Community acquired pneumonia and treatment options

• 6 mechanisms in pathogenesis of pneumonia – (inhalation, aspiration, direct inoculation, reactivation, defects in pulmonary defenses, blunted cellular or humoral immune response)
• In general, clinical presentation: pleuritic chest pain, fever, cough, decreased breath sounds, dull to percussion, egophony

• Classified as “typical” or “atypical” or viral
  • Typical = S. pneumoniae, H. influenza, S. aureus, enteric gram negative bacteria. More segmental or lobar infiltrate.
  • Atypical = Mycoplasma, Legionella, Chlamydia pneumonia. More diffuse infiltrate. Sputum gram stain usually negative.

• Empiric treatment prior to susceptibility testing- cover S. pneumoniae, S. aureus, H. influenzae. Give amoxicillin-clavulanate, and 2nd or 3rd generation cephalosporin, or respiratory fluoroquinolone (3rd and 4th generation).
CAP patient characteristics

• Smokers: S. pneumo, H. influenzae, Moraxella
• Post viral bronchitis: S. pneumo
• No co-morbidity: atypicals, viral
• Alcoholic: S. pneumo, anaerobes
• IV drug user: S. aureus
• Epidemic: Legionnaire’s
• Airway obstruction: anaerobes
• Animals: Psittacosis, Tularemia, Coxiella burnetii
Mechanisms of action of different antimicrobials

- **Penicillins**- Inhibits the transpeptidase enzyme step in peptidoglycan cell wall synthesis
  
  1\(^{st}\) generation: [ex Pen G] most streptococci, oral anaerobic coverage
  
  2\(^{nd}\) generation: [nafcillin] most streptococci, S. aureus (Penicillinase resistant)
  
  3\(^{rd}\) generation: [amoxicillin, ampicillin] most streptococci, basic G – coverage.
  
  Amoxicillin is oral DOC for susceptible strains of S. pneumoniae
  
  Amoxicillin with clavulanate treats beta lactamase producing bacteria like H. influenzae, Methicillin sensitive Staph aureus and anaerobes
  
  4\(^{th}\) generation: [piperacillin] extended spectrum, includes pseudomonas

- **Cephalosporins**- inhibits cell wall synthesis
  
  Parenteral DOC for CAP caused by susceptible strains of S pneumoniae, H influenzae, Staph aureus.
  
  1\(^{st}\) generation: G+ (including Staph aureus), basic G-
  
  2\(^{nd}\) generation: G+, diminished Staph aureus, improved G- coverage, some anaerobic coverage
  
  3\(^{rd}\) generation: further diminished S. aureus, further improved G-, some Pseudomonal coverage and diminished G+ coverage
  
  4\(^{th}\) generation: same as 3\(^{rd}\) plus coverage against Pseudomonas

**note that neither group is effective against “atypicals”**
• **Macrogldes**- inhibits 50s subunit of ribosome in protein synthesis
  Treats mycoplasma, legionnaire’s, chlamydial infections
  Active against most common pathogens and atypical agents. Macroglide resistance is emerging to Strep pneumoniae

• **Fluoroquinolones**- inhibits DNA gyrase
  Broad spectrum against likely agents of CAP. Active against penicillin resistant Strep pneumoniae. Resistance developing.
  1\textsuperscript{st} generation: G- NOT pseudomonas, UTI only, NO atypicals
  2\textsuperscript{nd} generation: G- including pseudomonas, S. aureus, some atypicals NOT pneumococcus
  3\textsuperscript{rd} generation: G-, G+, expanded atypicals
  4\textsuperscript{th} generation: same as 3\textsuperscript{rd} plus enhanced coverage of pneumococcus, decreased activity vs pseudomonas.

• **Tetracyclines**- inhibits 30s subunit of ribosome in protein synthesis
  G+ and G-, aerobic & anaerobic bacteria, “atypicals”- mycoplasma, chlamydia and category A bioterrorism agents
Streptococcus pneumoniae  
(2/3 of CAP cases)

• **Properties**: G + diplococci “lancet shaped”, α hemolytic.  
  #1 cause CAP: “rusty sputum”, single rigor, fever.

• **Tx and dose:**  
  sensitive strains treat with penicillin G 250,000-400,000 units/kg/day IV divided q 4-6 or amoxicillin (oral) 1g PO tid.  
  intermediate resistance strains are susceptible to 2\textsuperscript{nd}/3\textsuperscript{rd} generation parenteral cephalosporins and respiratory fluoroquinolones  
  Cefotaxime 1-2g IM/IV q6-8 or ceftriaxone1-2 g IM/IV q24h.  
  Levofloxicin 500mgIV/po qd (others: alatrofox-, gati-, moxi-)  

• **Prevention**: capsular vaccines (prevnar, pneumovax)
• **H. influenzae**
trimethoprim-sulfamethoxazole, Ampicillin IV, Amoxicillin po, azithro/clarithromycin, doxycycline
If severe, 3rd gen cephalosporin

• **Enteric gram negatives**
Anaerobes: clindamycin or beta lactam/beta lactamase inhibitor

• **Staph aureus**
Sensitive strains: Nafcillin or oxacillin (penicillinase resistant abx)
MRSA- Vancomycin

• **Atypicals**
Legionella- fluoroquinolone or azithromycin
Mycoplasma- erythro, azithro, clarithromycin, or fluoroquinolone
Chlamydia pneumoniae- doxycycline, erythrocyclin or fluoroquinolones
Duration of therapy

- S pneumoniae: until afebrile for 3-5d
- C pneumoniae: 7-14 d
- M pneumoniae: not well established.
- Legionella: 10-21 d
- S aureus, P aeruginosa, Klebsiella, anaerobes >3weeks