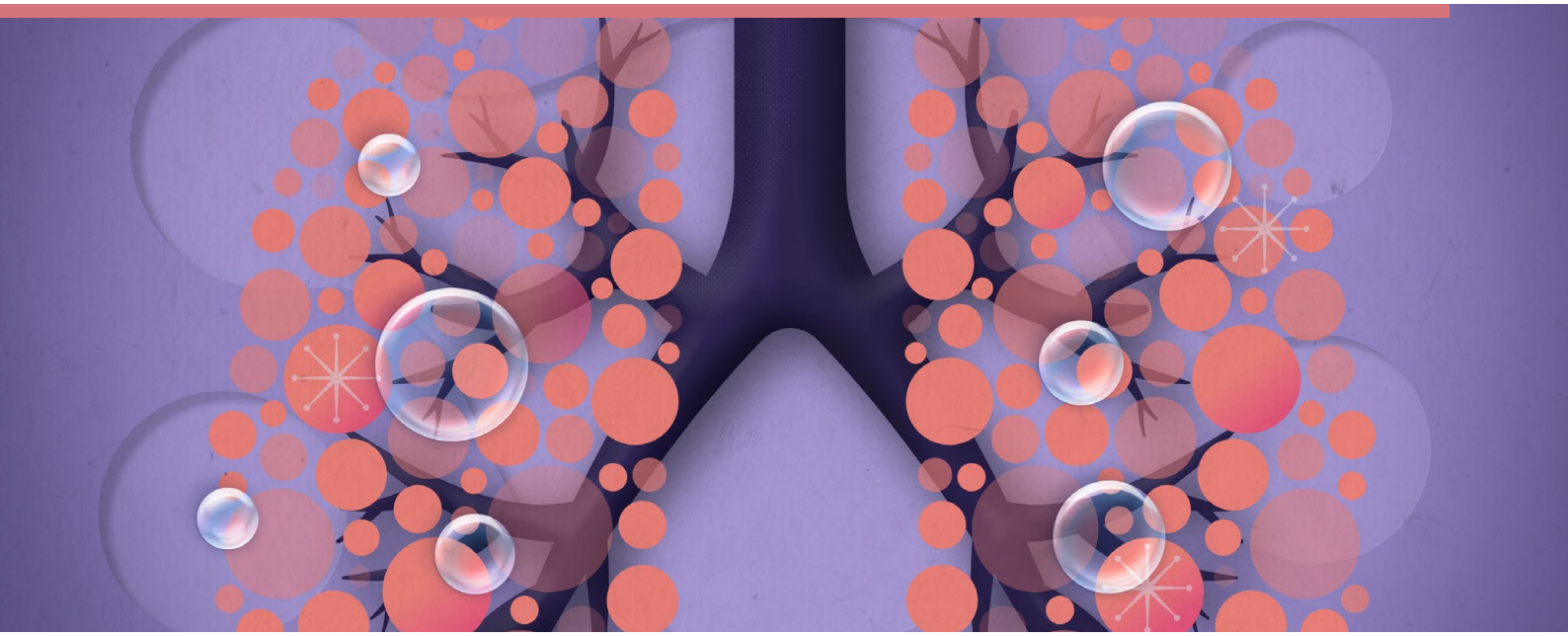


The management of **community-acquired pneumonia**

Pneumonia is a significant cause of mortality in children and older people, particularly among Māori and Pacific peoples. In New Zealand, Māori males are six times more likely to die from pneumonia than non-Māori males. Prompt identification and treatment will enable patients with initially less severe community-acquired pneumonia to be managed at home, reducing hospitalisation and mortality.

KEY PRACTICE POINTS:

- Community-acquired pneumonia is usually diagnosed clinically in primary care based on the presence of characteristic symptoms and signs:
  - Respiratory, e.g. dyspnoea, tachypnoea, increased respiratory effort, crackles on auscultation, pleuritic chest pain
  - Non-respiratory, e.g. fever, tachycardia, and less typically, abdominal pain and vomiting; non-specific symptoms may also be present such as confusion in older people and poor feeding in infants
- Laboratory tests (including microbiological testing) and imaging are not usually indicated in primary care for patients with suspected community-acquired pneumonia. Perform a COVID-19 test to rule out SARS-CoV-2 infection.
  - Laboratory testing, e.g. full blood count and CRP, may be considered for patients with moderate-to-severe symptoms and signs.
  - Referral for a chest X-ray may be indicated in some clinical situations, e.g. if the diagnosis of pneumonia is uncertain, underlying respiratory disease, suspected complications.
- Once a clinical diagnosis of community-acquired pneumonia has been made, determine suitability for community-based management. In adults, this decision can be guided by the CRB-65 (confusion, respiratory rate, blood pressure, age ≥ 65 years) severity assessment tool in addition to clinical judgement.
- Antibiotic treatment is usually empiric; a short course of high dose amoxicillin is first line for most patients. Advise patients to maintain adequate hydration and to take paracetamol or ibuprofen as required.
- Schedule a review two to three days after initiating antibiotic treatment. If there has been inadequate response to treatment, or clinical deterioration, reassess antibiotic choice and/or suitability for community management.
  - A chest X-ray post-treatment may be indicated for select patients. For example, in patients who had an abnormal X-ray at the time of initial diagnosis (e.g. effusion, atelectasis) or patients with poor clinical recovery to exclude underlying lung pathology.
- Where possible, advise patients on how to reduce their exposure to modifiable risk factors associated with pneumonia, e.g. smoking cessation, maintaining a smoke-free home and vehicle, seeking support for improving housing quality, vaccination.
  - Vaccination provides some protection against community-acquired pneumonia. Encourage patients to be up to date with the following vaccines (depending on eligibility): Prevenar 13 (PCV13), Pneumovax 23 (23PPV), *Haemophilus influenzae* type b (Hib; included as part of the DTaP-IPV-HepB/Hib [Infanrix-hexa] vaccine and Hib-PRP-T [Hiberix] vaccine), seasonal influenza, COVID-19.

