

ABSTRACT

Chest infections are a diverse group of infections of the airways and lungs, the most common of which are pneumonia and acute bronchitis. A well-taken history and examination will often reveal the type of chest infection a patient has, guide the choice of antibiotics and reveal features that would prompt a referral to hospital. Many of these infections can be treated on an outpatient basis in the community. Some will need a referral for hospital admission or respiratory specialist review. This paper will cover an approach to history and examination in patients with symptoms of chest infection. Several validated tools to aid clinical decision-making will be covered and these provide evidence-based and useful guidelines to a busy family physician. This paper will also cover some current antibiotic guidelines, a patient's journey through an emergency department visit, and some advice to patients on discharge.

Keywords:

Chest Infections, Pneumonia, Bronchitis, Community-acquired Pneumonia, Clinical Decision Rules, CURB-65, Pneumonia Severity Index

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INTRODUCTION

Chest infections are very common and can come in a variety of presentations from mild coughs to severe dyspnoea with unstable vital signs. The majority are mild, self-limiting, and arise from viral infections such as influenza, rhinovirus and adenoviruses, but some are due to bacterial pneumonias. In at-risk populations, for example the elderly, it can lead to significant morbidity and mortality.¹⁻³

In this article we will re-examine the approach to chest infections in adults, with a focus on useful history to be taken and signs to be looked for, and discuss when to refer a patient to the Emergency department. We will also cover a few chest infections that may have a different approach to management.

Type of Chest Infections

A chest infection is an infection of the lungs or airways. There are two main types of chest infections, namely Acute Bronchitis and Pneumonia. Most bronchitis cases are caused by viruses, whereas most pneumonia cases are due to bacteria.

THE IMPORTANCE OF A HISTORY

Certain populations are at increased risk of developing serious chest infections, such as young children with chronic diseases, smokers, the elderly, pregnant women, patients who are obese, asthmatic, diabetic or immunocompromised, and those with underlying heart and lung diseases like heart failure or chronic obstructive pulmonary disease (COPD), among others. Alcoholics and bed-bound patients are also at increased risk.

Thus it is important to get a good history to understand which population a patient falls into.

PRESENTATION**1) Cough**

The presence of a cough usually suggests respiratory tract involvement, however sometimes it may be due to reflux or diaphragmatic irritation from sub-diaphragmatic pathology. Chronic cough (more than 8 weeks) may be due to asthma, acid reflux, post-nasal drip, medication like ACE inhibitors, or malignancy, and may warrant a more detailed workup. The nature of the sputum also gives a clue to the pathology as the pink frothy sputum of pulmonary oedema will require an ED visit and haemoptysis may require a referral to a respiratory physician. Worsening productive cough and purulent sputum oftentimes is an indication for starting antibiotics.

2) Fever

The absence of fever may not exclude pneumonia and other serious infections. This may be absent in the elderly and immunocompromised patient. In others there may be chills and rigors without any fever. In fact the presence of a temperature $<36^{\circ}\text{C}$ is part of the Systemic Inflammatory Response Syndrome (SIRS) criteria which together with a respiratory source of infection indicates sepsis.

3) Dyspnoea

Dyspnoea causes are wide-ranging. A patient may be breathless from hypoxia because of a large area of lung affected by the chest infection, bronchoconstriction, or even from Kussmaul's sign of metabolic acidosis which may occur in sepsis.

4) Chest Pain

Chest pain in pneumonia may be pleuritic, localised to the site of infection and may worsen as the pneumonia progresses. If bronchoconstriction is present, central chest tightness may be felt instead and would be associated with auscultatable wheeze. If coughing has been persistent then one might expect pain of a muscular nature from intercostal muscle strain.

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5) General Symptoms

Septic patients may complain of systemic symptoms like weakness; lethargy; giddiness; poor oral intake from anorexia, nausea or vomiting; confusion; or drowsiness. Some may even present with a fall from the weakness or giddiness. These are more common in the elderly, who may not mount a febrile response. Some patients will complain of upper abdominal pain due to a lower-lobe pneumonia irritating the diaphragm on that side.

