

Lower Respiratory Tract Infection in Children

(<https://patient.info/doctor/lower-respiratory-tract-infection-in-children>)

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What is a lower respiratory tract infection?

Lower respiratory tract infection (LRTI) is infection below the level of the larynx and may be taken to include [bronchiolitis](#), bronchitis and [pneumonia](#). The presentation of these conditions will depend on age, infecting organism and site of infection.

For laryngotracheobronchitis, see the separate [Croup](#) article.

Epidemiology

Overall epidemiological data are poor because accurate diagnosis is limited by diagnostic methodology. The estimated incidence of community-acquired pneumonia in Europe is 14.4 per 10,000 children over the age of 6 and 33.8 per 10,000 children under the age of 5.^[1] Bronchiolitis is much more common; one third of all infants will develop it in their first year of life and 2-3% of these will need admission.

Haemophilus influenzae infection is now quite rare amongst UK children because of immunisation.

Pathophysiology

There is no hard and fast definition of LRTI that is universally agreed upon. Essentially, it is inflammation of the airways/pulmonary tissue, due to viral or bacterial infection, below the level of the larynx. Remember that gastro-oesophageal reflux may cause a chemical pneumonitis. Smoke and chemical inhalation may also cause pulmonary inflammation.

Viral infections^[2]

About 45% of children hospitalised with pneumonia have a viral aetiology.^[3] This includes:

- Influenza A.
- Respiratory syncytial virus (RSV).^[4]
- Human metapneumovirus (hMPV).^[2]
- Varicella-zoster virus (VZV) - chickenpox.

It is not possible to differentiate clinically between a viral and a bacterial pneumonia; therefore the National Institute for Health and Care Excellence (NICE) advises that if a child has pneumonia and does not need admission, they should be treated with antibiotics, even though many will have a viral infection.^[1]

Bacterial infections

These constitute about 60% of hospitalised pneumonia cases:^[3]

- *Streptococcus pneumoniae* (the majority of bacterial pneumonias).
- *H. influenzae*.
- *Staphylococcus aureus*.
- *Klebsiella pneumoniae*.
- Enterobacteria - eg, *Escherichia coli*.
- Anaerobes.

Atypical organisms

- *Mycoplasma pneumoniae* (14% of all cases of hospitalised pneumonia in children).^[3]
- *Legionella pneumophila*.

- *Chlamydomphila pneumoniae* (9% of hospitalised pneumonia in children).^[3]
- *Coxiella burnetii*.

Secondary bacterial infection

This is relatively common following viral upper respiratory tract infection (URTI) or LRTI.

Lower respiratory tract infection symptoms

Most often, LRTI is accompanied by fever and may be preceded by a typical viral URTI. It is important to assess all children with a fever accurately. NICE guidance on the management of feverish illness in children has been produced and can be used as part of the assessment of a child who has a suspected LRTI. . Pneumonia should be considered in children when there is a fever and any of the following signs:^[3]

- Tachypnoea with a respiratory rate higher than 60 (age <6 months), 50 (age 6-12 months) or 40 (age >12 months) breaths per minute.
- Crackles in the chest.
- Nasal flaring.
- Chest indrawing.
- Cyanosis.
- Oxygen saturation of 95% or less on room air.

In all age groups be aware that:

- Audible wheezing is not seen very often in LRTI (although it is common with more diffuse infections such as in *M. pneumoniae* and bronchiolitis).
- Stridor or croup suggests URTI, epiglottitis or foreign body inhalation.

History

Age and the type of LRTI will affect the symptoms and history.

- **Newborn and neonates** present with:
 - Grunting.
 - Poor feeding.
 - Irritability or lethargy.
 - Tachypnoea sometimes.
 - Fever (but neonates may have unstable temperatures, with hypothermia).
 - Cyanosis (in severe infection).
 - Cough (but this is unusual at this age).

In this age group beware:

- Particularly of streptococcal sepsis and pneumonia in the first 24 hours of life.
- All children younger than 3 months with a temperature of 38°C or higher are at high risk for serious illness and should be referred.^[5, 1]

- Chlamydial pneumonia, which may be accompanied by chlamydial conjunctivitis (presents in the second or third week).
- **Infants** present with:
 - Cough (the most common symptom after the first four weeks).
 - Tachypnoea (according to severity).
 - Grunting.
 - Chest indrawing.
 - Feeding difficulties.
 - Irritability and poor sleep.
 - Breathing, which may be described as 'wheezy' (but usually upper airway noise).
 - History of preceding URTI (very common).