This is a revision of a previously published article. What's new for this update:

- General article revision
- Antibiotic recommendations updated
- Section added on the CRB-65 tool
- Section added on causes of pneumonia in adults that do not typically respond to empiric treatment
- Pneumococcal vaccine Synflorix (PCV10) is no longer available in New Zealand

Epidemiology of community-acquired pneumonia

Pneumonia is caused by inhalation of microorganisms from the upper respiratory tract into the lungs, which subsequently induces an inflammatory response in the lower bronchial tree and alveoli.[1,2] *Streptococcus pneumoniae* is the most frequently identified cause, both in New Zealand and internationally.[2,3] Other causative organisms include *Mycoplasma pneumoniae*, *Legionella longbeachae*, *L. pneumophila*, *Staphylococcus aureus*, *Haemophilus influenzae*, *Chlamydophila pneumoniae* and viruses, e.g. human rhinovirus, influenza, respiratory syncytial virus (RSV), SARS-CoV-2.[4,5]

Viral aetiology for community-acquired pneumonia is becoming increasingly more common, likely due to the effects of vaccination against *S. pneumoniae* (see: "Vaccination can protect against community-acquired pneumonia").[6] Since the COVID-19 pandemic, SARS-CoV-2 has become a significant cause of community-acquired pneumonia.

Although pneumonia can occur at any time throughout year, it is more frequently diagnosed in winter months (except for *Legionella* pneumonia) and affects younger children, i.e. aged < 5 years, and older adults, i.e. aged > 65 years, the most (see: "Risk factors for pneumonia").[2,7]

Hospital- or community-acquired pneumonia?
Community-acquired pneumonia is classified as occurring in a person who has not been hospitalised in the month before symptom onset.[2] If a person has clinical features that suggest pneumonia after being hospitalised for at least two days (when there was no suspicion of incubation prior to admission), they are classified as having hospital-acquired pneumonia.[2] The threshold for referral of a patient with hospital-acquired pneumonia is generally lower than for community-acquired pneumonia.

Pneumonia incidence and mortality

The global incidence of pneumonia is estimated to be between 1 and 14 cases per 1,000 people each year.[2,8] The global mortality rate for people with pneumonia who are treated in the community is < 1%.[2] Mortality rates are higher for people treated in the hospital setting, reaching up to 18% in hospital wards or up to 50% in the intensive care unit.[2]

In New Zealand, hospitalisation rates in children with pneumonia have generally decreased since 2008 when pneumococcal vaccination was included in the childhood Immunisation Schedule (see: "Vaccination can protect against community-acquired pneumonia").[9,10] However, between 2016 and 2019 hospitalisation rates increased, before decreasing significantly in 2020, likely due to the COVID-19 pandemic.[9] There are no recent data on hospitalisation rates in adults with pneumonia in New Zealand.

Ethnic disparities

Pneumonia disproportionately affects people of Māori and Pacific ethnicity.[3,13] Māori have at least three times the rate of hospitalisations due to pneumonia than non-Māori, and Māori males have a mortality rate six times greater than non-Māori males.[13] Hospital admission rates for Māori and Pacific children are also higher compared to children of other ethnic groups.[9,10]

Risk factors for pneumonia

A range of modifiable and non-modifiable risk factors are associated with pneumonia. Young children and older adults, particularly with co-morbidities (see below) are the populations most at risk of developing community-acquired pneumonia.[2,7] Males are more often affected than females.[2,7]

Lifestyle-related risk factors include poor nutrition/malnutrition, reduced rates of breast feeding, exposure to tobacco smoke (via smoking or second-hand exposure), high alcohol intake, lower housing quality (i.e. lack of insulation and heating, damp, mouldy, overcrowded living conditions), low socioeconomic status, incomplete vaccination, regular contact with children.[2,10,14]

