cough as cough lasting more than eight weeks,[31] whereas other documents define it as lasting more than four weeks,[32] neither figure being evidence based. No matter how otherwise well the child seems, daily wet cough for eight weeks mandates prompt investigation or referral.

- Associated symptoms such as fever, breathlessness, fatigue, loss of weight
  - A child with breathlessness, and a history of previous chest retractions, nasal flaring, poor air entry, and crackles or wheezing on auscultation may have asthma.
- Risk factors—Prematurity, atopy, pollution, overcrowding, and daycare attendance[33] can account for increased frequency and severity of respiratory infections in children.

## Physical examination

Assess the child's general condition and perform a thorough respiratory examination. Usually there are no physical signs, especially if the child is examined between infections.

A child with productive cough is usually well, and the only sign is palpable secretions felt by placing the palms of the hands on in the chest while the child coughs or does a forced expiratory manoeuvre. Anecdotally, finger clubbing is often overlooked in children, and the chest is examined poorly. Physicians tend to rely too much on auscultation ("his chest is clear") and not enough on palpation during a cough or forced manoeuvre, which may demonstrate localised secretions in the airway requiring treatment.

## What investigations are needed?

There is no firm evidence to guide the optimal timing or sequence of investigations.

*No testing*—Many children need no further testing.[34] Usually, their respiratory infections are self limiting, mild in severity, and worse in winter. Typically, there are relatively long periods of wellness, there is no extra-pulmonary involvement or family history of severe infections, growth is normal, physical examination is unremarkable, and recovery between episodes is complete.

*Chest x ray*—In our experience, if a child who is said to have recurrent lower respiratory infections has never been ill enough to have a chest x ray, or the radiograph has shown no abnormality, further investigation is unlikely to yield a diagnosis. If in doubt, a chest x ray, full blood count (specifically a low lymphocyte count, which may be an early sign of immunodeficiency), and quantitative serum immunoglobulin tests may provide reassurance.[35] The radiation dose of a single chest x ray is minimal, and this investigation may reassure the family.

Patients may present with a history of documented acute or persistent radiological opacities on chest x rays, usually in secondary care. The non-specific term "radiological shadowing" is used because many conditions can cause radiological changes. There is considerable interobserver variation in interpretation of chest x rays which may be responsible for overdiagnosis of pneumonia.[36] Pragmatically, the approach to recurrent radiological shadowing varies with whether the abnormality is always in the same place or is multifocal. Box 2 lists the common causes for both. Middle lobe syndrome is a distinct clinical and radiological entity, and is the most common recurrent focal abnormality of the lung.[37] Figure 2 shows a representative chest x ray of a school-age child with a history of recurrent cough.

**Box 2: Differential diagnosis of radiological abnormalities**

**Common causes of recurrent localised radiographic changes**

- Right middle lobe syndrome
- Localised airway obstruction—Mucus plug, foreign body, endobronchial tuberculosis, localised malacia or stenosis
- Localised airway compression—Vascular rings and slings, enlarged lymph nodes, mediastinal mass
- Localised pulmonary parenchymal disease (localised bronchiectasis)

**Common causes of recurrent multifocal radiographic changes**

- Bronchiectasis
- Cystic fibrosis
- Primary ciliary dyskinesia
- Immunodeficiency
- Aspiration syndromes—Consider gastro-oesophageal reflux, H-type tracheoesophageal fistula (which may not present until adult life), and incoordinate swallow due to a laryngeal cleft or neurological disease

Radiographic resolution of acute pneumonia may take more than 12 weeks, and a follow-up chest x ray for uncomplicated acute pneumonia with complete clinical resolution is not recommended.[38]

## When should a child be referred?

If a serious illness is suspected, refer the child to secondary care without delaying for a chest x ray.[39] Box 3 lists specific red flags that should prompt referral to secondary care. You may also refer the child if the diagnosis is in doubt, the anticipated response to treatment does not happen, or the family is unhappy about the clinical trajectory.[40]

