PNEUMONIA

" Despite the constant presence of potential pathogens in the respiratory tract, the lungs are remarkably resistant to infection"

Pathophysiology:

- Defect in host defenses.
    - Altered LOC (stroke / seizure / GA).
    - Suppression of airway reflexes / Aspiration.
    - Endotracheal intubation / NGT.
    - Smoking (mucociliary dysfunction).
    - Immunosuppression (transplant, HIV, chemotherapy).
- Presence of virulent organism (incl. concomitant viral illness).
    - Strong association w/ preceding influenza
- Introduction of large inoculum of organisms.
- Proliferation leads to inflammation & immune response.
    - Antigen recognised → IL-1, IL-8, TNF = *inflammatory response*.
    - Transudation of plasma fluid into lung tissue → entry of IgM, IgG = *bacterial opsonisation, complement activation, agglutination & neutralisation.*
    - Neutrophils recruited to lungs to kill infecting organism.
    - Cell-mediated immunity defend against viruses and intracellular organisms (incl. Mycobacterium & Legionella spp.)
- As fluid (exudate / transudate) & inflammatory cells enter alveolar spaces to combat infection, the patient develops clinical & radiographic signs of pneumonia.

Aetiology:

Extremely difficult to identify the causative pathogen, even after thorough investigation.

- *S. pneumoniae* is the most common pathogen (esp. in ICU admissions & fatal cases).

Bacterial pathogens divided into *typical* & *atypical.*

- TYPICAL: (~ 25 % cases)
    - *Streptococcus pneumoniae*
    - *Haemophilus influenzae*
    - *Staphylococcus aureus*
    - *Klebsiella pneumoniae*
- ATYPICAL:
    - *Legionella*
    - *Mycoplasma*
    - *Chlamydophila* (previously Chlamydia)

Viral pathogens are also common (~ 18% of cases)

- Influenza & parainfluenza *are most common.*
- RSV
- Metapneumovirus
- Varicella-zoster
- Coronavirus (SARS!)

Others;

- *Pneumocystis* (PCP):
    - HIV-AIDS / Malignancy
- *Mycobacterium tuberculosis:*
    - Acute vs dormant infection. Reactivation w/ impaired immunity.

The patient's environment must be considered when predicting the causative organism & selecting treatment choices.

Table 68-1 Acquisition Environment Classification for Pneumonia

Classification	Criteria
Community-acquired pneumonia	Acute pulmonary infection in a patient who is not hospitalized or residing in a long-term care facility 14 or more days before presentation
Hospital-acquired pneumonia	New infection occurring 48 or more hours after hospital admission
Ventilator-acquired pneumonia	New infection occurring 48 or more hours after endotracheal intubation
Health care–associated pneumonia	Patients hospitalized for 2 or more days within the past 90 d
	Nursing home/long-term care residents
	Patients receiving home IV antibiotic therapy
	Dialysis patients
	Patients receiving chronic wound care
	Patients receiving chemotherapy
	Immunocompromised patients

Health care-associated pneumonia is associated w/ a greater likelihood of resistant organisms such as *Pseudomonas* and MRSA.

Clinical Features:

Symptoms:

- Cough
- Purulent sputum
- Dyspnoea
- Fever
- Fatigue
- Pleuritic chest pain
- Rigors / chills / night sweats

** Infants / small children have fever, irritability, tachypnoea, tachycardia & increased work of breathing (cough is minimal or absent) **