Co-morbid long-term conditions can increase the risk of community-acquired pneumonia, such as chronic obstructive pulmonary disease (COPD), diabetes, cardiovascular disease and chronic liver disease.[2,14] People who are immunocompromised are also at higher risk.[2,14]

Medicines associated with an increased risk of pneumonia include proton pump inhibitors, antipsychotics, inhaled corticosteroids and DPP-4 inhibitors (e.g. vildagliptin).[7]

Where possible, encourage patients to reduce their exposure to modifiable risk factors associated with pneumonia, e.g. smoking cessation, maintaining a smoke-free home and vehicle, improving diet/nutrition, seeking support to improve housing quality, being up to date with vaccinations (see: "Vaccination can protect against community-acquired pneumonia").[2,10]

Community-acquired pneumonia in children

Viruses, specifically RSV, are the most common cause of community-acquired pneumonia in children, particularly in those aged under two years. Purely bacterial pneumonia is infrequent in the pneumococcal vaccine era but *S. pneumoniae* is still the most commonly identified bacterial cause.[15, 16] In a small proportion of cases, a combination of bacterial and viral aetiology can occur.[15]

Symptoms and signs of pneumonia in children

Diagnosis of pneumonia is usually made clinically, based on the presence of characteristic symptoms and signs (see below).[17] Features can vary depending on the age of the child, aetiology and severity.[15] If pneumonia is suspected based on patient history (including risk factors) and symptoms, perform an age-appropriate examination, e.g. check temperature, heart rate, respiratory rate, oxygen saturation, observe and listen to the chest. Alternative diagnoses should also be considered, e.g. inhaled foreign body, asthma, bronchiolitis.[15]

Symptoms and signs of pneumonia in children may include:[15, 17, 18]

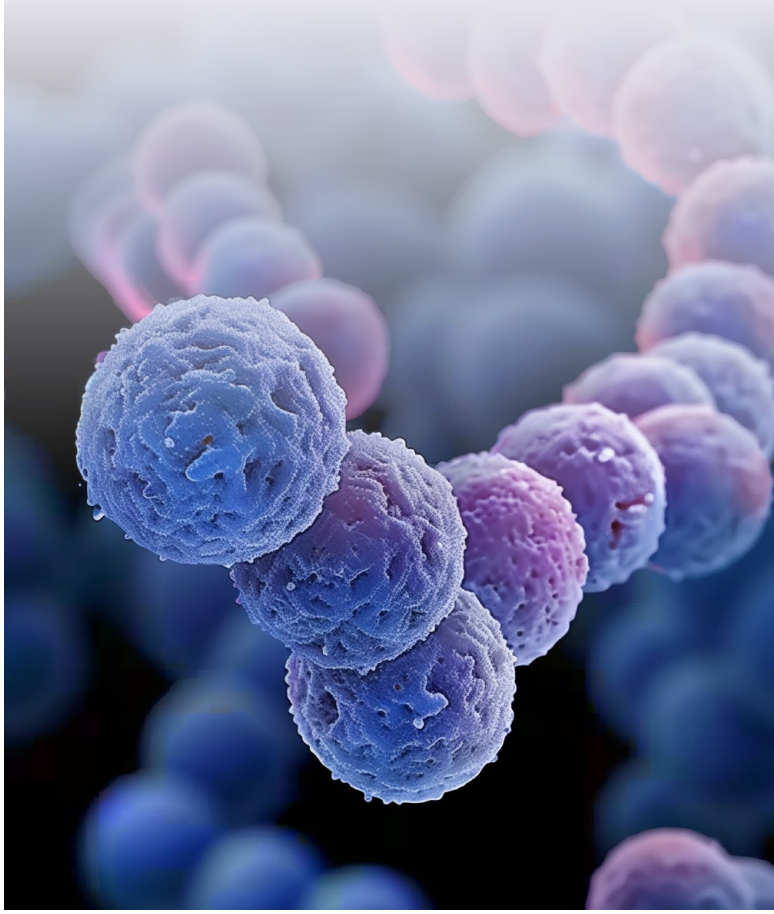
- Persistent fever (see: "**Identifying the risk of serious illness in young children with fever**")
- Tachypnoea at rest (Table 1)
- Increased respiratory effort (e.g. in-drawing, accessory muscle use, grunting, nasal flaring)
- Irritability
- Fatigue/lethargy
- Unwell appearance
- Poor feeding (infants)
- Dyspnoea, wheeze
- Cough
- Pleuritic chest pain
- Hypoxaemia
- Crackles, bronchial breathing, decreased or absent breathing sounds on auscultation
- Dullness to percussion

Children may also present with other less typical symptoms, e.g. abdominal pain, neck stiffness, vomiting.[15, 17] In practice, auscultatory signs are less frequently observed in young children with pneumonia; non-specific symptoms such as poor feeding, irritability/restlessness and lethargy may only be present.[15] In school-aged children who present with mild and non-specific symptoms and signs, consider the possibility of pneumonia caused by *M. pneumoniae* (also referred to as "walking pneumonia").[19]

Increasing rates of invasive pneumococcal disease reported in recent years

People with invasive pneumococcal disease, caused by *S. pneumoniae*, most often present with pneumonia, meningitis or septicaemia.[11] Fewer cases of invasive pneumococcal disease may therefore lead to fewer cases of pneumonia.

