2015 Updates in Therapeutics:
The Pharmacotherapy Preparatory Review & Recertification Course
Infectious Diseases
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Conflict of Interest Disclosures

Curtis Smith, Pharm.D.

– I have no conflicts of interest related to this presentation.
Learning Objectives

- Describe appropriate treatment of patients with respiratory tract infections, urinary tract infections, central nervous system infections, skin and soft tissue infections, osteomyelitis, intra-abdominal infections, and endocarditis.
- Identify appropriate preventive therapy for respiratory tract infections, central nervous system infections, endocarditis, and surgical wound infections.
Agenda

- Respiratory Tract Infections
- Urinary Tract Infections
- Central Nervous System Infections
- Skin and Soft Tissue Infections
- Osteomyelitis
- Intra-abdominal Infections
- Endocarditis
- Clostridium difficile Infection
- Surgical Prophylaxis
Respiratory Tract Infections - Pneumonia

- RL is a 68 year old male
- Chief complaint: cough and shortness of breath
- HPI: Symptoms began 4 days ago and have worsened over the last 24 hours. He is coughing up yellowish-green sputum and complains of chills with a fever to 102.4°F
- PMH: CAD with an MI 5 years ago, CHF, hypertension and osteoarthritis.
Pneumonia

- SH: rarely drinks alcohol; quit smoking
- Meds on admission: lisinopril 10mg daily, hydrochlorothiazide 25mg daily and acetaminophen 650mg QID.
- PE: alert and oriented - VS: Temp 101.8°F, HR 100, RR 24, BP 142/94.
- Labs: nl except BUN=32 mg/dl (Scr=1.23 mg/dl).
- Blood gases: pH 7.44, pCO₂ 35, pO₂ 82, O₂ sat 90%.
- Sputum specimen is not available.
Pneumonia

- Community-acquired
  - RL symptoms: cough/sputum, SOB, chills, fever
  - Potential for complicated course:
    - > 65, comorbid illnesses, high fever
    - CURB-65 score = 2 (Tables 1 and 2, pg 317)
  - Most common organisms
    - *S. pneumoniae*
    - *M. pneumoniae*
    - *H. influenzae*
Pneumonia

Which is the best empiric therapy for RL?

A. Ampicillin/sulbactam 1.5g IV q6h

B. Piperacillin/tazobactam 4.5g IV q6h plus gentamicin 180mg IV q12h

C. Ceftriaxone 1g IV q24h plus azithromycin 500mg IV daily

D. Doxycycline 100mg IV q12h
Pneumonia

- Community-acquired - Outpatient Therapy
  - Previously healthy / No antibiotics in 3 months
    - Macrolide (clarithromycin or azithromycin)
    - Doxycycline
  - Comorbidities / Antibiotics in 3 months
    - Fluoroquinolone (levo- 750mg, moxi-, gemi-)
    - Macrolide (or doxycycline) with high-dose amoxicillin (1g TID) or amoxicillin/clavulanate (2g BID) or cephalosporin (ceftriaxone, cefotaxime, cefpodoxime)
Pneumonia

Community-acquired (Moderately severe) – Inpatient Therapy

- Fluoroquinolone (levo- 750mg, moxi-, gemi-)
- Macrolide (or doxycycline) plus 3rd generation cephalosporin
- Macrolide (or doxycycline) plus ampicillin
- Macrolide (or doxycycline) plus ertapenem
Pneumonia

- Community-acquired (Severe) – Requiring ICU Therapy
  - ampicillin/sulbactam plus a respiratory fluoroquinolone or azithromycin
  - 3rd generation cephalosporin plus a respiratory fluoroquinolone or azithromycin
  - may also need broader antibacterial activity
  - MRSA empirical therapy:
    - ICU admission
    - Necrotizing or cavitary infiltrates
    - Empyema
Pneumonia

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B. Piperacillin/tazobactam 4.5g IV q6h plus gentamicin 180mg IV q12h

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C. Ceftriaxone 1g IV q24h plus azithromycin 500mg IV daily

D. Doxycycline 100mg IV q12h
Pneumonia

- BP is a 66 year old female
- HPI: CABG x2 8 days ago; now on ventilator in ICU. She is spiking temps and a tracheal aspirate shows many WBCs and Gram-negative rods.
- PMH: CAD with an MI 2 years ago, COPD, and hypertension.
Which is the best empiric therapy for BP?

A. Ceftriaxone 1 g IV daily plus gentamicin 480 mg IV every 24 hours plus linezolid 600mg IV q12h

B. Piperacillin/tazobactam 4.5g IV every 6 hours

C. Levofloxacin 750 mg IV daily plus linezolid 600mg IV q12h

D. Cefepime 2 g IV every 12 hours plus tobramycin 480 mg IV every 24 hours plus vancomycin 15 mg/kg IV q12h
Pneumonia

- Nosocomial pneumonia
  - Hospital-acquired pneumonia
  - Ventilator-associated pneumonia
  - Health-care associated pneumonia:
    - Hospitalized ≥ 2 days within 90 days
    - Residence in a nursing home or LTC facility
    - IV antibiotic or chemotherapy or wound care within the past 30 days
    - Attended a hospital or hemodialysis clinic
Pneumonia

- Nosocomial pneumonia
  - Risk factors in BP
    - Mechanical ventilation
    - Recent CABG
    - ICU stay/Prolonged hospitalization
    - Elderly
    - Underlying chronic lung disease
  - Gram-negative organisms and *S. aureus* predominate