** Elderly / debilitated patients often present w/ *non-specific* complaints **

Table 68-3 Clinical Characteristics of Common Bacterial Pneumonias

Organism	Symptoms	Sputum	Chest X-Ray
Streptococcus pneumoniae	Sudden onset, fever, rigors, pleuritic chest pain, productive cough, dyspnea	Rust-colored; gram-positive encapsulated diplococci	Lobar infiltrate, occasionally patchy, occasional pleural effusion
Staphylococcus aureus	Gradual onset of productive cough, fever, dyspnea, especially just after viral illness	Purulent; gram-positive cocci in clusters	Patchy, multilobar infiltrate; empyema, lung abscess
Klebsiella pneumoniae	Sudden onset, rigors, dyspnea, chest pain, bloody sputum; especially in alcoholics or nursing home patients	Brown "currant jelly"; thick, short, plump, gram-negative, encapsulated, paired coccobacilli	Upper lobe infiltrate, bulging fissure sign, abscess formation
Pseudomonas aeruginosa	Recently hospitalized, debilitated, or immunocompromised patient with fever, dyspnea, cough	Gram-negative coccobacilli	Patchy infiltrate with frequent abscess formation
Haemophilus influenzae	Gradual onset, fever, dyspnea, pleuritic chest pain; especially in elderly and COPD	Short, tiny, gram-negative encapsulated coccobacilli	Patchy, frequently basilar infiltrate, occasional pleural effusion
Legionella pneumophila	Fever, chills, headache, malaise, dry cough, dyspnea, anorexia, diarrhea, nausea, vomiting	Few neutrophils and no predominant bacterial species	Multiple patchy nonsegmented infiltrates, progresses to consolidation, occasional cavitation and pleural effusion
Moraxella catarrhalis	Indolent course of cough, fever, sputum and chest pain; more common in COPD patients	Gram-negative diplococci found in sputum	Diffuse infiltrates
Chlamydophila pneumoniae	Gradual onset, fever, dry cough, wheezing, occasionally sinus symptoms	Few neutrophils, organisms not visible	Patchy subsegmental infiltrates
Mycoplasma pneumoniae	Upper and lower respiratory tract symptoms, nonproductive cough, bullous myringitis, headache, malaise, fever	Few neutrophils, organisms not visible	Interstitial infiltrates, (reticulonodular pattern), patchy densities, occasional consolidation
Anaerobic organisms	Gradual onset, putrid sputum, especially in alcoholics	Purulent; multiple neutrophils and mixed organisms	Consolidation of dependent portion of lung; abscess formation

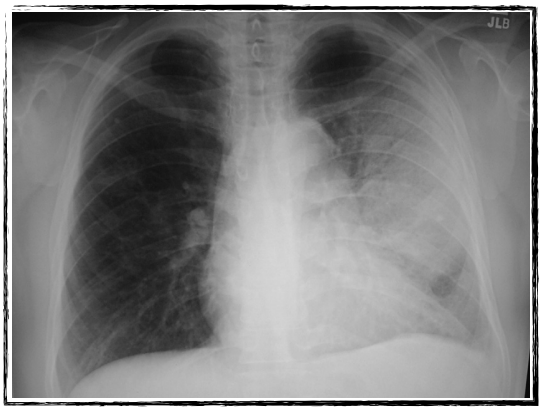
Signs:

- Fever / tachypnoea / hypoxia / tachycardia
- Inspiratory rales / crepitations / wheezing
- Bronchial breath sounds (ie. consolidation)
- Dullness / Decreased breath sounds (ie. pleural effusion)

Diagnostic Strategies:

Radiology:

- CXR
  - *usu. reserved for those w/ abnormal vital signs or lung examination)*
  - *usu. 24-48 hrs behind clinical picture.*



Changes include:

- Segmental vs sub-segmental vs interstitial infiltrates
- Air bronchograms
- Pleural effusions.
- Cavitations / abscesses.

- CT-CHEST
  - Greater sensitivity than CXR.

Laboratory Studies:

- WCC
  - > 15,000: increases probability of having a pyogenic bacterial aetiology.
  - Neutopaenia - yields evidence of immunosuppression.
- Electrolytes
  - Identifies underlying / concomitant renal or hepatic disease
  - Identifies metabolic acidosis. ??Associated sepsis.
- Sputum culture / gram-stain
  - Rarely changes therapy or patient outcome.
- Blood culture
  - Obtain in those w/ immunosuppression, severe sepsis or septic shock, or those with risk factors for endovascular infection (IVDU, prosthetics valves).
  - Of no value in *non-immunocompromised* adults.
- Pleural fluid aspiration
  - Saved for those with severe respiratory distress or tension physiology.
    - Otherwise deferred to inpatient team.
  - Cell count / differential / pH / gram stain / culture.
  - pH < 7.2 predicts need for thoracostomy tube.
- Serology / Urinary Antigens
  - May be helpful retrospectively, but of little use in ED.

Differential Diagnosis:

Inflammatory processes:

- Silicosis
- Chemical fumes (Chlorine / ammonia)
- Toxic drugs (bleomycin)
- Radiation
- Thermal injury

Immunological diseases:

- Sarcoidosis
- Good Pasture's

Others:

- CCF / Pulmonary Oedema
- Aspiration
- Hypersensitivity (Farmer's lung)
- Tumours / Lymphangitic spread

a little on Aspiration:
It is important to recognise the distinction between the acute aspiration of gastric contents (or other liquids) and bacterial pneumonia that may develop later as a complication of aspiration.