Invasive pneumococcal disease became a notifiable disease in New Zealand in 2008; a decreasing trend has generally been observed over time, but case numbers have fluctuated.[11] After a significant decline in cases during the 2020/2021 period, likely in part due to the COVID-19 pandemic public health measures, rates have been steadily increasing, particularly cases due to serotype 19A.[12] In 2022/2023 there were 692 cases of invasive pneumococcal disease reported in New Zealand; the highest annual incidence rate in the past ten years.[12] The change in the childhood Immunisation Schedule in 2022 to include PCV13 (which includes serotype 19A) is likely to help reverse this increasing trend (see: "Pneumococcal vaccination: PCV13 and 23PPV"). However, this will only occur with increasing coverage rates for infant pneumococcal immunisation, especially in high-risk populations.



Features more suggestive of bacterial pneumonia include fever > 38.5°C, chills and rigors, unwell appearance, marked tachypnoea and localised auscultatory findings, e.g. decreased breathing sounds, crackles over the affected lobe.[15, 19] The presence of low-grade fever, rhinorrhoea, wheeze and diffuse and bilateral auscultatory signs are more suggestive of viral pneumonia.[15, 19]

Table 1. Tachypnoea in children by age.[17]

Age	Breaths per minute
< 2 months	> 60
2 – 12 months	> 50
> 12 months	> 40

Further investigations are not usually required in the community

Laboratory testing (e.g. full blood count [FBC], C-reactive protein [CRP]) and microbiological testing are not routinely recommended in primary care for the investigation of suspected pneumonia in children.[17, 18] Perform a COVID-19 test to exclude SARS-CoV-2 infection.[16]

Referral for a chest X-ray is also not routinely required but may be considered in some clinical situations, e.g. if the diagnosis is uncertain/presentation not typical, underlying respiratory disease.[17]

When to refer a child with suspected pneumonia to hospital

This decision is based on history, clinical features, age and presence of co-morbidities.[17] Hospital referral is warranted for a child with any of the following:[17]

- Age less than three months
- Significant dehydration
- O_2 saturation < 93%
- Significant co-morbidity
- Respiratory distress that significantly interferes with feeding
- "Toxic" appearance
- Suspected severe pneumonia, e.g. severe tachycardia
- Suspected complications, e.g. effusion, abscess
- Social concerns, e.g. lack of transport if the child deteriorates, communication barriers
- Deterioration despite appropriate oral antibiotics

Management of community-acquired pneumonia in children

Antibiotic treatment is usually appropriate for all children with suspected community-acquired pneumonia as differentiating the cause of pneumonia is difficult, and a bacterial pathogen may still be present even when a virus is the primary causative agent.[15] However, Starship guidelines recommend that children with pneumonia with a likely viral aetiology do not require antibiotics.[17] In practice, antibiotic treatment is empiric, given that microbiology testing, e.g. viral PCR testing, is not routinely recommended or available in primary care (viral PCR testing is usually performed in secondary care).[15, 19]

The first-line antibiotic choice is:[17, 20]

- **Amoxicillin** 30 mg/kg/dose (maximum 1 g/dose)*, three times daily, for three to five days

* If aged less than one month, the maximum is 125 mg/dose, but initiation of oral antibiotics in the community is usually not appropriate in children aged less than three months as they should be referred to hospital for treatment

Amoxicillin is the first-line antibiotic choice for patients with community-acquired pneumonia as it is effective against the most common causes and is generally well tolerated; it is used at a high dose to cover potentially resistant *S. pneumoniae*.[15, 21]

Suitable alternatives to amoxicillin (if penicillin allergic) include*:

- **Erythromycin:** 10 – 12.5 mg/kg/**dose**, four times daily, for seven days (usual maximum 1.6 g/**day**; up to 4 g/**day** in severe infection)[20]
- **Azithromycin:** 10 mg/kg, once daily, on day one, followed by 5 mg/kg, once daily on days two to five[17]

* Doxycycline is also a suitable alternative antibiotic to amoxicillin in children aged over 12 years, however, there is no liquid formulation available for children unable to swallow tablets[17]

If there is a poor response after 48 hours of initial antibiotic treatment, it is likely the child has viral pneumonia (in which case, consider "watchful waiting") or a bacterial cause that does not typically respond to empiric antibiotics. In an older child, it is appropriate to take a sputum sample for microbiological testing. The addition of a macrolide antibiotic (e.g. erythromycin) can be considered in children aged over five years, as *M. pneumoniae* and *C. pneumoniae* (along with *S. pneumoniae*) are common pathogens in school-aged children,[15] but increasing rates of resistance has limited their effectiveness, including in *Mycoplasma* infection.[22] There is also a lack of clinical trial data that show clear benefit of macrolide antibiotics in children with pneumonia.[22] *Legionella* infection rarely occurs in children, even in high incidence regions.[23]