PHYSICAL SIGNS

1) Vital signs

Not all patients will mount a febrile response especially in the immunosuppressed or immunocompromised group, including the elderly. The presence of hypothermia may also be suggestive of sepsis, as demonstrated in the SIRS criteria. This is a tool used to determine which patients with infections are at risk of severe sepsis and may need closer monitoring and more aggressive resuscitation. Meeting 2 of the 4 parameters fulfils the criteria. While SIRS in itself is not specific to infections, its presence, combined with a source of infection, is the definition of sepsis.⁴

Table 1: Systemic Inflammatory Response Syndrome (SIRS) Criteria

- Fever of more than 38°C (100.4°F) or less than 36°C (96.8°F)
- Heart rate of more than 90 beats per minute
- Respiratory rate of more than 20 breaths per minute or arterial carbon dioxide tension (PaCO₂) of less than 32 mmHg
- Abnormal white blood cell count (>12,000/μL or < 4,000/μL or >10% immature [band] forms)

Tachycardia is also featured in SIRS. In addition, assuming a maximum of 100 beats per minute at 37°C, one can accept a maximum of 10 beats per minute rise in heart rate for every 1 degree rise in temperature. Beyond this, other reasons for the tachycardia should be entertained, such as dehydration or sepsis.

Tachypnoea is a prominent sign in many patients with significant chest infections. A rate above 20 is generally considered high and, again, this is seen in the SIRS criteria. Of note, pneumonia severity indicators like the CURB-65 rule and the Pneumonia Severity Index (PSI) both use a respiratory rate of above 30 breaths per minute to indicate severity of pneumonia and a higher mortality risk. These 2 clinical decision “rules” will be further elaborated later in this paper.

2) Lung examination

As fervently practiced in medical schools across the globe, a

complete and thorough examination of the chest that reveals signs such as unilateral decreased chest excursion, increased vocal fremitus or vocal resonance, a dull percussion note and crepitations in one lobe often point toward a consolidation. However, to a busy clinician, a careful auscultation with the addition of chest percussion reveals plenty. Stony dullness to percussion with decreased air entry indicates a pleural effusion, whereas decreased air entry or crepitations, bronchial breath sounds and dullness to percussion indicates a consolidation. Rhonchi that respond to beta agonists are expected in bronchitis. The presence of right upper or middle lobe consolidation can indicate aspiration or tuberculosis as a cause.

INVESTIGATIONS

Chest radiographs (CXR) should be done for patients with signs of consolidation, pleural effusion and those with persistent symptoms. There is often a time lag from clinical signs to radiological abnormalities which could delay diagnosis and treatment. Decisions should be made based on clinical signs rather than waiting for a CXR to confirm a diagnosis. When looking at the CXR, extra care should be taken to look behind the heart shadow for a consolidation of the left lower lobe, and for a “sail sign” and blunting of the right heart border often seen in right-middle-lobe consolidations.

A repeat CXR after treatment should be done no earlier than 28 days after the first one, again because of the time lag to resolution of radiological signs.⁷ Chronic lung diseases and masses to suggest underlying malignancy should be excluded on repeat X-ray, particularly in the at-risk groups.

Leukocytosis is common but need not be present in bacterial chest infections. Some patients may have leukopenia instead and often a left shift of the differential counts in favour of neutrophilia is seen. This may not be present in immunocompromised patients and those partially treated with antibiotics already. Interestingly, leucocytosis does not feature in either of the clinical decision rules below (see Tables 2 and 3).

WHEN TO REFER TO AN EMERGENCY DEPARTMENT

A family physician seeing a patient with community-acquired pneumonia has at least 2 validated and commonly used clinical decision rules to aid him/her in deciding if the patient should be sent to hospital for admission or not. These can be downloaded from the American Academy of Family Physicians website and online calculators are also available that will do the calculation for you and suggest the mortality risk and advise disposition accordingly. Both rules predict 30-day mortality risk and thus suggest admission for those with higher mortality risk from community-acquired pneumonia. The first clinical decision rule is CURB-65 (Table 2) where a score of 2 would predict 7% mortality risk and thus hospitalisation for IV

antibiotics is advised. A score of 3 or more may even require intensive care. If no blood test is available, there is a variation to this rule, called the CRB-65, where a score of 1 would suggest admission.