**Box 3: Red flags which should prompt referral to secondary care**

- Unexplained respiratory distress from day 1 of life
- History of severe, persistent, unusual, or recurrent infections
- History of choking
- Family history suggestive of a genetic disorder
- Signs of chronic illness, such as lethargy and recent weight loss
- Underlying condition which predisposes to recurrent infection, such as cerebral palsy
- Abnormal physical signs when the child is well, including digital clubbing and abnormal auscultatory signs
- Wet cough for >8 weeks continuously, no matter how well the child seems
- Failure to thrive
- Recurrent localised crackles in the same place

Detailed evaluation in secondary care may be indicated in a child with a single episode of pneumonia if it is atypical in course (either very severe, prolonged, or an unusual organism is isolated) or there are other features suggesting an underlying condition.

## How is it managed?

Reassurance is all that is required for otherwise healthy children. If there is doubt whether the child is healthy, it is good practice to arrange reassessment. Even if the child is healthy, recurrent infections may cause stress and impaired quality of life from sleep disturbance and the time carers may have to be away from work, and these issues should not be underestimated. Take time to determine these concerns and try to address them. Try to

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ensure the family leaves the consultation feeling that their concerns have been heard and understood and that there is a plan in place which satisfies them, such as a reassessment in a few weeks, preferably after risk factors have been removed where possible.

Avoid prescribing multiple courses of antibiotics to children in whom no specific diagnosis has been made. Short courses of antibiotics prescribed for common infections in childhood may result in partial attenuation of cough and high relapse rates.[41] Studies report that many children presenting with recurrent wheeze are prescribed antibiotics, while bronchodilators are underused.[42 43] If protracted bacterial bronchitis is suspected, prescribing a two week trial of co-amoxiclav is appropriate in primary care.[44] Resolution is common, but prolonged or recurrent bacterial bronchitis is well described.[45] Evidence for a longer duration of antibiotic treatment is currently lacking.

In younger children with suspected asthma in whom pulmonary function testing in primary care is impractical, a three stage therapeutic trial is legitimate before confirming the diagnosis of inhaled steroid sensitive asthma[21]: (*a*) a clear-cut response to a 4-8 week trial with low-medium dose of a inhaled corticosteroid; (*b*) relapse on stopping medication; and (*c*) response to recommencing medication.[5 46] It is important to explain to parents the rationale for this therapeutic trial and to reassure them when the disease is not confirmed. Response to a trial of inhaled bronchodilators may help to distinguish between asthma and lower respiratory infections.

### Unanswered questions and areas for future research

- What factors accurately predict the natural course of chronic cough in children?
- In a child with recurrent respiratory infections and a suspected serious condition, how can the diagnosis be confirmed or excluded with the minimum number of the least invasive tests?
- Evidence from good quality research studies is needed to inform the management of recurrent respiratory infections in children.

### Additional educational resources

#### Resources for healthcare professionals

- British Thoracic Society guidelines:
  - BTS cough in children recommendations. 2008. www.brit-thoracic.org.uk/standards-of-care/guidelines/bts-cough-in-children-recommendations
  - BTS guidelines for the management of community acquired pneumonia in children: update 2011. www.brit-thoracic.org.uk/standards-of-care/guidelines/bts-guidelines-for-the-management-of-community-acquired-pneumonia-in-children-update-2011
  - BTS/SIGN British guideline on the management of asthma. www.brit-thoracic.org.uk/standards-of-care/guidelines/btssign-british-guideline-on-the-management-of-asthma
- National Institute for Health and Care Excellence guidelines:
  - Fever in under 5s: assessment and initial management (clinical guideline CG160). 2017. www.nice.org.uk/guidance/cg160
  - Asthma: diagnosis, monitoring and chronic asthma management (NICE guideline NG80). 2017. www.nice.org.uk/guidance/ng80
- Bronchiectasis Toolbox. 2016. www.bronchiectasis.com.au (endorsed by the Thoracic Society of Australia and New Zealand)

#### Resources for patients

- NHS Choices. Cough. www.nhs.uk/conditions/cough

### Education into practice

- After reading this article, are there any factors in the history and physical examination when assessing a child with recurrent respiratory tract infections which you might alter?
- If the child seems healthy, how will you explain to parents about the likely cause and further management?