Maintaining adequate hydration is important and parents/caregivers should be instructed on how to do this (i.e. frequent intake of small amounts of fluid).[15, 16] Paracetamol and ibuprofen may be given as needed (use ibuprofen with caution in children who are dehydrated).[15, 16]

Follow-up after treatment

Arrange a follow-up review within a few days of starting antibiotics (either in person or via phone) to monitor treatment progress.[15] Children who do not respond adequately within 48 – 72 hours, or who clinically deteriorate, should be reassessed and severity of illness reviewed to determine ongoing suitability for community management.[15, 16] Consider referral for a chest X-ray in children who have not responded adequately after a course of antibiotics.[17] Discussion with a paediatric infectious diseases physician or paediatrician may also be appropriate for children with inadequate response to treatment.

Consider scheduling a review six weeks after antibiotic treatment to assess for any persisting symptoms and signs. Children who had significant abnormalities on chest X-ray at the time of initial diagnosis, e.g. atelectasis, should have a follow-up X-ray in four to six weeks after completing antibiotic treatment;[19] refer the child to a paediatrician if abnormalities have not resolved. Children with recurrent pneumonia affecting the same lobe should also have a follow-up X-ray.[19]

Community-acquired pneumonia in adults

Bacteria, predominantly *S. pneumoniae*, appear to be the most common cause of community-acquired pneumonia in adults.[5] However, as with children, identifying a causative organism is not possible in most cases.[5] Empiric use of antibiotics for all adults with suspected pneumonia being treated in the community is therefore usual practice.[5, 24]

Symptoms and signs of pneumonia in adults

A clinical diagnosis of pneumonia in adults is made based on the presence of characteristic symptoms and signs, which can vary widely.[1, 14] Symptoms and signs may be specific to the chest, but patients can also present with less specific and more varied respiratory and systemic symptoms. If pneumonia is suspected based on patient history (including risk factors) and symptoms, perform a physical examination, e.g. check temperature, heart rate, respiratory rate, oxygen saturation, examine the chest.

Symptoms and signs of pneumonia in adults may include:[1, 4, 14]

- Cough
- Fever (≥ 37.8°C)
- Tachypnoea (≥ 20 breaths per minute)
- Tachycardia (> 100 beats per minute)
- Oxygen saturation < 95%
- Sputum production
- Dyspnoea
- Pleuritic chest pain
- Focal signs on auscultation, e.g. crackles, egophony,[5] bronchial breathing
- Dullness to percussion
- Myalgia
- Fatigue
- Chills
- Abdominal pain
- Headache

Older or immunocompromised patients may present with subtle or less typical features which can make diagnosis challenging, e.g. lethargy, weakness, falls, changes in mental status, absence of fever.[4, 14]

Consider the possibility of alternative diagnoses, e.g. an exacerbation of asthma or COPD, bronchitis, congestive heart failure, gastro-oesophageal reflux disease, lung cancer, pulmonary embolism, tuberculosis.[1, 5]

Further investigations are not usually required in the community

Laboratory investigations (e.g. FBC, CRP) or microbiological testing is not routinely required in a primary care setting for the investigation of suspected pneumonia in adults.[6, 25] Perform a COVID-19 test to exclude SARS-CoV-2 infection.[4, 5] Some guidelines (e.g. United Kingdom NICE guidelines, British Thoracic Society guidelines) and regional HealthPathways in New Zealand recommend requesting laboratory testing (e.g. FBC, CRP, creatinine, electrolytes) and considering a sputum sample for culture and microscopy in patients with moderate-to-severe symptoms or signs.[25, 26]

Referral for a chest X-ray is also not routinely required but may be considered in some clinical situations such as if the diagnosis is unclear or if there is dullness to percussion or other signs of complications, e.g. suspected effusion, consolidation or lung collapse.[4, 25]

Management of community-acquired pneumonia in adults

Once a clinical diagnosis of community-acquired pneumonia has been made in an adult, determine suitability for community management.[26] Guidelines from NICE (UK), the British Thoracic Society and the American Thoracic Society and Infectious Diseases Society of America (and local HealthPathways) recommend using a validated pneumonia severity score to support clinical findings and judgement (see: "Calculating the CRB-65 score for adults").[6, 25, 26] Consider patient characteristics, e.g. oxygen saturation, hydration status, and co-morbidities along with "gut feeling" when deciding on the appropriate treatment location (see box).[26]

Calculating the CRB-65 score for adults

CRB-65 is a tool for assessing pneumonia in adults, validated for use in primary care. It is used to support clinicians in assessing pneumonia severity and guiding suitability for community management (Table 2).[25, 26]