317, 318
Pneumonia

- Nosocomial pneumonia
  - Risk factors for MDR organisms
    - Antibiotic therapy within the last 90 days
    - Hospitalization ≥ 5 days
    - High resistance in community or hospital unit
    - Risk factors for health-care associated pneumonia (recent hospitalization, nursing home, IV antibiotic or chemotherapy, home wound care, attend hospital or hemodialysis clinic)
    - Family member with MDR pathogen
    - Immunosuppressive disease and/or therapy
Pneumonia

- Nosocomial pneumonia – Early onset (< 5 days) and no risk factors for MDR organisms
  - Third-generation cephalosporin (ceftriaxone)
  - Fluoroquinolone (levo-, moxi-, cipro-)
  - Ampicillin-sulbactam
  - Ertapenem
Pneumonia

- Nosocomial pneumonia – Late onset ($\geq 5$ days) or risk factors for MDR organisms
  - Ceftazidime or cefepime plus aminoglycoside or fluoroquinolone (cipro-, levo-)
  - Imipenem or meropenem or doripenem plus aminoglycoside or fluoroquinolone (cipro-, levo-)
  - Piperacillin-tazobactam plus aminoglycoside or fluoroquinolone (cipro-, levo-)
  - Vancomycin or linezolid - if methicillin-resistant *S. aureus* (MRSA) is strongly suspected
    - history of MRSA infection/colonization, recent hospitalization or antibiotics, or presence of invasive health-care devices; or there is a high incidence locally (>10-15%).
Which is the best empiric therapy for BP?

A. Ceftriaxone 1 g IV daily plus gentamicin 480 mg IV every 24 hours plus linezolid 600 mg IV q12h

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D. Cefepime 2 g IV every 12 hours plus tobramycin 480 mg IV every 24 hours plus vancomycin 15 mg/kg IV q12h
Respiratory Tract Infections

What vaccinations would you recommend?

A. BP does not need any vaccinations

B. BP should receive pneumococcal now and influenza vaccine in the fall

C. BP should receive influenza in the fall but due to her current infection pneumococcal vaccine is not needed

D. BP should receive pneumococcal now but influenza vaccine is not needed
Influenza

- Epidemiology
- Cold or the flu?
- Pathophysiology
- Therapy / Prevention
  - amantadine, rimantadine
  - oseltamivir, zanamivir
Respiratory Tract Infections

- Vaccinations
  - Pneumococcal vaccines (PPSV23 / PCV13)
    - Persons aged $\geq 65$ years (PCV13 + PPSV23)
    - Persons 2-64 with chronic diseases (PPSV23)
    - Persons 18-64 who smoke or have asthma (PPSV23)
    - Persons 2-64 living in special environments (PPSV23)
    - Immunocompromised patients (PCV13 + PPSV23)
    - Persons 2-64 who are asplenic (PCV13 + PPSV23)
  - Influenza vaccine
    - Everyone older than 6 months should receive the vaccine annually

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# Respiratory Tract Infections

## Influenza Vaccines

<table>
<thead>
<tr>
<th>Influenza Vaccine</th>
<th>Indications</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inactivated influenza vaccine trivalent (IIV3, multiple brands)</td>
<td>6 months and older</td>
<td>Primary influenza vaccine</td>
</tr>
<tr>
<td></td>
<td></td>
<td>CDC has no preference for any other over IIV3</td>
</tr>
<tr>
<td>Influenza Vaccine Indications Notes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Inactivated influenza vaccine quadrivalent (LAIV4, FluMist)</td>
<td>2–49 years without underlying illnesses</td>
<td>Do not use in pregnant women</td>
</tr>
<tr>
<td></td>
<td>*recommended in 2-8 year olds</td>
<td>Do not use in household members, health care workers, and others who have close contact with severely immunosuppressed</td>
</tr>
<tr>
<td>High-dose trivalent influenza vaccine (high-dose Fluzone)</td>
<td>65 years and older</td>
<td>CDC has no preference for using this vaccine over the regular influenza vaccine.</td>
</tr>
<tr>
<td>Inactivated influenza vaccine quadrivalent (IIV4, Fluzone, Fluarix)</td>
<td>6 months and older</td>
<td>CDC has no preference for using this vaccine over the regular influenza vaccine.</td>
</tr>
<tr>
<td>Intradermal inactivated Influenza vaccine trivalent (IIV3, Fluzone intradermal)</td>
<td>18-64 years</td>
<td>Much smaller needle, but local reactions are significantly greater than the IM vaccines.</td>
</tr>
<tr>
<td>Inactivated influenza vaccine trivalent - cell culture based (IIV3, Flucelvax)</td>
<td>18 years and older</td>
<td>Grown in mammalian cell lines; exposed to eggs early in production – caution if egg allergic</td>
</tr>
<tr>
<td>Recombinant inactivated influenza vaccine trivalent (RIV3, FluBlok)</td>
<td>18 years and older</td>
<td>Produced by recombinant technology; safe for patients with egg allergies.</td>
</tr>
</tbody>
</table>
Respiratory Tract Infections

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Resp. Tract Infections - Sinusitis

- Diagnosis – viral vs. bacterial
- Treatment
  - First line therapy
    - Amoxicillin/clavulanate (regular or high dose)
  - Second line therapy
    - Respiratory fluoroquinolone
    - Doxycycline
    - Cefixime or cefpodoxime with clindamycin
  - Duration of therapy
    - Adults: 5-7 days
    - Children: 10-14 days