In this age group beware:

- Atypical and viral infections (especially pneumonia) may have only low-grade fever or no fever.
- **Toddlers/preschool children:**
 - Again, preceding URTI is common.
 - Cough is the most common symptom.
 - Fever occurs most noticeably with bacterial organisms.
 - Pain (chest and abdominal) occurs more often in this age group.
 - Vomiting with coughing is common (post-tussive vomiting).

Be aware that:

- Lower lobe pneumonias can cause abdominal pain.
- Severe infections will compromise breathing more.
- **Older children:**
 - There will be additional symptoms to those above.
 - More expressive and articulate children will report a wider range of symptoms.
 - Constitutional symptoms may be more vividly described.

Be aware that:

- Atypical organisms are more likely in older children.

Examination

- General points:
 - Examination can be difficult in young children (particularly auscultation).
 - A careful routine of observation is essential to identify respiratory distress early.

- Pulse oximetry can be very useful in evaluation. Typically - in pneumonia, for example - oxygen saturation may be 95% or less.
- High fever over 38.5°C may occur often.
- Look for other diseases (for example, rashes, pharyngitis) with careful systematic examination.

The following are signs of respiratory distress:

- Cyanosis in severe cases.
- Grunting.
- Nasal flaring. In children aged under 12 months this can be a useful indicator of pneumonia.^[6]
- Marked tachypnoea (see below).
- Chest indrawing (intercostal and suprasternal recession).
- Other signs such as subcostal recession, abdominal 'see-saw' breathing and tripod positioning.
- Reduced oxygen saturation (less than 95%).

If this does not respond to oxygen and general support of the child's own respiratory effort, intubation is likely to be required. Intubation is required when the child's own breathing becomes ineffective (with, for example, hypoxia, rising carbon dioxide and reduced level of consciousness).

- Observation:
 - Further careful observation in good light, with the chest and abdomen uncovered, is essential
 - Count respirations and note the respiratory rate (RR) - in breaths per minute. Tachypnoea is measured as:^[2]
 - RR >60/minute age 0 to 5 months.
 - RR >50/minute age 6 to 12 months.
 - RR >40/minute age over 12 months.
 - Observe the infant's feeding (to uncover decompensation during feeding).
 - Observe the chest movements (for example, looking for splinting of the diaphragm).
- Auscultation:
 - Examine with warm hands and a stethoscope.
 - Take the opportunity to examine a quiet sleeping child.
 - Concomitant upper respiratory noises can be identified by listening at the nose and chest.
 - Crackles and fever indicate pneumonia.

- Crackles in the chest may indicate pneumonia, particularly when accompanied by fever.
- Percussion:
 - Identifies consolidation.
 - Consolidation is a later and less common finding than the crackles of a pneumonia.
 - Later in older children there may be dullness to percussion over zones of pneumonic consolidation.
 - Bronchial breathing and signs of effusion occur late in children and localisation of consolidation can be difficult to diagnose.

Differential diagnosis

- Asthma.
- Inhaled foreign body.
- Pneumothorax.
- Cardiac dyspnoea.
- Pneumonitis from other causes:
 - Hypersensitivity pneumonitis
 - Smoke inhalation
 - Gastro-oesophageal reflux

Investigations

- General points:
 - Few tests are particularly useful or required.
 - The most useful tests give quick and meaningful results.
- FBC:
 - White cell count is often elevated. Although this may be very noteworthy in certain infections (like pneumococcal pneumonia), it is useful only as a general guide to the presence of infection.
 - It is important in very ill children who may be immunocompromised.
- Microbiological studies:
 - Rarely indicated or of help in general practice.
 - Blood cultures are seldom positive in pneumonia (fewer than 10% are bacteraemic in pneumococcal disease).
 - Blood and sputum cultures should generally be reserved for atypical or very ill patients (particularly those who may be immunocompromised).
- Imaging:
 - CXR is not routinely indicated in outpatient management.
 - CXR cannot differentiate reliably between bacterial and viral infections.
- Other tests:

- Tuberculin skin testing if tuberculosis is suspected.
- Cold agglutinins when mycoplasmal infection is suspected (but only 50% sensitive and specific).
- Urine latex agglutination tests may ultimately diagnose certain organisms but the tests take time and are rarely of use acutely.
- Three or more severe episodes of pneumonia over 12 months should prompt consideration of an HIV test.^[2]
- Diagnostic procedures:
 - Drainage and culture of pleural effusions may relieve symptoms and identify the infection.