One point is scored for each of the following clinical features that are present:[25, 26]

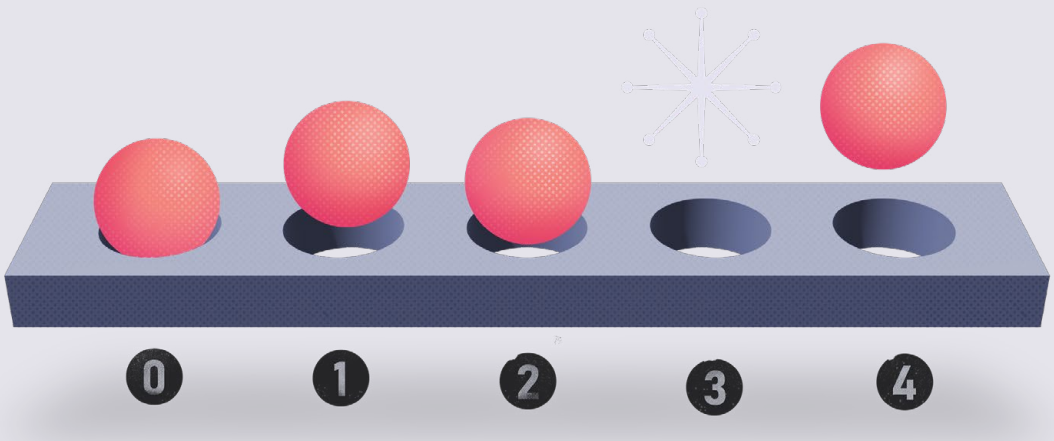
- **C**onfusion (new onset or score of eight or less on an **abbreviated mental test**)
- **R**espiratory rate ≥ 30 breaths per minute
- **B**lood pressure (systolic < 90 mmHg or diastolic ≤ 60 mmHg)
- **65** years or older

Other pneumonia severity tools are also available

The **Pneumonia Severity Index** (PSI) is preferentially recommended in the latest American Thoracic Society and Infectious Diseases Society of America guidelines,[6] but it requires input of 20 variables including laboratory test results and imaging, so is less practical in a primary care setting.[5, 8] There is another version of the CRB-65 tool – **CURB-65** which contains an additional variable; serum urea. However, serum urea is now infrequently requested in primary care, and the result is unlikely to be readily available to inform management decisions.[8, 14] In comparison to the PSI, the CURB-65 does not include information about co-morbidities and is less effective at guiding the decision of community versus hospital level care.[6, 14] There is no evidence that the CURB-65 is superior to the CRB-65.[25] The CRB-65 is therefore the most practical tool for use in primary care as it does not require laboratory testing or imaging.[5, 25]

Table 2. Pneumonia CRB-65 severity score.[25, 26]

Score	Severity and mortality risk	Suggested action
0	Low severity Mortality risk < 1%	Community management is likely to be suitable
1 – 2	Moderate severity Mortality risk 1 – 10%	Evaluate possibility of hospital referral, particularly if the score is 2. Consider the patients clinical condition, co-morbidities and social circumstances/home support when deciding whether to refer to hospital or manage in the community.
3 – 4	High severity Mortality risk > 10%	Hospital referral is recommended



When to refer an adult with suspected pneumonia to hospital

This decision is based on clinical features, including severity of symptoms, and the presence of co-morbidities.[6, 26] Suitability for community management can also be guided by using validated pneumonia-specific tools, e.g. the CRB-65, in addition to clinical judgement (see: "Calculating the CRB-65 score for adults").[6, 26] Consider hospital referral for patients with the following (especially in combination):[6, 26]

- Age ≥ 65 years
- Altered mental state (confusion)
- Relevant co-morbidities, e.g. heart failure, renal or hepatic impairment, frailty
- Suspected complications, e.g. septicaemia, abscess
- Respiratory rate ≥ 30 breaths per minute
- Pulse rate > 125 beats per minute
- O_2 saturation ≤ 92%
- Systolic blood pressure < 90 mmHg or diastolic blood pressure ≤ 60 mmHg
- Dehydration
- Lack of reliable support at home

Oral antibiotic treatment is appropriate for all adults with suspected pneumonia who are managed in the community.[5]

The first-line antibiotic choice is:[28]

- **Amoxicillin** 1 g, three times daily, for five days

Practice point. Lower doses of amoxicillin (e.g. 500 mg, three times daily) may have previously been standard practice but they are now regarded as inadequate by experts, as the pneumococcal minimum inhibitory concentration to penicillin is increasing, i.e. to overcome increasing resistance, higher doses of amoxicillin are required. However, based on clinical judgement there may still be some patients for whom 500 mg, three times daily, is an appropriate dose.