325, 326
Urinary Tract Infections

- GN is a 62 year old female
- Chief complaint: 3 day history of urinary frequency and dysuria.
- HPI: Over the last 24 hours she has had nausea, vomiting and flank pain.
- PMH: Type 2 DM, HTN, multiple DVTs
- Meds on admission: glyburide 5mg po daily, enalapril 10mg po BID, warfarin 3mg po daily and metoclopramide 10mg po QID.
Urinary Tract Infections

- PE: alert and oriented - VS: Temp 102.8°F, HR 120, RR 16, BP lying down: 140/75, standing 110/60.
- Labs: Normal except INR=2.7, BUN=26 mg/dl, Scr=1.88 mg/dl and WBC = 12,000/mm³.
- UA: turbid, 2+ glucose, pH 7.0, protein 100 mg/dl, 50-100 WBC, + nitrites, 3-5 RBC, bacteria and casts.
Urinary Tract Infections

How should GN be treated?

A. TMP/SMZ DS po BID for 7 days

B. Ciprofloxacin 400mg IV BID then 500mg po BID for 10 days

C. Gentamicin 140mg IV q24h for 3 days

D. Tigecycline 100 mg once, then 50 mg every 12 hours and then doxycycline 100 mg 2 times/day for 10 days.
Community-acquired UTI organisms

- K. pneumoniae
- P. mirabilis
- Enterococcus
- S. saprophyticus
- E. coli
Urinary Tract Infections

- **Nosocomial UTI organisms**

  - Fungi
  - Enterococcus
  - *P. mirabilis*
  - *S. aureus*
  - *K. pneumoniae*
  - Other Gram-negative
  - *E. coli*
  - *P. aeruginosa*
Urinary Tract Infections

- Predisposing factors in GN:
  - age
  - female
  - diabetes mellitus

- Cystitis vs. Pyelonephritis
  - Symptoms: dysuria, frequency and urgency only vs. these symptoms plus nausea, vomiting, flank pain, fever, increased WBC, casts
Factors associated with complicated UTIs:

- Male sex
- Hospital-acquired
- Pregnancy
- Anatomical abnormality of the urinary tract
- Childhood urinary tract infection
- Recent antimicrobial use
- Diabetes
- Indwelling urinary catheter
- Recent urinary tract instrumentation
- Immunosuppression
Urinary Tract Infections

- Acute uncomplicated cystitis
  - TMP/SMZ* 3 days
  - Nitrofurantoin 5 days
  - Fosfomycin 1 dose

Alternatives:
- Fluoroquinolones 3 days
- Beta lactams 3-7 days

* avoid if resistance prevalence is known to exceed 20% or if used for UTI in previous 3 months
## Urinary Tract Infections

- **Acute uncomplicated pyelonephritis**
  - **Fluoroquinolone**
    - If uropathogen resistance > 10% use initial dose of long acting beta lactam or once daily aminoglycoside
  - **TMP/SMZ**
    - If sensitivities unknown use initial dose as listed above
  - **Beta lactam**
    - Less effective – use initial dose as listed above

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fluoroquinolone</td>
<td>5-7 days</td>
</tr>
<tr>
<td>TMP/SMZ</td>
<td>14 days</td>
</tr>
<tr>
<td>Beta lactam</td>
<td>10-14 days</td>
</tr>
</tbody>
</table>
Urinary Tract Infections

- Complicated UTIs
  - Fluoroquinolone
  - Aminoglycoside
  - Extended spectrum beta lactam (penicillin, cephalosporin, carbapenem)  
  
- Pregnancy
  - Amoxicillin
  - Nitrofurantoin
  - Cephalexin

5-14 days

7 days
Urinary Tract Infections

How should GN be treated?

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B. Ciprofloxacin 400mg IV BID then 500mg po BID for 10 days

C. Gentamicin 140mg IV q24h for 3 days

D. Tigecycline 100 mg once, then 50 mg every 12 hours and then doxycycline 100 mg 2 times/day—duration of antibiotics: 10 days.
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D. Tigecycline 100 mg once, then 50 mg every 12 hours and then doxycycline 100 mg 2 times/day—duration of antibiotics: 10 days.
Urinary Tract Infections

- Catheter-related UTIs
  - short-term indwelling catheters
  - long-term indwelling catheters

- Prostatitis
  - acute
  - chronic

- Epididymitis
Skin and Skin Structure Infections

- **Cellulitis**
  - *S. pyogenes, S. aureus* (MRSA empirical therapy if penetrating trauma, especially from illicit drug use, purulent drainage, or with concurrent evidence of MRSA infection elsewhere)

- **Erysipelas**
  - *S. pyogenes*

- **Necrotizing fasciitis**
  - Streptococcal
  - Mixed - includes anaerobes

- **Shingles vaccine (Zostavax®)**
Diabetic Foot Infections

- GN now has right foot ulcer
- Ulcer: red, swollen, deep - ? osteomyelitis

Which organism(s) is (are) responsible?

A. S. pyogenes
B. P. aeruginosa
C. S. aureus
D. Polymicrobial with Gm+, Gm- and anaerobes
Diabetic Foot Infections

- Due to neuropathy, vasculopathy, and immunologic defects
- Generally polymicrobial
- Preventative therapy:
  - examine feet
  - wear proper shoes
  - no barefoot walking
  - keep feet clean and dry
  - have toenails cut properly
Diabetic Foot Infections

- GN now has right foot ulcer
- Ulcer: red, swollen, deep - ? osteomyelitis

Which organism(s) is (are) responsible?

A. *S. pyogenes*

B. *P. aeruginosa*

C. *S. aureus*

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Diabetic Foot Infections

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Which organism(s) is (are) responsible?

