Pneumonia

Who is at risk in your practice?

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GPs play an important role in the diagnosis, management and referral of patients with pneumonia and are uniquely placed to implement preventive measures such as smoking cessation and vaccination.

KEY POINTS

- Risk factors for pneumonia include increasing age, smoking and presence of chronic diseases, such as chronic lung disease, heart disease and diabetes.
- Preventive measures include influenza and pneumococcal vaccination and smoking cessation.
- GPs are at the front line of management of patients with pneumonia, including diagnosis, starting empirical outpatient antibiotic therapy and referring those who are very ill or at risk of deterioration to hospital.
- A chest x-ray is important for diagnosis of pneumonia.
- Most patients respond to empirical antibiotic therapy with amoxycillin, doxycycline or an appropriate macrolide antibiotic.
- Patients with nonresolving pneumonia require reassessment to confirm the diagnosis, identify the pathogen and look for complications or underlying disease such as malignancy.

Epidemiology

Over 100 years ago, William Osler described pneumonia as 'the old man’s friend', allowing elderly patients a relatively rapid death without significant suffering. With improved nutrition, social welfare and the availability of immunisations and antibiotics, the death toll for pneumonia has reduced dramatically. However, lung infection remains a significant cause of morbidity and mortality in Australia, particularly in elderly people and those with chronic disease. The adult Australians at greatest risk of developing pneumonia, the role of preventive measures and practical aspects of the investigation, management and referral of patients with suspected pneumonia are discussed in this article. Practice points regarding management of patients with pneumonia are summarised in Box 1. Five case histories illustrate a range of patients with pneumonia (Figures 1 to 5).

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PNEUMONIA continued

1. PRACTICE POINTS FOR THE MANAGEMENT OF PATIENTS WITH PNEUMONIA

- Bacterial pneumonia is often secondary to a viral infection. In patients with coryza typical of a cold or “flu”, failure to improve as expected or worsening of symptoms may represent superimposed bacterial infection requiring antibiotics.
- The vast majority of patients with pneumonia respond to ‘standard’ antibiotic therapy. Patients with nonresolving pneumonia require formal assessment to confirm the diagnosis, identify the pathogen and look for underlying disease such as malignancy.
- An episode of pneumonia, particularly one requiring hospitalisation, provides a potent opportunity to assist smoking cessation. There is good evidence that the success rate of smoking cessation is directly related to provision of at least one month of supportive contact after hospital discharge.2 GPs play a key role in co-ordinating and providing brief interventions, psychological support and pharmacotherapy.
- Never forget tuberculosis. There are 1000 new cases of tuberculosis in Australia each year, with most patients presenting with pulmonary infection. Risk factors for tuberculous pneumonia include past travel to or residence in a high-risk country, a household or other close contact, and employment in the health industry.2

What is pneumonia?

Pneumonia describes an inflammatory process involving the alveolar spaces, typically caused by infection. The differentiation between pneumonia and bronchitis, a lower respiratory tract infection that does not affect the lung parenchyma, can be difficult in clinical practice, particularly in patients with chronic lung disease in whom the baseline chest x-ray is abnormal. Pneumonia may be classified based on aetiology (bacterial, viral or fungal), location of organism acquisition (community-acquired, hospital-acquired or healthcare-associated) or pathophysiology (e.g. aspiration or immunosuppression-related).

The classification of pneumonia as ‘atypical’ is generally discouraged as it incorrectly implies a distinctive clinical pattern.8 Although certain clinical features occur more commonly with specific pathogens, this association generally does not allow accurate differentiation of causative organisms.

For the remainder of this article, the term pneumonia will be used to refer only to cases of presumed infectious aetiology, where a patient in the community or in a nursing home presents with symptoms that are either respiratory (e.g. cough, dyspnoea, chest pain) or systemic (e.g. fever, malaise, confusion) and new changes that are consistent with consolidation on chest x-ray.

What causes pneumonia?