### A patient's perspective

We are the parents of two girls aged 4 and 2 years. Our daughters have been affected by repeated chest infections, especially in the winter. We were very upset by these episodes and had to seek medical attention frequently. Colds, sore throat, earache, running nose, and cough were so frequent during the last winter that our doctor has now prescribed an immunostimulant drug for our daughters for three months to increase their immunity.

On a typical day, the following scolding is frequent: "Don't lay on the floor," "Put your hat on," "Button up your coat." We carefully tuck them up in bed at night to prevent them from catching cold. Sneezing is a symptom alert. If there are more than three sneezing bouts during the day, we are quite sure that they will catch a cold in the next few days. Fever is rarely present, but cough is often disturbing, especially at night. Of course, our sleep is frequently troubled by this.

Inhaled aerosols, cough medicines and nasal lavages have become a part of our lives. When our children have a terrible cough, we used to administer oral steroids ("only few tablets"). In such a way, we can guarantee some hours of sleep. Our daughters are so used to taking medicines that occasionally they ask for them ("Can you just put nasal drops in my nose?" "Can I have my cough medicines?").

We shared our worries with some friends who had similar experiences with their children. Occasionally, we consult the internet. We have recently read that some microbes may be found in the throat of children, and we will ask our doctor to obtain a pharyngeal swab.

Compared with previous years, we feel more prepared and are less worried about serious medical complications. We expect these episodes will decrease in number and severity as our children grow.

### How patients were involved in the creation of this article

The article was discussed with parents of children with recurrent chest infections, and one family contributed their experience. As a result, we increased the emphasis on the stress and impairment of quality of life of the family caused by recurrent infections in their child

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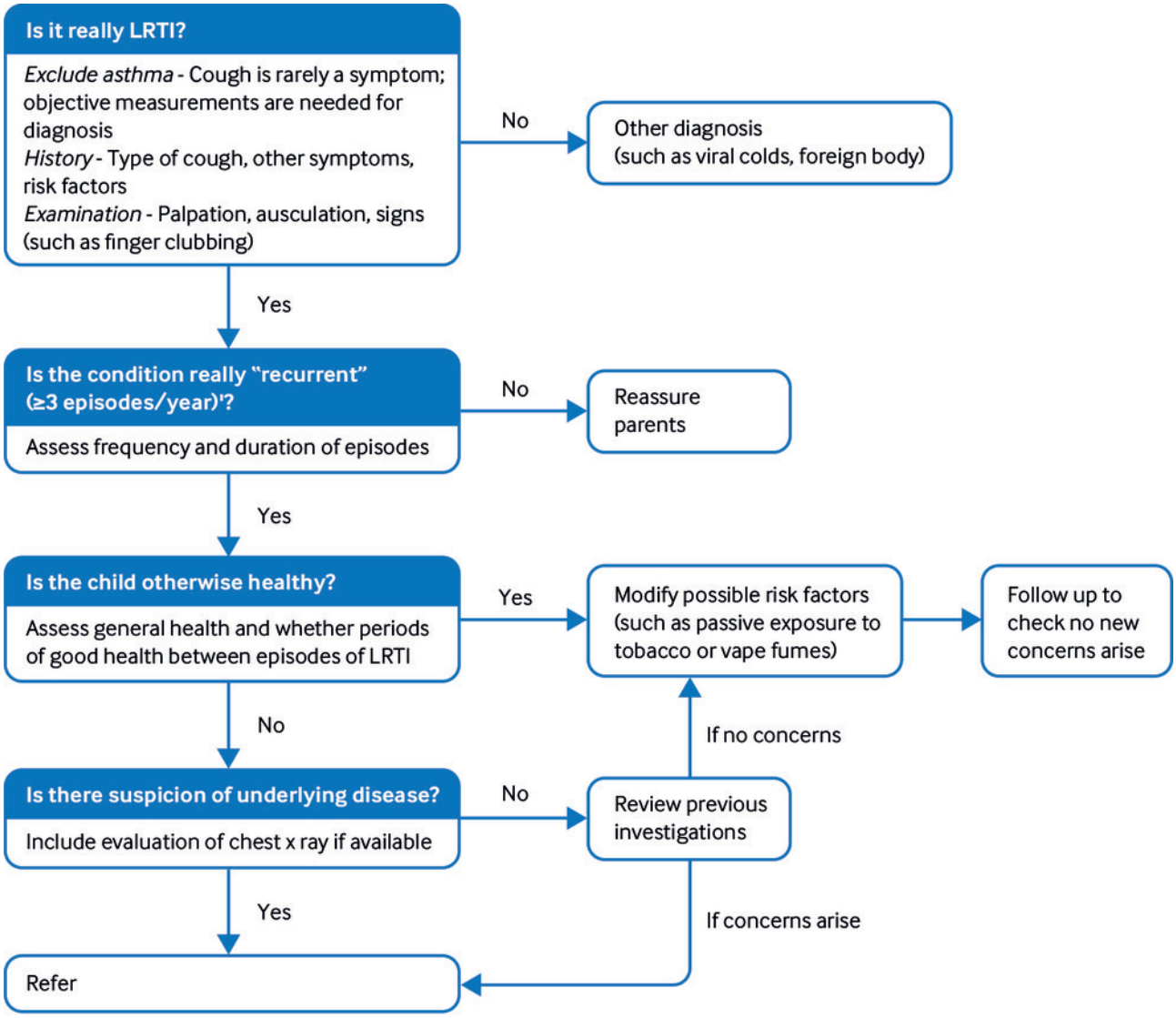
# Table