A. S. pyogenes
B. P. aeruginosa
C. S. aureus
D. Polymicrobial with Gm+, Gm- and anaerobes
Diabetic Foot Infections

Which is the best empiric therapy for GN?

A. Nafcillin 2g IV q6h for 6-12 weeks

B. Tobramycin 120mg IV q12h plus levofloxacin 750mg IV daily for 1-2 weeks

C. Ampicillin/sulbactam 3g IV q6h for 2-3 weeks

D. BKA followed by ceftriaxone 1g IV q24h for 1 week
Diabetic Foot Infections

- **Mild**
  - No MRSA risk factors – treat like cellulitis
  - MRSA risk factors – doxycycline or TMP/SMZ

- **Moderate to Severe**
  - Broad-spectrum agents
  - Add MRSA or Pseudomonas activity if necessary

- **Duration**
  - Mild to moderate: 1-2 weeks
  - Severe: 2-3 weeks
  - Osteomyelitis: greater than 4 weeks

- **Surgical therapy**
Diabetic Foot Infections

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D. BKA followed by ceftriaxone 1g IV q24h for 1 week

333 (356)
Osteomyelitis

- WA is a 55 year old male
- Chief complaint: weight loss, malaise and severe back pain and spasms that have progressed over the last 2 months; LE loss of sensation
- PMH: 4 months PTA – surgery for fractured tibia and subsequent infection; also has hypertension and diverticulitis
- PE: alert and oriented - VS: Temp 99.4 °F, HR 88, RR 14, BP 130/85
Osteomyelitis

- Labs: WNL. WBC = 14,300, ESR = 89 mm/hr and C-reactive protein = 12 mg/dL.
- MRI: bony destruction of the lumbar vertebrae 1 and 2. Confirmed by a bone scan.
- CT guided bone biopsy growing Gram-positive cocci in clusters.
Osteomyelitis

How should WA be treated?

A. Vancomycin 15 mg/kg IV every 12 hours; total antibiotic duration 6 weeks

B. Nafcillin 2 g IV every 6 hours; total antibiotic duration 2 weeks

C. Levofloxacin 750mg oral daily; total antibiotic duration 6 weeks

D. Ampicillin/sulbactam 3g IV every 6 hours; total antibiotic duration 2 weeks
Osteomyelitis

- Hematogenous spread
  - Primarily children (adults – vertebrae)
  - Risk factors: bacteremia, sickle cell disease
  - Organisms: usually monomicrobial
    - Children: *S. aureus*
    - Adult: *S. aureus*
    - Sickle cell: *Salmonella, S. aureus*
    - IV drug users: *Pseudomonas*
Osteomyelitis

- Contiguous spread
  - Primarily adults
  - Risk factors: ORIF, GSW, dental and soft tissue infections
  - Organisms: usually mixed
    - *S. aureus*
    - Other Gram positive (*S. epidermidis*, Strep)
    - Gram negative rods
    - Anaerobes
Osteomyelitis

- Vascular insufficiency
  - Adults
  - Risk factors: DM, PVD
  - Organisms: usually polymicrobial
    - *S. aureus*, *S. epidermidis*, *Streptococcus*, Gram negative rods, anaerobes
Osteomyelitis

- WA presentation / clinical findings:
  - Risk factors: recent surgery and infection
  - S/S: Lower back pain, loss of sensation
  - Labs: elevated WBC, ESR and CRP
  - Bone changes on MRI and positive bone scan

335, 336
Osteomyelitis

- Neonates < 1 month
  - Nafcillin plus cefotaxime OR
  - Nafcillin plus an aminoglycoside
- Infant (1-36 months)
  - Cefuroxime
  - Ceftriaxone
  - Nafcillin plus cefotaxime
- Pediatric (> 3 years)
  - Nafcillin or cefazolin or clindamycin
Osteomyelitis

- Adult
  - Nafcillin or cefazolin or vancomycin
  - Choose additional antibiotics based on patient specific characteristics
- Sickle cell anemia patients
  - Ceftriaxone / cefotaxime or ciprofloxacin / levofloxacin
- Prosthetic joint infections
  - Vancomycin plus rifampin or nafcillin plus rifampin
Osteomyelitis

- Length of therapy
  - Acute osteomyelitis
    - 4-6 weeks
  - Chronic osteomyelitis
    - 6-8 weeks of parenteral therapy and 3-12 months of oral therapy
Osteomyelitis

How should WA be treated?

A. Vancomycin 15 mg/kg IV every 12 hours; total antibiotic duration 6 weeks

B. Nafcillin 2 g IV every 6 hours; total antibiotic duration 2 weeks

C. Levofloxacin 750mg oral daily; total antibiotic duration 6 weeks

D. Ampicillin/sulbactam 3g IV every 6 hours; total antibiotic duration 2 weeks
Osteomyelitis

How should WA be treated?

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B. Nafcillin 2 g IV every 6 hours; total antibiotic duration 2 weeks

C. Levofloxacin 750mg oral daily; total antibiotic duration 6 weeks

D. Ampicillin/sulbactam 3g IV every 6 hours; total antibiotic duration 2 weeks
CNS Infections

- DM is a 21 year old male
- Chief complaint: worst headache of his life; pain with neck movement
- PMH: none
- PE: extreme pain 10/10 - VS: Temp 102.4 °F, HR 110, RR 18, BP 130/75
CNS Infections

- Labs: WNL. WBC = 22,500/mm$^3$ (82 polys, 11 bands, 5 lymphs, 2 monos).

