Antimicrobial Handbook – 2012

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Access at http://cdhaintra.cdha.nshealth.ca/departmentservices/pharmacy/rxpublications.cfm

Antimicrobial Handbook
## Microbiology
### Susceptibility Reports May 2009

### Gram Positive Isolates - % Susceptible

<table>
<thead>
<tr>
<th>Organism</th>
<th>Ampicillin</th>
<th>Cefazolin</th>
<th>Ciprofloxacin</th>
<th>Clindamycin</th>
<th>Erythromycin</th>
<th>Gentamicin</th>
<th>Nitrofurantoin</th>
<th>Norfloxacin</th>
<th>Pipercillin/Tazobactam</th>
<th>Tetracycline</th>
<th>Tobramycin</th>
<th>TMP-SMZ</th>
<th>Vancomycin</th>
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<tbody>
<tr>
<td>Staphylococcus aureus</td>
<td>NT 81</td>
<td>81</td>
<td>76</td>
<td>64</td>
<td>81</td>
<td>64</td>
<td>98</td>
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<td>97</td>
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<tr>
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<tr>
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<tr>
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<td>NT 67</td>
<td>IR</td>
<td>IR</td>
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<td>97</td>
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</tr>
</tbody>
</table>

* For use in urinary tract infection only.
* IR - Usually not active either because of intrinsic or acquired resistance.
* NT - Not tested.

Methicillin resistant *S. aureus* strains are resistant to all penicillins, cephalosporins, and carbapenems.

### Gram Negative Isolates - % Susceptible

<table>
<thead>
<tr>
<th>Organism</th>
<th>Ampicillin</th>
<th>Cefazolin</th>
<th>Ciprofloxacin</th>
<th>Clindamycin</th>
<th>Erythromycin</th>
<th>Gentamicin</th>
<th>Nitrofurantoin</th>
<th>Norfloxacin</th>
<th>Pipercillin/Tazobactam</th>
<th>Tetracycline</th>
<th>Tobramycin</th>
<th>TMP-SMZ</th>
<th>Vancomycin</th>
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<td>Klebsiella pneumoniae</td>
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<td>Proteus mirabilis</td>
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<td>96</td>
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<td>98</td>
<td>89</td>
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<td>96</td>
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<td>IR</td>
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<td>96</td>
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<td>97</td>
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<td>97</td>
<td>99</td>
<td>100</td>
</tr>
<tr>
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<td>50</td>
<td>97</td>
<td>IR</td>
<td>IR</td>
<td>IR</td>
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<tr>
<td>Klebsiella oxytoca</td>
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<td>100</td>
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<td>99</td>
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<td>93</td>
<td>99</td>
<td>96</td>
<td>95</td>
<td>98</td>
</tr>
<tr>
<td>Morganella morganii</td>
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<td>IR</td>
<td>IR</td>
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<td>IR</td>
<td>97</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
</tbody>
</table>

* For use in urinary tract infection only.
* IR - Usually not active either because of intrinsic or acquired resistance.
## Microbiology

### Susceptibility Reports 2009 (cont’d)

### AFERMENTORS - % SUSCEPTIBLE

<table>
<thead>
<tr>
<th></th>
<th>Ceftazidime</th>
<th>Ciprofloxacin</th>
<th>Imipenem</th>
<th>Meropenem</th>
<th>Piperacillin/Tazobactam</th>
<th>Piperacillin</th>
<th>Amikacin</th>
<th>Tobramycin</th>
<th>Ceftriaxone</th>
<th>Ticarcillin/Clavulanate</th>
<th>TMP-SMZ</th>
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</thead>
<tbody>
<tr>
<td><em>Pseudomonas aeruginosa</em></td>
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<td>72</td>
<td>85</td>
<td>75</td>
<td>84</td>
<td>85</td>
<td>68</td>
<td>82</td>
<td>92</td>
<td>IR</td>
<td>IR</td>
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<td><em>Stenotrophomonas maltophilia</em></td>
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<td>0</td>
<td>8</td>
<td>98</td>
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<tr>
<td><em>Acinetobacter baumannii</em></td>
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<td>91</td>
<td>94</td>
<td>NT</td>
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<td>98</td>
<td>IR</td>
<td>NT</td>
<td>90</td>
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<tr>
<td><em>Burkholderia cepacia</em></td>
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<td>3</td>
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<td>56</td>
<td>IR</td>
<td>IR</td>
<td>IR</td>
<td>IR</td>
<td>19</td>
</tr>
</tbody>
</table>

IR - Usually not active either because of intrinsic or acquired resistance.
NT - Not tested.
N.B. - Specific susceptibilities should be consulted where they are available, as individual results can be especially difficult to interpret when the number of isolates tested is small.
## Guidelines for Interpretation of Gram Stain Results

