

## Epidemiology

Approx annual incidence of community-acquired pneumonia (CAP) is ~10 per 1000 adult pop., ~15/1000 5-15yr, & ~40/1000 <5y. Most episodes in autumn or winter.

### Risk factors

- Age: especially infants, young children and the elderly
- Lifestyle: smoking, alcohol
- Preceding viral infections, e.g. influenza predisposing to pneumococcal infection
- Respiratory: asthma, COPD, malignancy, bronchiectasis, cystic fibrosis
- Immunosuppression, AIDS, cytotoxic therapy - increased risk of infection with *Staphylococcus*, tuberculosis, gram negative bacilli and *Pneumocystis carinii*
- Intravenous drug abuse, often associated with *Staphylococcus aureus* infection
- Hospitalisation (nosocomial) - often involving gram negative organisms
- Aspiration pneumonia (and its risk factors)
- Underlying predisposing disease: diabetes mellitus, cardiovascular disease

## Community acquired pneumonia

### Causes include:

- Bacteria: *Streptococcus pneumoniae* (>50% of cases). *Haemophilus influenzae* (10-15%), *Staphylococcus aureus*, *Klebsiella pneumoniae*, Enterobacteria (e.g. *E. coli*), anaerobes. *Moraxella catarrhalis* and *Pseudomonas* are more common in COPD patients.
- 'Atypical' pathogens: *Mycoplasma pneumoniae* (>10%), *Bordetella pertussis*, *Legionella pneumophila*, *Chlamydia pneumoniae*, *Chlamydia psittaci*, *Coxiella burnetii*.
- Viruses (~3% adults, ~35% children): Influenza A, RSV, adenovirus, parainfluenza.
- Mixed pathogens (~40% in children, <5% in adults)

## Hospital acquired pneumonia

- Defined as a new infection of lung parenchyma more than 48hrs after admission.
- Occurs mostly in the severely debilitated, immunocompromised or mech. ventilated.
- Infection occurring during the first four days of the hospital stay is usually caused by *Streptococcus pneumoniae*, *Haemophilus influenzae* and *Moraxella catarrhalis*.
- Onset more than four days after admission is more often caused by Gram-negative enterobacteria, *Staphylococcus aureus* or *Legionella pneumophila*.
- Hospital acquired pneumonia is often caused by multiple organisms.

## Presentation

### Symptoms

- Pneumonia usually develops over several days with cough and sputum production (possibly with haemoptysis), dyspnoea, pleuritic chest pain, weakness, malaise and often myalgia.
- More severe pneumonia may lead to confusion, respiratory distress and cyanosis.
- Presentation may be more sudden with a dramatic rigor as the first symptom and this is more common in healthy young adults.
- In older patients, the presentation may be more insidious, with minimal cough and no fever. This age group often present with confusion and hypothermia.
- Occasionally, a lower lobe infection irritates the diaphragm to cause upper abdominal pain, which is referred to the shoulder.

## Signs

- Fever, breathless at rest.
- Chest expansion is reduced on the affected side.
- Percussion is dull over the diseased lobe or lobes.
- Auscultation may reveal crackles, bronchial breathing or pleural friction rub, depending on the degree of consolidation.
- Occasionally, there is evidence of an effusion with stony dullness on the affected side.
- Septicaemia should be suspected if the patient is cold, clammy and hypotensive.
- Immunocompromised patients may present with just fever, tachypnoea and agitation or altered mental function.

Typical (pneumococcus, H.influenzae, Staph. Aureus) pattern is: Normally well ± mild URTI, sudden onset of fever, rigor/s (typically single), pleuritic CP and a dry cough → productive of mucopurulent sputum. Lobar/segmental consolidation on CXR. Spont recovery in 7-10d in untreated survivors heralded by a 'crisis' of sweats. Deviation from this → atypical pattern.