- LP: Glucose = 44 mg/dl (peripheral = 110), protein = 220 mg/dl, and WBC = 800/mm$^3$ (85% neutrophils, 15% lymphocytes).

- Gram stain shows abundant Gram negative cocci.
# CNS Infections

## Meningitis - Etiology

<table>
<thead>
<tr>
<th>Age</th>
<th>Most likely organisms</th>
<th>Less common organisms</th>
</tr>
</thead>
<tbody>
<tr>
<td>Newborns (&lt; 1 month)</td>
<td><em>Streptococcus agalactiae</em>, <em>Listeria monocytogenes</em>, <em>S. pneumoniae</em>, <em>N. meningitidis</em></td>
<td><em>E. coli</em>, <em>Klebsiella sp.</em>, <em>Herpes simplex type 2</em></td>
</tr>
<tr>
<td>1 mo.- 2 years</td>
<td><em>S. pneumoniae</em>, <em>N. meningitidis</em>, <em>H. influenzae</em>, <em>Streptococcus agalactiae</em></td>
<td><em>Viruses</em>, <em>E. coli</em></td>
</tr>
<tr>
<td>2-50 years</td>
<td><em>N. meningitidis</em>, <em>S. pneumoniae</em></td>
<td><em>H. influenzae</em>, <em>Viruses</em></td>
</tr>
<tr>
<td>&gt; 50 years</td>
<td><em>S. pneumoniae</em>, <em>N. meningitidis</em>, <em>H. influenzae</em></td>
<td><em>L. monocytogenes</em>, <em>S. agalactiae</em>, <em>aerobic gram-negative bacilli</em>, <em>viruses</em></td>
</tr>
</tbody>
</table>
Meningitis

- Clinical Presentation
  - Symptoms in DM
    - Fever
    - Headache, nuchal rigidity
  - Lumbar puncture

<table>
<thead>
<tr>
<th>Component</th>
<th>Normal CSF</th>
<th>Bacterial Meningitis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Glucose</td>
<td>30-70 mg/dl (⅔ peripheral)</td>
<td>&lt; 50 mg/dl (≤0.4 CSF:blood)</td>
</tr>
<tr>
<td>Protein</td>
<td>&lt; 50 mg/dl</td>
<td>&gt; 150 mg/dl</td>
</tr>
<tr>
<td>WBC</td>
<td>&lt; 5/mm³</td>
<td>&gt; 1200/mm³</td>
</tr>
</tbody>
</table>
Meningitis

- **Lumbar Puncture**
  - CSF stains
    - Gram stain (microorganisms)
    - Latex agglutination – high sensitivity, 50-100%, for common organisms; not routinely recommended

- **Laboratory findings**
  - Increased WBC with a left shift
  - Positive CSF Gram stain
  - Positive CSF cultures (positive 75-80% of cases of bacterial meningitis)
Meningitis

How should DM be treated?

A. Penicillin G 4 million units IV every 4 hours plus dexamethasone 4mg IV every 6 hours

B. Ceftriaxone 2g IV every 12 hours

C. Ceftriaxone 2g IV every 12 hours plus dexamethasone 4mg IV every 6 hours

D. Ceftriaxone 2g IV every 12 hours plus vancomycin 1000mg IV every 12 hours
Meningitis

- Neonates < 1 month
  - Ampicillin plus aminoglycoside OR
  - Ampicillin plus cefotaxime

- Infant (1-23 months)
  - 3rd generation cephalosporin (cefotaxime or ceftriaxone) plus vancomycin
Meningitis

- Pediatric and Adult (2-50 years)
  - 3rd generation cephalosporin (cefotaxime or ceftriaxone) plus vancomycin

- Older adults (> 50 years)
  - 3rd generation cephalosporin (cefotaxime or ceftriaxone) plus vancomycin plus ampicillin

- Penetrating head trauma, post neurosurgery or CSF shunt
  - Vancomycin plus cefepime or ceftazidime or meropenem
Meningitis

- Therapy of specific pathogens
  - *S. pneumoniae*
  - *N. meningitidis*
  - *H. influenzae*
  - *Streptococcus agalactiae*
  - *Listeria monocytogenes*

- Length of therapy
  - *N. meningitidis* – 7 days
  - *H. influenzae* – 7 days
  - *S. pneumoniae* – 10-14 days
Adjunctive Corticosteroid Therapy

- Risks versus benefits
  - less hearing loss in children with *H. influenzae*
  - improved outcomes in adults with *S. pneumoniae*
  - may decrease antibiotic penetration

- Dose and administration
  - give 10-20 mins before or same time as antibiotics
  - dexamethasone 0.15 mg/kg q6h for 2-4 days
  - use in children with *H. influenzae* meningitis or adults with pneumococcal meningitis, but may need to initiate before knowing specific causative bacteria.
Meningitis

How should DM be treated?

A. Penicillin G 4 million units IV every 4 hours plus dexamethasone 4mg IV every 6 hours

B. Ceftriaxone 2g IV every 12 hours

C. Ceftriaxone 2g IV every 12 hours plus dexamethasone 4mg IV every 6 hours

D. Ceftriaxone 2g IV every 12 hours plus vancomycin 1000mg IV every 12 hours
Meningitis

How should DM be treated?

A. Penicillin G 4 million units IV every 4 hours plus dexamethasone 4mg IV every 6 hours

B. Ceftriaxone 2g IV every 12 hours

C. Ceftriaxone 2g IV every 12 hours plus dexamethasone 4mg IV every 6 hours

D. Ceftriaxone 2g IV every 12 hours plus vancomycin 1000mg IV every 12 hours
Meningitis

Following diagnosis there is concern regarding prophylaxis. What is the best recommendation?