However, the drawback of this rule is that it doesn't take into account the background medical history of the patient. For instance, a neutropenic patient on chemotherapy, a renal transplant patient on immunosuppressants, or a man with underlying malignancy and renal failure, who has a CURB-65 score of 1, may be at higher mortality risk than predicted. That is why the second rule, called the Pneumonia Severity Index (PSI), is preferred.⁶ The PSI incorporates parameters like gender, comorbidities, physical signs, and radiological and biochemical parameters. There are 5 risk classes, with classes I and II requiring outpatient or home-based antibiotics and classes IV and V requiring admission. Class III is often determined by the system one works in, for instance if early follow-up or outpatient intravenous antibiotics are possible then this class can be treated outpatient as well because the predicted mortality is only 2.6 percent.

The other groups of patients that should be referred to ED for admission are those with persistent/ worsening pneumonia despite outpatient treatment, those with underlying lung disease that may have poorer respiratory reserves, and the immunosuppressed/ immunocompromised.

Pneumonia patients with admission to hospital for at least 48hrs within the 3 months prior, or those with outpatient visits to hospital, outpatient intravenous therapies, residing in a long-term care facility or nursing home within the last 1 month, may have healthcare-associated pneumonia (HCAP) and would need admission for intravenous broad-spectrum antibiotics such as Piperacillin-Tazobactam.

Bronchitis and other mild chest infections should be referred to an Emergency department (ED) if there is no response to outpatient treatment or if frequent nebulisations are required or if patient is hypoxic, breathless or demonstrates signs and symptoms of sepsis.

Anyone with a suspicion of pulmonary tuberculosis (pTB) or sepsis should also be referred to hospital or, in the case of well patients with likely pTB, they can be referred to the TB control unit and MOH can be notified of the suspected pTB.

WHEN TO TREAT IN OUTPATIENT SETTING

As deduced from Tables 2 and 3, patients with community-acquired pneumonia (CAP) can be treated as outpatients using those guidelines and choice of antibiotics changes with bacterial strains in each setting. For Singapore General Hospital, current hospital guidelines for empiric outpatient treatment suggests giving Oral Amoxycillin 1g 8-hourly with Oral Klacid 500mg 12-hourly.

Those that require admission for inpatient antibiotics receive

IV Ceftriaxone 2g once daily and oral Klacid, whereas those with severe pneumonia (non-ICU) receive IV Ceftazidime 2g 8-hourly with IV Levofloxacin 750mg once daily. Levofloxacin 750mg once daily is the drug of choice in beta-lactam allergic patients. Tazocin, Meropenem and Azithromycin are reserved for hospital-acquired pneumonias and severe pneumonias requiring intubation respectively. Steroids should be avoided in patients with infections unless the infection has led to an exacerbation of underlying asthma/ chronic obstructive airway disease, for instance.

Patients with a suggestion of aspiration pneumonia usually receive IV Ceftriaxone and have anaerobic bacterial cover with Metronidazole in addition. Those with chronic obstructive airway disease get Co-amoxiclav.

WHEN TO REFER TO A RESPIRATORY PHYSICIAN

When a patient has recurrent infections or if there is suspicion of an underlying lung disease or malignancy (e.g., on follow-up radiograph), then a respiratory outpatient follow-up can be arranged. Patients with asthma or COPD that have frequent chest infections or need to have their underlying disease controlled can also see the respiratory physician. Pleural effusions or persistent breathlessness after treatment can also benefit from this.

ADVICE TO PATIENTS

It is advisable to let patients know the duration of antibiotics they need to complete and to review them in your clinic for progress or deterioration. Advice should also be given to go to the Emergency Department if there is breathlessness or deterioration, chest pain, poor oral intake, altered mental state, weakness, dehydration and other systemic symptoms as these may suggest sepsis has set in.

A PATIENT'S ED JOURNEY

Chest infection patients in ED can either be discharged with outpatient therapy with family physician review or respiratory consult depending on the need, or they can be admitted. Admissions can be either to the ED short-stay ward for between 8-23 hours, or they may be admitted to the hospital ward for usual inpatient care. If suitable for the short-stay ward, they may receive 2-3 doses of intravenous antibiotics, antipyretics and are reviewed serially and then can be discharged back into the community with outpatient antibiotics. The patients suitable for short-stay unit admission in ED are the younger patients (age less than 60 years) with unilobar pneumonia, who must not have any recent recurrent pneumonias within 1 year, who are not from a nursing home, and who have not been admitted to hospital recently. They should also be non-diabetic, without significant premorbid medical problems or cancer, and be haemodynamically stable. If they worsen, remain febrile, tachycardic or breathless, are unable to feed or turn unstable, they should then be transferred to the inpatient ward.