A suitable alternative to amoxicillin for patients with severe penicillin allergy (e.g. anaphylaxis) is **doxycycline** 200 mg, twice daily on day one, followed by 100 mg, twice daily, on days two to five.[28] For patients with mild penicillin allergy (e.g. rash), **cefalexin**, 1 g, three times daily, for five days, can be prescribed.

For patients with more severe symptoms (but who are still suitable for community management), or who have not improved after 48 hours of initial antibiotic treatment, consider **combination treatment** with amoxicillin (1 g, three times daily, for five days) PLUS a macrolide (e.g. azithromycin, 500 mg, once daily, for three days; or roxithromycin, 300 mg, once daily, for five days) as this will also cover other possible causes of pneumonia, e.g. *Legionella*.

Patients with certain causes of pneumonia require a longer antibiotic treatment duration or an alternative antibiotic (see: "Causes of pneumonia that do not typically respond to empiric antibiotic treatment"); discuss a pathogen-specific regimen with an infectious diseases physician or clinical microbiologist. Advise patients to drink adequate fluids and to take paracetamol or ibuprofen as required, e.g. for chest pain, sore throat.[4, 25]

For information on cough medicines and alternative treatments/remedies for acute cough associated with a viral upper respiratory tract infection, see: **bpac.org.nz/2023/cough-medicines.aspx**

For information on the management of other symptoms associated with respiratory tract infections, see: **bpac.org.nz/2018/cold-season.aspx** and **bpac.org.nz/2019/rti.aspx**

Follow-up after treatment

Arrange a follow-up review within a few days of starting antibiotics (either in person or via phone) to monitor treatment progress, or advise the patient to make contact if they are not improving.[4, 25] Patients who do not show improvement within 48 – 72 hours of starting antibiotic treatment, or who clinically deteriorate, should have their antibiotic choice reassessed (e.g. add a macrolide after taking a sputum sample for microbiological testing) and severity of illness reviewed to determine suitability for community management.[4, 25] Consider referral for a chest X-ray in patients who have not responded adequately after a course of antibiotics and there were chest signs on examination.

A follow-up chest X-ray four to six weeks after completing antibiotic treatment may be appropriate for patients:[2, 25]

- Who had a chest X-ray at the time of initial diagnosis and it was abnormal, e.g. effusion; refer to a respiratory specialist if abnormalities have not resolved
- With poor clinical recovery (to exclude malignancy)
- Who have recovered from pneumonia but are at high risk of underlying lung pathology, e.g. a patient with significant smoking history

Spirometry testing may be performed in patients who smoke (or with a history of smoking) to identify underlying COPD, once they have recovered from pneumonia.

Offer advice to address modifiable risk factors for pneumonia, e.g. vaccination, and encourage smoking cessation (as appropriate).[2, 25]

Causes of pneumonia that do not typically respond to empiric antibiotic treatment

If one of the following causes of community-acquired pneumonia is suspected in a patient, it is usually appropriate to consult with a clinical microbiologist or infectious diseases physician on any test(s) to perform and to inform antibiotic recommendations. The likely cause of pneumonia cannot usually be accurately predicted based on clinical features.[23, 25] In practice, the following causes of pneumonia may be suspected based on inadequate response to empiric antibiotics and the presence of risk factors.

Legionella

Legionella species are a relatively common cause of community-acquired pneumonia in New Zealand.[29] *Legionella* species are often associated with more severe, sometimes fatal, cases of pneumonia and symptoms and signs can be similar to pneumococcal pneumonia.[23, 29] *Legionella* pneumonia is most common in warmer months (although it can occur at any time) and is particularly associated with recent use of potting mix or compost (usually *L. longbeachae*) or exposure to a contaminated water source (usually *L. pneumophila*), e.g. spa pools, rain water tanks, air conditioning systems.[23] People with COPD, immunocompromise, who smoke or with recent travel to an outbreak area are at higher risk.[2, 14] Gastrointestinal effects may be more prominent in people with *Legionella* pneumonia than with other causes of pneumonia.[23]

If a patient is not responding to empiric antibiotics and there is recent history of potting mix or compost exposure, consider *Legionella* infection. Azithromycin or roxithromycin are usually added to empiric treatment and a longer duration of treatment will be needed; see local HealthPathways for details.

Mycobacterium tuberculosis

Pneumonia due to *M. tuberculosis* typically only occurs in people who have immigrated from, or have recently travelled to, an area where *M. tuberculosis* is endemic, e.g. India, South Africa.[15] People with immunodeficiency, e.g. HIV infection, are also at increased risk.[15, 24]

Pneumocystis jirovecii

P. jirovecii, a fungus, previously known as *P. carinii*, is the causative organism of *Pneumocystis* pneumonia.[30, 31] Infection with *P. jirovecii* usually occurs only in people with severe immunodeficiency, e.g. due to advanced HIV infection, organ or bone marrow transplant, corticosteroid treatment (≥ 20 mg/day for ≥ 2 weeks), chemotherapy.[1, 31] Hospital admission for treatment (usually high dose trimethoprim + sulfamethoxazole) is generally required.[30]