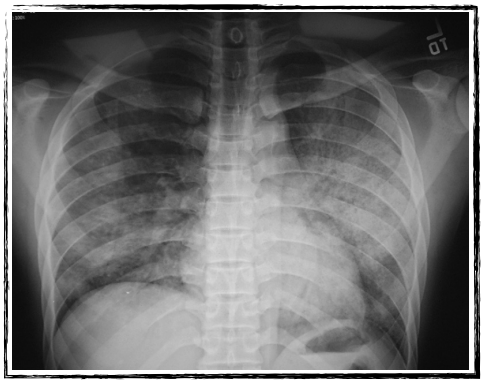
Aspiration disrupts surfactant and causes an inflammatory response that may lead to hypoxia and respiratory failure. This can lead to fever, leukocytosis, purulent sputum and radiographic infiltrates which mimics pneumonia.

Prophylactic administration with antibiotics remains controversial. Systemic corticosteroids have no benefit.

HIV-associated Pneumonia:
The approach to HIV-infected patients w/ respiratory complaints must consider the likelihood of *opportunistic lung infections*.

In addition of *Pneumocystis,* there is increased incidence of pneumonia due to *M. tuberculosis,* pneumococcus and *H. influenzae.* Other less important causes in HIV-patients include *mycobacterium avium* complex, CMV, aerobic gram-negative bacilli & *cryptococcus* species.

The potential for opportunistic infections can be predicted by an absolute CD4 count of < 200/mm^3.



Features of PCP:

- Subacute onset productive cough.
- Fever.
- Dyspnoea & hypoxia.
- Diffuse interstitial infiltrates on CXR.
- Raised serum LDH

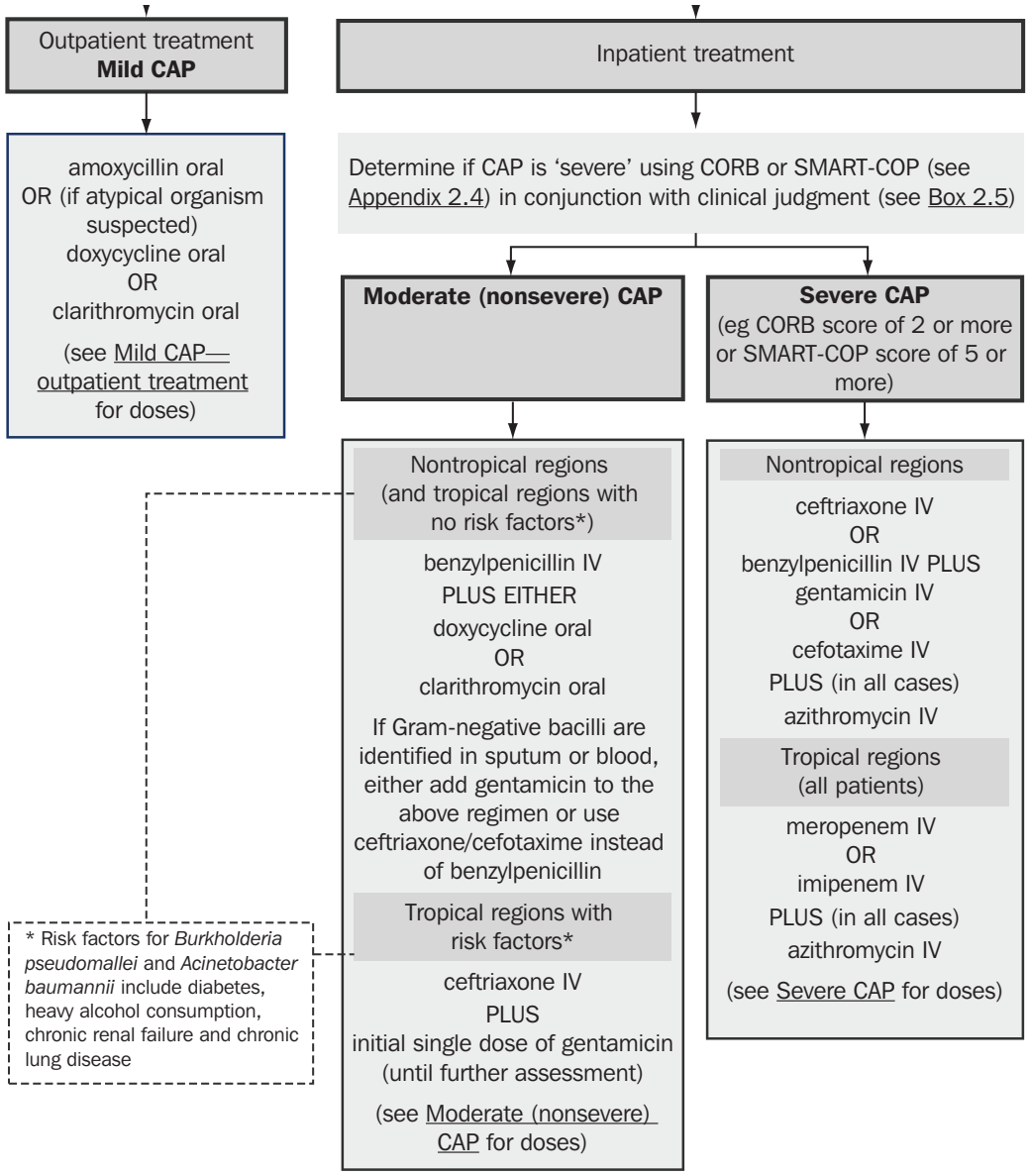
Subacute presentations of PCP (more common) is characterised by nonproductive cough, exertional dyspnoea and weight loss, associated with tachypnoea and tachycardia.