There are more than 100 potential microbial causes of pneumonia. However, even with extensive microbiological investigation, no causative organism is identified in up to 50% of patients with pneumonia.9 Most cases in which a microbial cause is identified are attributable to a handful of organisms (Box 2).10-12 The spectrum of microbes varies with age, illness severity and geographical location, and can be dynamic in cases of outbreaks and epidemics. Specific pathogens can be associated with particular risk factors (Table 1). A medical, social, occupational and travel history may give clues to likely causative organisms.

Worldwide, Streptococcus pneumoniae is the most common identifiable cause of community-acquired pneumonia. More than 90 distinct serotypes have been described; most, if not all, are capable of causing serious disease in humans. Up to 50% of children and 20% of adults have asymptomatic colonisation of the nasopharynx with S. pneumoniae.13,14 Independent risk factors for colonisation include crowded living conditions, low household income, smoking and recent antibiotic use. Organisms are presumably aspirated or aerosolised from the oropharynx or nasopharynx to the alveoli, where they cross the respiratory epithelium and begin the infective process. Conversion of asymptomatic colonisation to overt infection and invasive disease is not entirely understood but may be related to ‘priming’ of the airway by inflammation, for example caused by smoking exposure or viral infection.15 Epidemiological data show definite seasonality and correlation of viral activity with invasive pneumococcal disease (IPD).1,6 Indeed bacterial pneumonia is often secondary to a viral infection.

Viral pneumonia must not be underestimated, with many surveys identifying respiratory viruses as the second most common cause for patients to require hospitalisation.11 Influenza remains the predominant viral cause of pneumonia and also predisposes to superimposed bacterial infection, particularly with S. pneumoniae but also with Staphylococcus aureus.17 Other viral causes of pneumonia include respiratory syncytial virus, parainfluenza viruses, human metapneumovirus and coronaviruses. Bacterial and viral co-infection occurs frequently, commonly reported in 7 to 10% of those with positive microbiology, but may be found in up to 26%.18

The frequent failure to identify the organism responsible for pneumonia, along with the fact that neither radiological nor clinical features can reliably differentiate between the different aetiologies, has led to the practice of empirical antibiotic therapy (see below).

Who is at risk of pneumonia?

Although pneumonia can occur at any time of life, the incidence increases with age, with a marked increase after the age of 65 years.19,20

Indigenous Australians have a particularly increased risk of pneumococcal
pneumonia, with contributing factors including high rates of oropharyngeal colonisation, low vaccination uptake and high prevalence of other comorbidities, such as smoking and chronic lung disease.  

Active smoking is associated with a greater risk of severe sepsis, hospitalisation and death in comparison with nonsmoking.  

Smoking has a profound effect on respiratory defence mechanisms, including alteration of mucociliary transport and inherent humoral and cellular defences. Moreover, smoking has been shown to increase adhesion of S. pneumoniae, S. aureus and Haemophilus influenzae to the oropharyngeal epithelium.  

Passive smoking is also associated with increased risk.

Although moderate alcohol consumption (two to four standard drinks daily) confers a modest protective effect, higher intake is associated with an increased risk of pneumonia and death. This has been attributed to impairment of local and systemic host immune mechanisms, as well as reduced alertness and favouring of aspiration. Alcohol misuse together with tobacco smoking have been suggested to be the most preventable risk factors for IPD.

Risk factors for aspiration pneumonia include increased age, poor oral hygiene, neurological disorders such as stroke and dementia, and oesophageal motility disorders such as gastro-oesophageal reflux disease. Aspiration of oropharyngeal contents can also occur when the coordination of swallow and breathing is impaired, such as in COPD.

A range of chronic diseases are associated with an increased risk of pneumonia including, but not limited to:
- chronic respiratory disease (e.g. COPD, bronchiectasis)
- cardiovascular disease (e.g. coronary artery disease, congestive heart failure)
- cerebrovascular disease
- chronic kidney disease
- chronic liver disease
- malignancy
- diabetes
- dementia
- immunodeficiency.