### Gram-Positive Cocci (GPC)
- **Pairs, chains, clusters:**
  - *Staphylococcus* sp
- **Pairs, chains:**
  - *Streptococcus* sp
  - *Enterococcus* sp
- **Pairs, lancet-shaped:**
  - *Streptococcus pneumoniae*
- **Pairs:**
  - *Enterococcus* sp

### Gram-Positive Bacilli (GPB)
- **Diphtheroids:**
  - Small, pleomorphic:
    - *Corynebacterium* sp
  - Large, with spores:
    - *Clostridium* sp
  - *Bacillus* sp
- **Branching, beaded, rods:**
  - *Nocardia* sp
  - *Actinomyces* sp (anaerobe)
- **Other:**
  - *Listeria* sp (blood/cerebrospinal fluid)
  - *Lactobacillus* sp (vaginal/blood)

### Gram-Negative Cocci (GNC)
- **Diplococci**
  - *Pneumococcus*
    - **Pairs:**
      - *Neisseria meningitidis*
      - *Neisseria gonorrhoeae*
      - *Moraxella catarrhalis*
  - **Other:**
    - *Acinetobacter* sp

### Gram-Negative Bacilli (GNB)
- **Enterobacteriaceae:**
  - *Escherichia coli*
  - *Serratia* sp
  - *Klebsiella* sp
  - *Enterobacter* sp
  - *Citrobacter* sp
- **Nonfermentative:**
  - *Pseudomonas aeruginosa*
  - *Stenotrophomonas (Xanthomonas) maltophilia*
  - *Many others*
  - *Haemophilus influenzae*
  - *Bacteroides fragilis* group (anaerobe)
  - *Fusobacterium* sp (anaerobe)
  - *Capnocytophaga* sp

1 These guidelines are not definitive but presumptive for the identification of organisms on gram stain. Treatment will depend on the quality of the specimen and appropriate clinical evaluation.
### Key Characteristics of Selected Organisms

#### Gram-Positive Cocci (GPC)
- **Catalase-positive:**
  - Staphylococcus sp
- **Catalase-negative:**
  - Enterococcus sp
  - Streptococcus sp (chains)
  - Micrococcus sp (usually insignificant)
- **Coagulase-positive:**
  - Staphylococcus aureus
- **Coagulase-negative:**
  - Coagulase-negative staphylococci (CNS):
    - Blood: Staphylococcus epidermidis or CNS
    - Urine: Staphylococcus saprophyticus
  - Staphylococcus lugdunensis

#### Gram-Positive Bacilli (GPB)
- **Diphtheroids:**
  - May be Corynebacterium sp: often blood culture contaminants
  - Corynebacterium jeikeium: resistant to many agents except vancomycin
- **Anaerobic diphtheroids:** Propionibacterium acnes
- **Bacillus sp:**
  - Bacillus anthracis: non-motile and non-β-hemolytic
  - Bacillus subtilis: i.e., large, "box car" rods with spores
- **Listeria monocytogenes:** cerebrospinal fluid, blood
- **Lactobacillus sp:** vaginal flora, rarely in blood
- **Lactococcus sp:** Branching, beaded; partial acid-fast-positive
- **Listeria monocytogenes:**
  - Rapid growing mycobacteria:
    - Mycobacterium fortuitum
    - Mycobacterium cheloniae/abscessus

#### Gram-Negative Cocci
- **Neisseria meningitidis**
- **Neisseria gonorrhoeae**
- **Moraxella (Branhamella) catarrhalis**
- **Acinetobacter sp**

#### Gram-Negative Bacilli (GNB)
- **Lactose-positive:**
  - Escherichia coli
  - Klebsiella pneumoniae (mucoid)
  - Enterobacter sp
  - Citrobacter sp
- **Lactose-negative/oxidase-negative:**
  - Proteus mirabilis: indole-negative
  - Proteus vulgaris: indole-positive
  - Providencia sp
  - Morganella morganii
  - Serrata sp
  - Salmonella sp
  - Shigella sp
  - Acinetobacter sp
  - Stenotrophomonas (Xanthomonas) maltophilia (nonfermenter)
- **Lactose-negative/oxidase-positive:**
  - Pseudomonas aeruginosa (green; "grape-odor")
  - Aeromonas hydrophilia (may be lactose-positive)
  - Rare:
    - Other Pseudomonas sp
    - Moraxella sp
  - Alcaligenes sp
  - Burkholderia sp

---

*Antimicrobial Handbook* 5
Key Characteristics of Selected Organisms (continued)

**Fungi**

- **Moulds:**
  - Aseptate hyphae:
    - Zygomycetes, such as:
      - *Rhizopus* sp
      - *Mucor*
  - Septate hyphae:
    - Brown pigment (phaeohyphomycetes), such as:
      - *Bipolaris* sp
      - *Exserohilum* sp
      - *Alternaria* sp
      - *Curvularia* sp
      - *Sporothrix schenckii*³
    - Non-brown pigmented (hyalohyphomycetes, most common), such as:
      - *Aspergillus* sp (*Aspergillus fumigatus, Aspergillus flavus*)
      - *Fusarium* sp
      - *Penicillium* sp
      - *Paecilomyces* sp
      - *Dermatophytes*