Management:

- Consider *ISOLATION / PPE* (masks).
    - esp. if risk factors or investigations point towards *TB, influenza, VZV*.
- *Respiratory support*
    - Supplemental oxygen (+/- intubation & mechanical ventilation)
- *Haemodynamic support*
    - Fluids / Inotropes / Early goal directed therapy.

- *ANTIMICROBIALS*.
    - Timely administration is associated w/ better outcomes.
    - ABx is empirical & selection should be based on Hx, Ix and local epidemiological data & resistance patterns.

Empiric Antibiotic Therapy: suggested by Therapeutic Guidelines.



Special Cases:

- Health care-associated pneumonia requires ABx coverage for:
  - *Pseudomonas* = Fluoroquinolones (Ciprofloxacin, Moxifloxacin) PLUS *imipenem / meropenem* OR *piperacillin-tazobactam.*
  - *MRSA* = Vancomycin, Linezolid, TMP-SMX, tigecycline.
- AIDS:
  - Add *Trimethoprim-Sulfamethoxazole* (for PCP).
  - Addition of steroids reduces mortality & clinical deterioration in patients w/ PaO_2 < 70mmHg or A-a gradient > 35 mmHg.
- Aspiration:
  - Metronidazole, piperacillin-tazobactam, moxifloxacin.
- Influenza positive rapid antigen testing = consider *oseltamivir.*

Disposition:

There is tremendous variability in physician admission decisions for pneumonia, with a common tendency to overestimate disease severity. Whilst there are no firm guidelines for hospital admission, a scoring system may assist in hospitalisation decisions.

Commonly used scoring systems include:

- Pneumonia Severity Index (PSI).
    - Cumbersome. Weighted heavily upon age & comorbidities.

- CURB-65.

> C = confusion
> U = uraemia (> 7 mmol/L)
> R = respiratory rate > 30/min
> B = blood pressure (< 90 mmHg systolic OR < 60 mmHg diastolic)
> 65 = age over 65 years.
>
> Scores of 0-1 = outpatient therapy, whereas 2+ = admit.

- SMART-COP
    - Assesses risk of requiring intensive respiratory or vasopressor support.

50 years old or less			more than 50 years old		
S	systolic BP less than 90 mm Hg	2 points	**S**	systolic BP less than 90 mm Hg	2 points
M	multilobar CXR involvement	1 point	**M**	multilobar CXR involvement	1 point
A	albumin less than 35 g/L	1 point	**A**	albumin less than 35 g/L	1 point
R	respiratory rate 25 br/min or more	1 point	**R**	respiratory rate 30 br/min or more	1 point
T	tachycardia 125 bpm or more	1 point	**T**	tachycardia 125 bpm or more	1 point
C	confusion (acute)	1 point	**C**	confusion (acute)	1 point
O	oxygen low PaO_2 less than 70 mm Hg, or O_2 saturation 93% or less, or PaO_2/FiO_2 less than 333	2 points	**O**	oxygen low PaO_2 less than 60 mm Hg, or O_2 saturation 90% or less, or PaO_2/FiO_2 less than 250	2 points
P	pH less than 7.35	2 points	**P**	pH less than 7.35	2 points

Interpretation of SMART-COP score

0 to 2 points—low risk of needing intensive respiratory or vasopressor support (IRVS)

3 to 4 points—moderate risk (1 in 8) of needing IRVS

5 to 6 points—high risk (1 in 3) of needing IRVS

7 or more points—very high risk (2 in 3) of needing IRVS