TABLE 2. CURB-65 AND CRB-65 SEVERITY SCORES FOR COMMUNITY-ACQUIRED PNEUMONIA

<i>Clinical factor</i>		<i>Points :</i>
• C onfusion		1
• Blood U rea nitrogen > 7 mmol/L (19 mg per dL)		1
• R espiratory rate ≥ 30 breaths per minute		1
• Systolic B lood pressure < 90 mm Hg or Diastolic blood pressure ≤ 60 mm Hg		1
• Age ≥ 65 years		1

CURB-65 score	Deaths/total (mortality risk %)*	Recommendation†
0	7/1,223 (0.6)	Low risk; consider home treatment
1	31/1,142 (2.7)	Low risk; consider home treatment
2	69/1,019 (6.8)	Short inpatient hospitalisation or closely supervised outpatient treatment
3	79/563 (14.0)	Severe pneumonia; hospitalise; consider admitting to intensive care
4 or 5	44/158 (27.8)	Severe pneumonia; hospitalise; consider admitting to intensive care

CRB-65 score‡	Deaths/total (mortality risk %)*	Recommendation†
0	2/212 (0.9)	Very low risk of death; usually does not require hospitalisation
1	18/344 (5.2)	Increased risk of death; consider hospitalisation
2	30/251 (12.0)	Increased risk of death; consider hospitalisation
3 or 4	39/125 (31.2)	High risk of death; urgent hospitalisation

CURB-65 = Confusion, Urea nitrogen, Respiratory rate, Blood pressure, 65 years of age and older.
CRB-65 = Confusion, Respiratory rate, Blood pressure, 65 years of age and older.

*—Data are weighted averages from validation studies.

†—Recommendations are consistent with British Thoracic Society guidelines.
Clinical judgment may overrule the guideline recommendation.

‡—A CRB-65 score can be calculated by omitting the blood urea nitrogen value, which gives it a point range from 0 to 4. This score is useful when blood tests are not readily available.

TABLE 3. PNEUMONIA SEVERITY INDEX FOR COMMUNITY-ACQUIRED PNEUMONIA

Risk factor :	Points:		
<i>Demographics</i>			
Men	Age (years) : ____		
Women	Age (years) – 10 : ____		
Nursing home resident	+10		
<i>Comorbidities</i>			
Neoplasm	+30		
Liver disease	+20		
Heart failure	+10		
Stroke	+10		
Renal failure	+10		
<i>Physical examination findings</i>			
Altered mental status	+20		
Respiratory rate ≥ 30 breaths per minute	+20		
Systolic blood pressure < 90 mm Hg	+20		
Temperature $< 95^{\circ}\text{F}$ (35°C) or $\geq 104^{\circ}\text{F}$ (40°C)	+15		
Pulse rate ≥ 125 beats per minute	+10		
<i>Laboratory and radiographic findings</i>			
Arterial pH < 7.35	+30		
Blood urea nitrogen > 9 mmol/L (30 mg per dL)	+20		
Sodium < 130 mmol per L	+20		
Glucose ≥ 250 mg per dL ($>14\text{mmol/L}$)	+10		
Haematocrit < 30 percent	+10		
Partial pressure of arterial oxygen < 60 mm Hg	+10		
Pleural effusion	+10		
Point total	Risk class		
Deaths/total (%) in Adults with CAP	Recommendation†		
< 51	I	3/1,472 (0.2)	Outpatient therapy should be considered, especially for patients in classes I and II
51 to 70	II	7/1,374 (0.5)	
71 to 90	III	41/1,603 (2.6)	
91 to 130	IV	149/1,605 (9.3)	Patient should be hospitalised
> 130	V	109/438 (24.9)	
†—Recommendations are consistent with clinical guidelines. Clinical judgement may overrule the guideline recommendation.			

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LEARNING POINTS

- **A detailed history often reveals the diagnosis and likely pathogen, and guides management in chest infections.**
- **Vital signs and blood tests are components of several clinical decision rules and they have been shown to predict 30-day mortality in community-acquired pneumonias.**
- **Healthcare-associated pneumonia has to be considered if the patient had been hospitalised for at least 48hrs in the last 90 days, or if there were outpatient visits, dialysis, day surgery or nursing home visits or other contact with a healthcare institution in the last 30 days.**
- **Antibiotic choice should be guided by the likely cause of the infection and the risk of severe sepsis.**