A. HCPs with close contact should receive rifampin 600mg every 12 hours for 4 doses.

B. Those in dorm and classes should receive rifampin 600mg daily for 4 days

C. Those in ED should receive the meningococcal conjugate vaccine

D. Those in ED should receive rifampin 600mg every 12 hours for 4 doses
Meningitis

- *Neisseria meningitidis*

  - Chemoprophylaxis – for close contacts (household or daycare) and exposure to oral secretions of index case
    - Adults - rifampin 600mg q12h x 4 doses
    - Children - rifampin 10 mg/kg q12h x 4 doses
    - Infants (< 1 month) - rifampin 5 mg/kg q12h x 4 doses
Meningitis

- Neisseria meningitidis
  - Meningococcal conjugate [and polysaccharide] vaccine (lack serogroup B)
    - All young adolescents (11-12 years)
    - College freshman (especially living in dormitories)
    - Military recruits
    - Travel to “meningitis belt”
    - Asplenia (anatomic or functional)
    - Terminal complement component disorder
    - Outbreaks
  - Booster – 5 years later in adolescents and 2 months and every 5 years in asplenic patients

Trumenba® - serogroup B meningococcal vaccine
Meningitis

Following diagnosis there is concern regarding prophylaxis. What is the best recommendation?

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Meningitis

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D. Those in ED should receive rifampin 600mg every 12 hours for 4 doses
Endocarditis

- TS is a 48 year old male
- Chief complaint: fever, chills, nausea/vomiting, anorexia, lymphangitis in his right hand and lower back pain.
- PMH: kidney stones 4 years ago.
- SH: TS is homeless and an IV drug abuser (heroin) for the past year but quit 2 weeks ago.
Endocarditis

- PE: alert and oriented - VS: Temp 100.8°F, HR 114, RR 12, BP 127/78; Cardiac: faint systolic ejection murmur; Ext: right hand is erythematous and swollen.
- Labs: WNL. HIV negative.
- Cultures: Blood culture - MSSA. Two more cultures were drawn that are both now growing Gram-positive cocci in clusters.
- TEE: vegetation on the mitral valve.
Endocarditis

How should TS be managed?

A. Nafcillin IV therapy for 2 weeks

B. Nafcillin IV + rifampin therapy for 6 weeks

C. Nafcillin IV + gentamicin IV therapy for 2 weeks

D. Nafcillin IV for 6 weeks with gentamicin for the first 3-5 days
Endocarditis

- TS presentation / clinical findings:
  - Risk factors: IV drug use
  - Fever, chills, low back pain
  - PE: low-grade fever, cardiac murmur
  - Positive blood culture
Endocarditis

- Causative organisms

- Streptococci
- Enterococci
- S. aureus
- Coag-neg Staph
- C. albicans
- Other
**Endocarditis**

- **Viridans *Streptococci***
  - penicillin G (± gentamicin)
  - ceftriaxone (± gentamicin)
  - vancomycin

* treatment is for 2-4 weeks (gentamicin allows for shorter course of therapy)
* treatment is for 6 weeks with prosthetic valve
Endocarditis

- Methicillin sensitive *S. aureus*
  - oxacillin or nafcillin (± gentamicin)
  - cefazolin (± gentamicin)
  - vancomycin

- Methicillin resistant *S. aureus*
  - vancomycin
  - daptomycin – native valve only
  * treatment is for 6 weeks (gentamicin for first 3-5 days decreases bacterial load)
  * treatment is for ≥ 6 weeks plus gentamicin for 2 weeks in prosthetic valves – also add rifampin
Endocarditis

- Enterococci
  - penicillin G or ampicillin plus streptomycin or gentamicin
  - vancomycin plus streptomycin or gentamicin

* treatment is for 4-6 weeks
* treatment is for 6 weeks in prosthetic valves
* streptomycin or gentamicin must be given due to inherent resistance
Endocarditis

How should TS be managed?

A. Nafcillin IV therapy for 2 weeks

B. Nafcillin IV + rifampin therapy for 6 weeks

C. Nafcillin IV + gentamicin IV therapy for 2 weeks

D. Nafcillin IV for 6 weeks with gentamicin for the first 3-5 days
Endocarditis

How should TS be managed?

A. Nafcillin IV therapy for 2 weeks

B. Nafcillin IV + rifampin therapy for 6 weeks

C. Nafcillin IV + gentamicin IV therapy for 2 weeks

D. Nafcillin IV for 6 weeks with gentamicin for the first 3-5 days
Endocarditis

TS tooth extraction 6 months later. What do you recommend for prophylaxis?

A. Tooth extractions do not require prophylaxis.

B. Amoxicillin 2g, 1 hour before the extraction

C. Amoxicillin 3g, 1 hour before and 1.5g, 6 hours for 4 doses after the extraction.

D. TS does not need prophylaxis.
Endocarditis Prophylaxis

- See tables for:
  - **Endocarditis prophylaxis:**
    - Conditions in which prophylaxis is necessary
    - Dental procedures that require prophylaxis
    - Other procedures that require prophylaxis
  - **Dental or respiratory tract procedures:**
    - Antibiotic dosed prior to procedure only
    - ampicillin, amoxicillin
    - clindamycin, cephalexin, cefazolin, ceftriaxone, macrolide

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Endocarditis

TS tooth extraction 6 months later. What do you recommend for prophylaxis?