**Table 1| Pointers to an underlying specific diagnosis in a child with recurrent lower respiratory infections**

| Feature | Suggestive of |
|---|---|
| **History** | |
| Moist cough every day for >4-8 weeks | Persistent bacterial bronchitis or bronchiectasis |
| Neonatal respiratory distress, very early onset of symptoms in a term baby | Primary ciliary dyskinesia |
| Prolonged, recalcitrant rhinorrhoea or otorrhoea | Primary ciliary dyskinesia |
| Very sudden onset of symptoms with or without a history of choking | Foreign body aspiration |
| Choking with feeding, difficulty in swallowing, easy vomiting | Aspiration |
| Failure to thrive, bulky stools | Cystic fibrosis |
| SPUR (Severe, Persistent, Unusual or Recurrent) infections | Immunodeficiency |
| Persistent cough and new onset tiredness or weight loss | Tuberculosis |
| **Physical examination** | |
| Digital clubbing | Chronic lung infection or interstitial lung disease |
| Lymphadenopathy, thrush in mouth | Immunodeficiency |
| Nasal polyps | Cystic fibrosis |
| Foul smelling nasal or ear discharge, middle ear effusion, abnormal situs | Primary ciliary dyskinesia |
| Severe chest deformity (Harrison's sulcus, barrel chest) | Severe chronic lung disease |
| Fixed monophonic or asymmetric wheeze | Inhaled foreign body or localised bronchial obstruction |
| Persistence of lung crackles on auscultation | Bronchiectasis or tuberculosis |
| Signs of cardiac or systemic disease | Cardiac or systemic conditions |

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# Figures




Suggested approach based on authors' experience

**Fig 1** Diagnostic approach to children with recurrent lower respiratory infections

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**Fig 2** Chest x ray of a school-age child with a history of recurrent cough: lateral view shows a wedge shaped area of increased density with apex at the hilum and the base towards the pleura. This is right middle lobe consolidation ("right middle lobe syndrome") which requires further investigation and treatment

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