Although pulse oximetry and blood CRP may be useful to assess whether a child presenting with a cough may have a serious LRTI, there is no strong evidence for these or any other specific indicators having a significant influence on prognosis in children with acute cough and respiratory tract infection in primary care.^[8]

Lower respiratory tract infection management

Decision to admit

Most children with LRTI and pneumonia can be treated as outpatients, with oral antibiotics. Older children can be managed with close observation at home if they are not distressed or significantly dyspnoeic and the child's carer(s) can cope with the illness. Viral bronchitis and croup do not require antibiotics and mild cases can be treated at home.

Admission is advised for severe LRTI. Immediate referral should be done if any of the following are present:^[1]

- Oxygen saturation <92%.
- Respiratory rate >60 breaths/minute. or grunting or marked chest recession.
- Cyanosis.
- A child who looks very unwell and is difficult to rouse or to keep awake.
- A temperature of 38°C or higher in a child aged three months or less.
- Absent breath sounds with a dull percussion note, suggesting pleural effusion.

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Referral should also be considered in the following situations:

- A child aged 3-6 months with a temperature of 39°C or higher.
- Tachycardia of more than 160 beats/minutes (<1 year), 150 beats/minute (aged 1-2 years) or 140 beats/minute (aged 2 to 5 years).
- A reduction of 25-50% in the usual fluid intake.
- Pallor reported by the carer.

- Abnormal response to social cues, needing prolonged stimulation to wake or decreased activity.
- Nasal flaring
- Prolonged capillary refill time or other signs of dehydration (eg, dry mucous membranes or reduced urine output).

Presence of comorbidity - eg, congenital heart disease, chronic lung disease of prematurity, chronic respiratory conditions such as cystic fibrosis, bronchiectasis or immune deficiency should also prompt consideration of admission.

Admission should also be considered for:

- All children under the age of 6 months.
 - Children in whom treatment with antibiotics has failed (most children improve after 48 hours of oral, outpatient antibiotics).
 - Patients with troublesome pleuritic pain.
 - Patients for whom social factors may affect their parent/carer's ability to care for them or where there are concerns that red flag symptoms may be missed. A long distance to access healthcare in the event of deterioration should also be taken into account.
- Physiotherapy has no place in treatment of uncomplicated pneumonia in children without pre-existing respiratory disease.

Before admission

Be sure to offer the child and their carer(s) general support, explanation and reassurance.

- Respiratory support as required, including oxygen.
- Pulse oximetry to guide management is helpful.
- Severe respiratory distress with a falling level of consciousness and failure to maintain oxygenation indicates a need for intubation.

In hospital

- Resuscitation and respiratory support as required.
- Intravenous access and fluids in severe cases.
- CXR confirmation of the diagnosis and identification of effusions and empyema.

Medication

- Antibiotic treatment:
 - It can be difficult to distinguish between viral and bacterial infection and young children can deteriorate rapidly, so consider antibiotic therapy (depending on presentation) and likelihood of bacterial aetiology.
 - Amoxicillin is recommended as a first choice for oral antibiotic therapy.^[1]

- If a child is genuinely allergic to penicillin, consider using a cephalosporin, macrolide or quinolone, depending on any local antibiotic prescription guidelines, patterns of resistance and suspected organism.
- Vancomycin may be added to treatment of toxic-looking children when there is a high rate of penicillin resistance.
- Aciclovir is used for herpes virus pneumonia.

Delayed antibiotics^[9]

- One study looked at patients aged 3 years and older in UK primary care judged not to need immediate antibiotics for respiratory tract infections to compare four strategies of delayed prescription: re-contact for a prescription, post-dated prescription, collection of the prescription, and be given the prescription (patient led).
- During the trial, a strategy of no antibiotic prescription was added as another randomised comparison.
- The study found that strategies of no prescription or delayed antibiotic prescription resulted in:
 - Fewer than 40% of patients using antibiotics.
 - Less strong beliefs in antibiotics.
 - Similar symptomatic outcomes to immediate prescription.
- It was concluded that, if clear advice is given to patients, there is probably little to choose between the different strategies of delayed prescription.

Complications and prognosis

- Complete resolution after treatment should be expected in the vast majority of cases.
- Bacterial invasion of the lung tissue can cause pneumonic consolidation, septicaemia, empyema, lung abscess (especially *S. aureus*) and pleural effusion.
- Respiratory failure, hypoxia and death are rare unless there is previous lung disease or the patient is immunocompromised.

Lower respiratory tract infection prevention

- Prevention of pneumococcal pneumonia and influenza by vaccination, for high-risk individuals with pre-existing heart or lung disease.
- Smoking in the home is a major risk factor for all childhood respiratory infection.
- There is insufficient evidence to recommend zinc supplementation for reduction of the incidence of pneumonia.^[10]