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C. Amoxicillin 3g, 1 hour before and 1.5g, 6 hours for 4 doses after the extraction.

D. TS does not need prophylaxis.
Endocarditis

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A. Tooth extractions do not require prophylaxis.
B. Amoxicillin 2g, 1 hour before the extraction
C. Amoxicillin 3g, 1 hour before and 1.5g, 6 hours for 4 doses after the extraction.
D. TS does not need prophylaxis.
Peritonitis—Intraabdominal Infection

- Primary peritonitis
- Secondary peritonitis
- Therapy
  - **Mild/moderate community acquired**
    - Cefoxitin, cefazolin, cefuroxime, ceftriaxone or cefotaxime plus metronidazole, ticarcillin/clavulanate, ertapenem, moxifloxacin, ciprofloxacin or levofloxacin plus metronidazole, tigecycline
  - **High risk/Severe community or health-care acquired**
    - Piperacillin/tazobactam, ceftazidime or cefepime plus metronidazole, imipenem, meropenem or doripenem, ciprofloxacin or levofloxacin plus metronidazole (potentially add aminoglycoside or vancomycin when necessary)
Clostridium difficile Infection

- Risk factors and Symptoms
- Therapy
  - Initial episode and first recurrence:
    - Metronidazole 500mg PO/IV TID for 10-14 days
    - Vancomycin 125mg PO four times daily for 10-14 days
    - Fidaxomicin 200mg PO two times daily for 10 days

  - Second and third recurrences:
    - Consider fidaxomicin if not already given
    - Consider higher doses of vancomycin
    - Taper therapy
    - Pulse therapy
    - Consider rifaximin 400mg twice daily for 14 days

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Surgical Prophylaxis

Which of the following is the best practice for optimizing surgical prophylaxis:

A. Redose antibiotics for procedures longer than 4 hours or involving major blood loss.
B. Give antibiotics for 24 hours after the procedure – this will optimize prophylaxis.
C. Pre-operative antibiotics can be given up to 4 hours before the incision.
D. Vancomycin should be the antibiotic of choice due to its long $t_{1/2}$ and activity against MRSA.
Surgical Prophylaxis

Infection Rate of Various Surgical Procedures

Surgical Procedure

Clean
Clean-Contaminated
Contaminated
Dirty

0%
10%
20%
30%
40%
50%
Surgical Prophylaxis

- Timing
Surgical Prophylaxis

- **Timing**

  Infection Rate According to Duration of Surgery

![Graph showing infection rate over duration of surgery]

- Infection Rate
  - < 3 hours
  - 3-4 hours
  - > 4 hours

- Duration of Surgery

  - 0%
  - 5%
  - 10%
  - 15%
  - 20%
Surgical Prophylaxis

- Duration
  - most only require antibiotics when the patient is in the OR
  - cardiac procedures may require 24-48 hours of antibiotics after surgery
Surgical Prophylaxis

- Antibiotic Spectrum
  - only need activity against skin flora
  - vancomycin should NOT routinely be used
  - clean-contaminated procedures may require additional antibiotics
  - colorectal surgery requires broad spectrum antibiotics
Surgical Prophylaxis

Which of the following is the best practice for optimizing surgical prophylaxis:

A. Redose antibiotics for procedures longer than 4 hours or involving major blood loss.

B. Give antibiotics for 24 hours after the procedure – this will optimize prophylaxis.

C. Pre-operative antibiotics can be given up to 4 hours before the incision.

D. Vancomycin should be the antibiotic of choice due to its long $t_{1/2}$ and activity against MRSA.
Which of the following is the best practice for optimizing surgical prophylaxis:

A. Redose antibiotics for procedures longer than 4 hours or involving major blood loss.

B. Give antibiotics for 24 hours after the procedure – this will optimize prophylaxis.

C. Pre-operative antibiotics can be given up to 4 hours before the incision.

D. Vancomycin should be the antibiotic of choice due to its long $t_{1/2}$ and activity against MRSA.
Surgical Prophylaxis

Specific Surgical Procedures

- Gastrointestinal
- Ob/Gyn
- Cardiothoracic
- Orthopedic
- Head and Neck
- Urologic
Questions / Comments

Suggested References - Page 354, 355
Self-assessment Questions – Pages 314, 315
Answers to Self-assessment Questions – Page 358, 359
1. Which of the following would be the best empiric therapy for P.E.?
   a. Doxycycline 100 mg PO 2 times/day (BID)
   b. Cefuroxime axetil 250 mg PO 2 times/day (BID)
   c. Levofloxacin 750 mg PO daily
   d. Trimethoprim/sulfamethoxazole DS PO 2 times/day (BID)
Self Assessment Questions

1. Which of the following would be the best empiric therapy for P.E.?
   a. Doxycycline 100 mg PO 2 times/day (BID)
   b. Cefuroxime axetil 250 mg PO 2 times/day (BID)
   c. Levofloxacin 750 mg PO daily
   d. Trimethoprim/sulfamethoxazole DS PO 2 times/day (BID)
2. HW should be given:
   a. Azithromycin 500mg, followed by 250mg orally for 4 more days.
   b. Amoxicillin/clavulanic acid 875 orally twice daily.
   c. Oseltamivir 75mg orally twice daily for 5 days.
   d. Symptomatic treatment only.
Self Assessment Questions