## Differential diagnosis

- Different organism responsible
- Pulmonary oedema, pleural effusion
- Pneumothorax
- Pulmonary embolus
- Asthma, COAD
- Bronchiectasis
- Fibrosing alveolitis
- Neoplasm
- Sarcoidosis
- Cx: e.g. empyema, lung abscess

## Investigations

- Chest x-ray (doesn't reliably differentiate organism), rarely CT in complicated cases
- Pulse oximetry, ABG if ↓SaO<sub>2</sub> or severe.
- FBC, UEC (↓Na<sup>+</sup> more common in Legionella), Blood cultures (+ve in 5-10% T>38°C)
- Cold agglutinins to detect Mycoplasma pneumoniae
- PCR/serology for viruses, mycoplasma, pertussis, Chlamydia, Legionella & Coxiella burnetii
- Sputum examination and culture - usefulness debated. (Up to 50% bacterial ID)
- Urinary antigen assays for Pneumococcus & Legionella
- Aspiration of pleural fluid (for biochemistry and culture)
- Mantoux, bronchial sputum/washings or gastric aspirates for TB (AFBs)

## Management

Supportive management: O<sub>2</sub>/ventilation PRN, fluids, analgesics/antipyretics, ?bronchodilators. ??Chest physio. Antibiotics (if ?bacterial) normally for 7 days unless stated otherwise.

### Paediatric Community-acquired pneumonia

Admission general indications: age<1y, hypoxia, poor feeding, underlying disease, social situation.

Age≤3mo: **ampicillin** 50mg or **benzylpenicillin** 60mg/kg IV q6h PLUS **gentamicin** 7.5mg/kg IV OD  
If pneumonitis or pertussis suspected add: **azithromycin** 10 mg/kg PO OD for 5d OR (if child >1 month old) **clarithromycin** 7.5mg/kg PO q12h x 7d OR **erythromycin** 10mg/kg PO/IV q6h x 14d  
(In neonates, erythromycin may cause pyloric stenosis, and clarithromycin is of unknown safety)

Age>3mo: Mild - **amoxicillin** 25mg/kg orally q8h x 7d (but if <1yr consider adm & IV)

Moderate - **benzylpenicillin** 30mg/kg IV q6h

Severe - **cefotaxime** 25mg/kg IV q8h x 7d PLUS **flucloxacillin** 50mg/kg IV q6h

Tropical Aus AND DM, CF, CHD, RhF: **meropenem** 25mg/kg to 1g IV, q8h

If ?atypical (esp >5yrs) **clarithromycin** 7.5-12mg/kg OR **roxithromycin** 4mg/kg to 150mg q12h

## Adult Community-acquired pneumonia

- Mx aided by scoring systems
- Pneumonia Severity Score (PSI)

Risk factor	Points
Men	Age (yrs)
Women	Age (yrs)-10
Nursing home resident	+10
History of neoplasm	+30
History of liver disease	+20
History of heart failure	+10
History of stroke	+10
History of renal failure	+10
Altered mental status	+20
RR $\geq$ 30 breaths/min	+20
SBP < 90 mmHg	+20
Temp <35C or $\geq$ 40C	+15
HR $\geq$ 125 bpm	+10
Arterial pH <7.35	+30
BUN >30 mg/dL	+20
Na <130 mmol/L	+20
Glucose $\geq$ 250 mg/dL	+10
Hematocrit <30%	+10
PaO <sub>2</sub> <60 mmHg	+10
Pleural effusion	+10

PSI Class	Total Points	30-day mortality	Disposition
I	<51	0.1%	Outpatient
II	51-70	0.6%	Outpatient
III	71-90	0.9%	Outpatient vs short-stay inpatient
IV	91-130	9.3%	Inpatient
V	>130	27.0%	Inpatient ICU

- CURB-65 Criteria: **C**onfusion, **U**rea >7, **R**R  $\geq$ 30, **sBP** <90mmHg (or **dBP**  $\leq$ 60mmHg), **A**ge  $\geq$ 65.
  - If **0-1**: Low mort (<1%) - Home Rx, **2**: Mod mort (7.6%) - Short stay or hospital outpatient, **>=3**: High Mortality (>21%) - Adm hospital (**>=4**: (>42%) - Consider ICU)
- Antibiotics by disposition:

### Outpatient:

- **Amoxicillin** 1g PO q8h x 7d ( $\pm$  stat dose of **benzylpenicillin** 1.2g IV) PLUS
- **Clarithromycin** 250mg PO q12h x 7d for atypicals

### Inpatient (Ward, Mod severe)

- Non-tropical: **benzylpenicillin** 1.2g IV q6h (OR if trop Aus AND DM, EtOH, CRF or chr lung dis: **ceftriaxone** 2g IV OD + **gentamicin** 4-6mg/kg IV OD) x 7d PLUS
- **Clarithromycin** 250mg PO q12h x 7d for atypicals

### Inpatient (ICU, Severe):

- **Ceftriaxone** 1g IV OD (OR if trop Aus AND DM, EtOH, CRF or chr lung dis: **meropenem** 1g IV q8h) PLUS
- **Azithromycin** 500mg IV for atypicals