Pseudomonas aeruginosa

P. aeruginosa is a relatively common cause of hospital-acquired pneumonia but is an unusual cause of community-acquired pneumonia.[1, 2] Risk factors for pneumonia caused by *P. aeruginosa* include immunocompromise, bronchiectasis, cystic fibrosis, lung transplant, COPD and smoking.[1, 24]

Vaccination can protect against community-acquired pneumonia

Pneumococcal vaccination can protect against cases of community-acquired pneumonia caused by *S. pneumoniae*.[1, 14] *Haemophilus influenzae* type b (Hib) vaccines (included as part of the DTaP-IPV-HepB/Hib [Infanrix-hexa] and Hib-PRP-T [Hiberix] vaccines) can also prevent cases of community-acquired pneumonia.[1, 15] The seasonal influenza vaccine is recommended to help prevent pneumonia secondary to influenza or secondary bacterial infection.[14, 16] Also encourage patients to be up to date with COVID-19 vaccination.[5]

For further information on seasonal influenza and COVID-19 vaccines, see: **bpac.org.nz/2024/vaccinations.aspx**

Pneumococcal vaccination: PCV13 and 23PPV

There are two pneumococcal vaccines available in New Zealand: PCV13 (Prevenar 13) and 23PPV (Pneumovax 23). PCV10 (Synflorix) is no longer available, as other pneumococcal vaccines provide broader protection against pneumococcal serotypes.[32] Since the introduction of pneumococcal vaccination in New Zealand in 2008, there have been fewer cases of invasive pneumococcal disease and pneumonia, and fewer associated hospitalisations.[33]

PCV13 is a conjugate vaccine that protects against 13 pneumococcal serotypes.[32, 34] Protection is expected to last up to five years in children who are vaccinated with PCV13 when aged ≤ 5 years; if administered to older children/adolescents or adults, protection is expected to last for at least five years after immunisation.[34] Higher valent vaccines PCV15 and PCV20 have been approved and recommended for use in the USA and Europe (in 2021/2022) and may be available in New Zealand in the coming years.[35]

23PPV is a polysaccharide vaccine that provides broader coverage than PCV13, protecting against 23 pneumococcal serotypes.[32, 34] Pure polysaccharide vaccines in general do not provide long-lasting protection, especially in young children who do not develop good immune responses to these.[34] 23PPV should be considered for use only in children and adults who are at increased risk of pneumococcal disease due to certain underlying medical conditions (see below).

Who is eligible to receive funded pneumococcal vaccination?

All children should receive three funded doses of PCV13 at ages six weeks, five months and 12 months, as part of the childhood Immunisation Schedule.[32] Children at high risk of pneumococcal disease, e.g. immunosuppressed, cochlear implant, premature birth (< 28 weeks), can receive an additional dose at age three months.[32] 23PPV is not part of the childhood Immunisation Schedule, but is recommended and funded for children aged two years and over who are at higher risk of pneumococcal disease.[32]

An extended pneumococcal vaccination programme is available for selected groups. Up to four additional doses of PCV13 and up to three additional doses of 23PPV are funded for vaccination (or re-vaccination) in children and adults at high risk of pneumococcal disease or with eligible conditions, e.g. HIV infection, primary immunodeficiency, undergoing renal dialysis, Down syndrome.[32] The vaccination schedule differs depending on the patient's age, see the **Immunisation Handbook** for details; 23PPV should be administered at least eight weeks after PCV13.[32]

For the full list of pneumococcal vaccine eligibility criteria, see: **schedule.pharmac.govt.nz/ScheduleOnline.php?edition=&osq=Pneumococcal**

Pneumococcal vaccination is recommended but not funded for some groups

Pneumococcal vaccination may be considered (not funded) for people with multiple co-morbidities, e.g. asthma, diabetes, and/or exposure to risk factors, e.g. smoking, alcohol dependence.[32] The accumulation of co-morbidities and risk factors increases the risk of invasive pneumococcal disease, which can be comparable to the risk in people with a high risk condition.[32]

Vaccination with PCV13 and 23PPV is recommended but not funded (unless they meet other eligibility criteria) for people:[32]

- Aged 65 years and over
- At higher risk of pneumococcal disease or its complications, e.g. due to co-morbidities such as diabetes, chronic heart, renal or pulmonary disease, or alcohol dependence
- Who are immunocompromised and at increased risk of pneumococcal disease, e.g. people with nephrotic syndrome, multiple myeloma, lymphoma
- Who have had invasive pneumococcal disease in the past
- Who smoke

23PPV is also recommended but not funded for people with intracranial shunts or cerebrospinal fluid leakage (PCV13 is funded for these people).[32]

For further information on Pneumovax 23, see: **bpac.org.nz/BPJ/2011/april/pneumovax23.aspx** (N.B. Article published in 2011 so some information may no longer be current.)

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