2. HW should be given:
   a. Azithromycin 500mg, followed by 250mg orally for 4 more days.
   b. Amoxicillin/clavulanic acid 875 orally twice daily.
   c. Oseltamivir 75mg orally twice daily for 5 days.
   d. Symptomatic treatment only.
3. Which study design would be the most appropriate?
   a. Case series
   b. Case-control study
   c. Prospective cohort study
   d. Randomized clinical trial
Self Assessment Questions

3. Which study design would be the most appropriate?
   a. Case series
   b. Case-control study
   c. Prospective cohort study
   d. Randomized clinical trial
Self Assessment Questions

4. Which is the best empiric therapy for SC?
   a. Cefpodoxime 200mg BID.
   b. Clindamycin 300mg oral QID.
   c. Amoxicillin/clavulanate 875mg/125mg every 12 hours.
   d. No antibiotic therapy is needed as this is a typical viral infection
Self Assessment Questions

4. Which is the best empiric therapy for SC?
   a. Cefpodoxime 200mg BID.
   b. Clindamycin 300mg oral QID.
   c. Amoxicillin/clavulanate 875mg/125mg every 12 hours.
   d. No antibiotic therapy is needed as this is a typical viral infection
5. Which of the following would be the best empiric therapy for NR?
   a. Oral nitrofurantoin ER 100 mg twice daily for 3 days.
   b. Ciprofloxacin 500mg oral twice daily for 7 days.
   c. Trimethoprim/sulfamethoxazole i DS oral twice daily for 3 days.
   d. Cephalexin 500mg oral four times daily for 3 days.
5. Which of the following would be the best empiric therapy for NR?
   a. Oral nitrofurantoin ER 100 mg twice daily for 3 days.
   b. Ciprofloxacin 500mg oral twice daily for 7 days.
   c. Trimethoprim/sulfamethoxazole i DS oral twice daily for 3 days.
   d. Cephalexin 500mg oral four times daily for 3 days.
6. Which of the following is the best for BY?
   a. No therapy since she is chronically catheterized and has no symptoms.
   b. No antibiotic therapy but the catheter should be changed.
   c. Ciprofloxacin 500mg orally twice daily for 7 days and a new catheter.
   d. Ciprofloxacin 500mg orally twice daily for 14-21 days without a change in catheter.
Self Assessment Questions

6. Which of the following is the best for BY?
   a. No therapy since she is chronically catheterized and has no symptoms.
   b. No antibiotic therapy but the catheter should be changed.
   c. Ciprofloxacin 500mg orally twice daily for 7 days and a new catheter.
   d. Ciprofloxacin 500mg orally twice daily for 14-21 days without a change in catheter.
Self Assessment Questions

7. Which of the following would be the best empiric therapy for VE?
   a. Nafcillin 2g IV q6h – infection may worsen and necrotizing fasciitis needs to be ruled out.
   b. Penicillin G 2 million units IV q4h – this is probably erysipelas.
   c. Piperacillin/tazobactam 3.375 g IV q6h – surgical debridement is vitally important.
   d. Enoxaparin 80mg SQ BID and warfarin 5mg po daily.
7. Which of the following would be the best empiric therapy for VE?

a. Nafcillin 2g IV q6h – infection may worsen and necrotizing fasciitis needs to be ruled out.
b. Penicillin G 2 million units IV q4h – this is probably erysipelas.
c. Piperacillin/tazobactam 3.375 g IV q6h – surgical debridement is vitally important.
d. Enoxaparin 80mg SQ BID and warfarin 5mg po daily.
8. Which of the following would be the best empiric therapy for RK?
   a. This is aseptic meningitis and no antibiotics are necessary.
   b. Ceftriaxone 2g IV every 12 hours until the CSF cultures are proven negative for bacteria.
   c. Ceftriaxone 2g IV every 12 hours plus vancomycin 1000mg IV every 12 hours.
   d. Acyclovir 500 mg IV every 8 hours until the CSF culture results are complete.
8. Which of the following would be the best empiric therapy for RK?

a. This is aseptic meningitis and no antibiotics are necessary.

b. Ceftriaxone 2g IV every 12 hours until the CSF cultures are proven negative for bacteria.

c. Ceftriaxone 2g IV every 12 hours plus vancomycin 1000mg IV every 12 hours.

d. Acyclovir 500 mg IV every 8 hours until the CSF culture results are complete.
9. What is the most appropriate therapy for LG?
   a. penicillin G plus gentamicin for 2 weeks
   b. vancomycin plus gentamicin for 2 weeks
   c. ampicillin plus gentamicin for 6 weeks
   d. cefazolin plus gentamicin for 6 weeks
Self Assessment Questions

9. What is the most appropriate therapy for LG?
   a. penicillin G plus gentamicin for 2 weeks
   b. vancomycin plus gentamicin for 2 weeks
   c. ampicillin plus gentamicin for 6 weeks
   d. cefazolin plus gentamicin for 6 weeks
Self Assessment Questions

10. Which of the following would be the best follow up antibiotics for NL?

a. Vancomycin 1000mg IV every 12 hours plus metronidazole 500mg IV every 8 hours

b. Ceftriaxone 1g IV daily plus ciprofloxacin 400mg IV every 12 hours.

c. Ertapenem 1g IV daily.

d. No antibiotics are needed following surgical repair of a perforated appendix.
10. Which of the following would be the best follow up antibiotics for NL?
   a. Vancomycin 1000mg IV every 12 hours plus metronidazole 500mg IV every 8 hours
   b. Ceftriaxone 1g IV daily plus ciprofloxacin 400mg IV every 12 hours.
   c. Ertapenem 1g IV daily.
   d. No antibiotics are needed following surgical repair of a perforated appendix.