The risk of pneumonia in patients with multimorbidity, commonly defined as the presence of two or more chronic medical conditions, appears increased but the extent of the increase is difficult to quantify. Certain comorbidities may occur together, conferring an increased probability of community-acquired pneumonia (‘risk stacking’). For instance, the common scenario of comorbid diabetes, chronic heart disease and COPD has been suggested to confer a hypothetical odds ratio of 7.5 or higher, which increases to more than 40 with the addition of ongoing smoking. The presence of multiple health conditions is also associated with poorer prognosis; a prospective study showed that multimorbidity was an independent risk factor for death or hospitalisation within 90 days (Figure 1).

**Which adults should be offered vaccination?**

Influenza vaccination reduces the likelihood of acquiring influenza, particularly when vaccine and circulating strains are well matched. Adjusted analysis of case-control studies has shown that in community-dwelling patients aged 65 years and over, influenza vaccination reduces the risk of pneumonia, hospital admission and death. Current Australian guidelines strongly recommend annual influenza vaccination.

**TABLE 1. PNEUMONIA PATHOGENS ASSOCIATED WITH SPECIFIC RISK FACTORS**

<table>
<thead>
<tr>
<th>Risk factor group</th>
<th>Pathogens</th>
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<tbody>
<tr>
<td>Contact with young children</td>
<td>Viruses, Bordetella pertussis</td>
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<tr>
<td>'Flu' season</td>
<td>Influenza, Streptococcus pneumoniae, Staphylococcus aureus (including MRSA)</td>
</tr>
<tr>
<td>Recent travel</td>
<td>Viruses, Legionella spp., Mycobacterium tuberculosis (South-East Asia), Burkholderia pseudomallei (Far North Queensland), SARS virus, MERS virus (Middle East)</td>
</tr>
<tr>
<td>Exposure to animals</td>
<td>Chlamydia psittaci (birds), Coxiella burnetii (farm animals)</td>
</tr>
<tr>
<td>Chronic lung disease</td>
<td>Haemophilus influenzae, Pseudomonas aeruginosa, Moraxella catarrhalis</td>
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<tr>
<td>Nursing home residents</td>
<td>Enterobacteriaceae (Gram-negative bacteria), MRSA</td>
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Abbreviations: MERS = Middle East respiratory syndrome; MRSA = methicillin-resistant S. aureus; SARS = severe acute respiratory syndrome.

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**Figure 1.** A 48-year-old man presented with malaise, rigors and delirium. He had minimal breathlessness and cough. Blood tests showed hypotension. A chest x-ray showed bilateral consolidation. Urine antigen testing was positive for *Legionella pneumophila* serogroup 1. The patient’s risk factors for pneumonia included heavy smoking and alcohol intake.
vaccination for all adults aged 65 years and older, Aboriginal and Torres Strait Islander people aged 50 years and older and patients at increased risk of complications, including adults with chronic illness or obesity and pregnant women. Systemic adverse effects occur in 1 to 10% of patients and may mimic influenza, but patients should be reassured that the vaccine does not contain live virus and that fever, malaise and myalgia represent a normal immune response.

Pneumococcal vaccination is effective in reducing IPD. Patients at highest risk of IPD are those with asplenia, haematological malignancy and transplant (Figure 2). Other conditions associated with an increased risk of IPD closely resemble general pneumonia risk factors. Currently, 6 to 10% of patients requiring hospitalisation for community-acquired pneumonia have positive blood cultures or bacteraemia, and over half of these cases are caused by S. pneumoniae. Recent evidence has demonstrated that pneumococcal vaccination also confers protection against nonbacteraemic pneumococcal pneumonia, with a 45% reduction in risk of disease caused by vaccine-related strains. Up to three doses of 23-valent pneumococcal polysaccharide vaccine are recommended for adults, depending on age, Indigenous status and the presence of conditions associated with increased risk of IPD. One or more doses of 13-valent pneumococcal conjugate vaccine are also recommended in those at greatest risk of IPD (Table 2).

**What other prevention measures should be encouraged?**
Pneumonia prevention interventions include addressing individual patient factors as well as the socioeconomic determinants associated with increased risk. Practical advice should include:
- hand hygiene
- cough etiquette
- avoiding sick contacts
- maintaining healthy nutrition
- maintaining good oral hygiene
- optimising chronic health conditions
- undertaking regular physical activity
- smoking cessation
- reducing alcohol intake.