## *Staphylococcal pneumonia* (assoc: IVDU, nosocomial, measles/flu epidemics, empyema common)

- **Flucloxacillin** or **cephalothin** 2g (child: 50 mg/kg up to 2 g) IV q6h
- If immediate penicillin hypersensitivity or sev ill: **vancomycin** 25mg/kg to 1g IV q12h

## *Hospital-acquired pneumonia:*

- Mild disease
  - **Augmentin Duo Forte** T q12h or **benzylpenicillin/gentamicin** x 7d
- Moderate to Severe disease
  - **ceftriaxone** 1 g IV, daily OR **ticarcillin+clavulanate** 3+0.1g IV q6h OR **benpen/gent**

## *Penicillin anaphylaxis:*

- **Moxifloxacin** 400mg PO IV/OD x 7d as single agent

**SMART-COP:** to predict need for intensive respiratory or vasopressor support (IRVS)

Risk factor	Points	Total # Points	Risk of needing IRVS
Systolic BP <90 mmHg	2	0-2	Low
Multi-lobar CXR involvement	1	3-4	Moderate (1 in 8)
Albumin <3.5 g/dL	1	5-6	High (1 in 3)
RR <sub>≥</sub> 25 (<50y) or ≥30 (>50y)	1	≥7	Very high (2 in 3)
Tachycardia HR ≥125 bpm	1		
Confusion (new onset)	1		
Oxygen low Age ≤50y: PaO <sub>2</sub> <70mmHg or SaO <sub>2</sub> ≤93% or PaO <sub>2</sub> /FiO <sub>2</sub> <333 Age >50y: PaO <sub>2</sub> <60mmHg or SaO <sub>2</sub> ≤90% or PaO <sub>2</sub> /FiO <sub>2</sub> <250	2		
pH (arterial) <7.35	2		

### Complications

- Pleural effusion (95% sterile) and empyema (cont. fever and ↑WCC after 4-5 days of ABx therapy). Mx: CT, pleurocentesis - if pH <7.2, LDH >1000, glu <2.5 or orgs → Drain + ABx
- Lung abscess: can occur in pneumococcal, but classically in staphylococcal or klebsiella.
- Pneumatocoele, pneumothorax & pyopneumothorax (e.g. following rupture of a staphylococcal lung abscess).
- Postinfective bronchiectasis.
- Others: ARF, DVT, septicaemia, pericarditis, endocarditis, osteomyelitis, septic arthritis, cerebral abscess, meningitis (particularly in pneumococcal pneumonia).

### Prognosis

- Mortality from CAP is about 1% unless untreated & bacteraemia when much higher
- Nosocomial mortality is approximately ~10-15% and up to 30-50% in ICU
- Infection with pseudomonas is uncommon but carries 60% mort.
- Repeat CXR @ 4-6wks only required if severe case or persistent symptoms

### Prevention

- Early appropriate antibiotic therapy reduces mortality and morbidity.
- Influenza and pneumococcal vaccination.
- Targeted risk reduction, such as smoking cessation.

### Notes for specific situations:

*Pneumocystis carinii* - more common in immunocompromised, AIDS. Hypoxia. Rx: **cotrimoxazole**  
*Legionella pneumophila* - (aerosol spread → cooling towers, a-c units etc) - predilection for lower zones, ↓Na<sup>+</sup>, ↓PO<sub>4</sub>, ↑transaminases, relative bradycardia, headache, abdo pain/diarrhoea, no earache/sore throat/rash. Rx: **azithromycin** 500mg IV/PO. If critical add **ciprofloxacin** 400mg IV q12h. Treat for 14-21 days.

*Klebsiella pneumoniae* - EtOHlics, COAD, DM. Gram Neg. Most often RUL.

*Mycoplasma pneumoniae* - More common 5-10y children & young adults. Insidious onset, persistent dry cough, headache, Erythema multiforme/SJS, bullous myringitis, cardiac & neurological Cx.

*Psittacosis* - Chlamydia psittaci - bird exposure. Epistaxis, GIT symptoms. Rx as for mycoplasma.

*Coxiella Burnetti* - Q fever - animal/milk exposure. Headache, malaise, meningitis, hepatitis, endocarditis. Rx **doxycycline** or **chloramphenicol**.

*Cavitation*: Klebsiella, TB, S. aureus, E. coli, fungi (Aspergillus), anaerobe abscess, *Echinococcus*, neoplasm → may req. CT ± biopsy or bronchoscopy