**How should patients be investigated and managed?**
The combination of history taking and physical examination is insufficient to confidently rule in or rule out a diagnosis of pneumonia. The elderly in particular may present without the classic symptoms that suggest pneumonia (cough, breathlessness and fever), and many present with confusion alone. GPs are best placed to manage patients pragmatically at first presentation, including provision of antibiotics if pneumonia is clinically suspected. Guidelines emphasise the need to risk-stratify patients; those with severe illness

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**TABLE 2. AUSTRALIAN RECOMMENDATIONS ON PNEUMOCOCCAL VACCINATION USING 23VPPV IN ADULTS**

<table>
<thead>
<tr>
<th>Risk of invasive disease</th>
<th>23vPPV vaccine recommendations*</th>
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| Highest risk (category A)† | • Three doses for all patients  
• Third dose to be given at:  
  – age 65 years (non-Indigenous) or  
  50 years (Indigenous) OR  
  – five years after second dose (whichever is later) |
| Increased risk (category B) | • At least two doses for all patients  
• Two doses to be given if age 65 years or older (non-Indigenous) or 50 years or older (Indigenous)  
• A third dose for younger patients to be given at:  
  – age 65 years (non-Indigenous) or 50 years (Indigenous) OR  
  – five years after second dose (whichever is later) |
| Normal (healthy) | • Single dose if age 65 years or older (non-Indigenous)  
• Two doses if age 50 years or older (Indigenous) |

Abbreviations: 23vPPV = 23-valent pneumococcal polysaccharide vaccine; CSF = cerebrospinal fluid.
* Minimum of five years between doses.
† Patients at greatest risk should also receive a single dose of 13-valent pneumococcal conjugate vaccine (13vPCV), preceding the 23-valent polysaccharide vaccine by two months. In patients who have had the polysaccharide vaccine, the 13vPCV dose should be given at least 12 months later. Stem cell transplant recipients should receive three doses of 13vPCV.
(e.g. altered mentation or abnormal vital signs) or comorbidities that confer worse clinical outcomes should be referred for inpatient management.3,41

Pulse oximetry allows simple and rapid assessment of oxygenation and is an essential component of clinical assessment of patients with suspected pneumonia. Peripheral capillary oxygen saturation (SpO₂) less than 92% on room air is associated with major adverse events and increased mortality; these patients should be referred immediately for inpatient care.42

Patients with suspected pneumonia who are assessed as suitable to manage in the community should be treated with oral antibiotics (see below). In addition, they should be advised to rest, avoid smoking, drink fluids and take simple analgesics/antipyretics. They should be counselled to present to a hospital emergency department if they do not improve.

Imaging
A chest x-ray is the most useful test for diagnosing pneumonia and should be performed in all patients with suspected pneumonia. Typical findings include patchy alveolar and/or interstitial infiltrates, with ‘air bronchograms’ (the hallmark finding of lung consolidation) and in some cases demarcation of fissions. Left lower lobe consolidation may appear as retrocardiac opacification, more easily seen on a lateral view. In patients with underlying lung disease, comparison with previous imaging may be helpful (Figure 3).

There is no need to perform CT of the chest initially. CT may be required if there is a clinical suspicion of pneumonia complicated by other pulmonary problems (e.g. pulmonary embolus, empyema, abscess or endobronchial obstruction). If patients are sufficiently ill for these diagnoses to be considered, they are likely to require hospitalisation.

Microbiological testing
Microbiological testing of respiratory secretions and blood is frequently not performed for patients with suspected pneumonia in primary care because empirical antibiotic therapy is highly successful. Important exceptions where we recommend collection of specimens for microbiological analysis include:

- patients with comorbid disease who may be infected with antibiotic-resistant or unusual organisms
- patients who do not respond to initial empirical antibiotic therapy
- patients with weight loss, haemoptysis and other risk factors for tuberculosis
- patients with suspected Legionella infection or influenza during outbreaks.

Sputum cultures from patients who have not yet commenced antibiotics are particularly valuable for identifying putative organisms and selecting antibiotics with the narrowest sensitivity spectrum. Sputum samples collected in the community are very useful if patients subsequently present to hospital because of clinical deterioration.

Antibiotic treatment
Antibiotic treatment should be based on local microbiology, suspected organisms and patient factors such as allergies and comorbidities. The Australian Therapeutic Guidelines recommend initial oral therapy with amoxycillin for five to seven days.43 For patients with immediate penicillin hypersensitivity, doxycycline or an appropriate macrolide antibiotic are effective alternatives and have the added benefit of activity against Mycoplasma pneumoniae, which accounts for a significant proportion of cases of community-acquired pneumonia in young adults (Figure 4). For patients with COPD, who are more likely to be infected with H. influenzae, the pre-emptive addition of clavulanic acid may be appropriate. First-line empirical antibiotic options are listed in Table 3.43,44
When should patients be referred?

Pneumonia is an acute condition with significant morbidity and mortality. If patients do not respond within 48 hours of empirical therapy then referral to hospital is advised. Failure of the patient to improve as expected can be due to a variety of reasons, including:

- local or systemic complications of pneumonia (e.g. pleural effusion, empyema, sepsis; Figure 5)
- complicating comorbidities (e.g. COPD, heart failure)
- incorrect diagnosis (e.g. undiagnosed malignancy)
- unusual or antibiotic-resistant pathogens (occurs in a minority of cases)
- an inhaled airway foreign body (in patients at high risk of aspiration).

How should patients be followed up?

GPs play a key role in the follow up of patients with pneumonia. Chest x-ray changes can persist for several weeks following clinical improvement. All patients should have follow-up imaging at around six weeks to ensure resolution of consolidation. Persistent changes may reflect underlying disease such as malignancy or bronchiectasis.

Conclusion

The risk of acquiring pneumonia and subsequent prognosis are closely related to patient factors such as age, comorbidity and disability. GPs are at the front line, often being the first physician to assess patients with pneumonia and commence treatment. Patients should be promptly risk-stratified and referred for further investigation and/or hospitalisation if required. Follow-up imaging is important to confirm resolution of pneumonia. Finally, GPs have an invaluable role in identifying the patients who are most at risk and promoting preventive health measures, including optimising chronic health conditions, encouraging smoking cessation and providing vaccinations.

References

A list of references is included in the website version (www.medicinetoday.com.au) and the iPad app version of this article.

COMPETING INTERESTS: Associate Professor Morgan has received honoraria from pharmaceutical companies for speaking at meetings, including speaking about the Community-Acquired Pneumonia Immunization Trial in Adults (CAPiTA) study. She was not an investigator in the study. Dr Chung: None.

TABLE 3. ANTIBIOTICS FOR EMPIRICAL OUTPATIENT TREATMENT OF COMMUNITY-ACQUIRED PNEUMONIA IN ADULTS

<table>
<thead>
<tr>
<th>Antibiotic</th>
<th>Comments</th>
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<tbody>
<tr>
<td>Amoxycillin 1 g orally, 8-hourly for 5 to 7 days</td>
<td>Consider addition of clavulanic acid, especially if Gram-negative organisms are suspected. Liquid formulations are available and may be easier for some patients.</td>
</tr>
<tr>
<td>Doxycycline 100 mg orally, 12-hourly for 5 to 7 days</td>
<td>Preferred if atypical pathogens suspected (e.g. Mycoplasma, Chlamydophila, Legionella). Avoid in pregnant women.</td>
</tr>
<tr>
<td>Roxithromycin 150 mg orally, 12-hourly for 5 to 7 days</td>
<td>May be used if doxycycline is poorly tolerated and cover against atypical pathogens is required. Interacts with many drugs and causes QT prolongation.</td>
</tr>
<tr>
<td>Cefuroxime 500 mg orally, 12-hourly for 5 to 7 days</td>
<td>May be used in patients with penicillin allergy (excluding hypersensitivity). Provides little additional cover compared with amoxycillin, apart from Gram-negative organisms.</td>
</tr>
</tbody>
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* Adapted from Therapeutic Guidelines and the Australian Medicines Handbook.
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References