- Thermally dimorphic (yeast in tissue, mould in lab):
  - *Histoplasma capsulatum* (slow growing)
  - *Blastomyces dermatitidis*
  - *Coccidioides immitis*

- **Yeast:**
  - *Candida* sp; *Candida albicans* if germ tube-positive
  - *Cryptococcus* sp (no pseudohyphae); *Cryptococcus neoformans* if latex- or CAD-positive
  - *Candida glabrata*
  - *Trichosporon* sp
  - *Rhodotorula, Saccharomyces* sp

**Anaerobes**

- **GNB:**
  - *Bacteroides* sp (*Bacteroides fragilis*)
  - *Fusobacterium* sp

- **GNC:**
  - *Veillonella* sp

- **GPC:**
  - *Peptostreptococcus* sp

- **GPB:**
  - *Propionibacterium acnes*
  - *Clostridium* sp (spores)
  - *Actinomyces* sp (branching, filamentous)
  - *Lactobacillus* sp
  - *Eubacterium* sp
  - *Bifidobacterium* sp

---

1 May be either bacillary or coccoid.
2 May be lactose negative.
3 May produce red pigment and appear lactose-positive initially.
4 Clinically can act as *Staphylococcus aureus*, laboratory results will reflect this by using MIC interpretation for *Staphylococcus aureus*.
Selected Prescribing Criteria For Restricted Anti-infective Agents

Cefotaxime and ceftriaxone (Cefotaxime should be used in place of ceftriaxone for patients with biliary sludging or severe diarrhea)
> Treatment of nosocomial pneumonia.
> EMPIRIC therapy of severely ill patients with suspected Gram negative infection.
> Documented Gram negative infection resistant to 1st and 2nd generation cephalosporins in patients who cannot receive aminoglycosides.
> Meningitis.
> Spontaneous bacterial peritonitis, community-acquired secondary peritonitis (or hospital acquired with no previous antimicrobial therapy), or intra-abdominal abscess.
> Community acquired pneumonia in patients treated with a fluoroquinolone in the last 3 months.
> Therapy for low risk febrile neutropenic patients.
> Other indications on recommendation by the Division of Infectious Diseases.

Ceftazidime
> Treatment of documented Pseudomonas infections.
> Empiric therapy for presumed Pseudomonas infections in febrile neutropenic and cystic fibrosis patients.
> Other indications on recommendation by the Division of Infectious Diseases.

Ciprofloxacin IV
Patients unable to take oral ciprofloxacin and one of:
> Treatment of a documented Gram-negative infection due to an organism resistant to other antibiotics or when another antibiotic is contraindicated.
> Treatment of respiratory infections in cystic fibrosis.
> Empiric therapy of ICU nosocomial pneumonia where Pseudomonas or other resistant Gram-negative infections are suspected.
Therapy of high-risk febrile neutropenia for patients with a severe B-lactam allergy.

Treatment of intra-abdominal infections in patients who cannot receive penicillin or aminoglycoside-containing regimens.

Peritonitis protocol for peritoneal dialysis patients.

Other indications on recommendation by the Division of Infectious Diseases.

**Imipenem**

- Treatment of resistant infections in cystic fibrosis patients.
- Treatment of documented resistant infections or where resistance to piperacillin-tazobactam or third-generation cephalosporins is likely.
- Other indications on recommendation by the Division of Infectious Diseases.

**Piperacillin-tazobactam**

- As a single agent for the treatment of serious Gram-negative or polymicrobial infections, including mixed aerobic and anaerobic infections, where the use of other agents is not appropriate because of resistance, contraindications or adverse events.
- Treatment of high risk febrile neutropenia.
- Other indications on recommendation by the Division of Infectious Diseases.
## Antibiotic Cost Awareness

<table>
<thead>
<tr>
<th>Name</th>
<th>Route</th>
<th>Average Adult Dosage</th>
<th>Regimen</th>
<th>$ per dose</th>
<th>$ per day</th>
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</thead>
<tbody>
<tr>
<td><strong>Aminoglycosides</strong></td>
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<td></td>
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</tr>
<tr>
<td>Amikacin</td>
<td>IV/IM</td>
<td>1000 mg (15 mg/kg)</td>
<td>q24h</td>
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<tr>
<td>Gentamicin</td>
<td>IV/IM</td>
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<td>Streptomycin</td>
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<td>ABLC* (amphotericin B lipid complex)</td>
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<td><strong>Antivirals</strong></td>
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<td>IV</td>
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<td>$0.25</td>
</tr>
<tr>
<td>Oseltamivir (prophylaxis)</td>
<td>po</td>
<td>75 mg</td>
<td>q24h</td>
<td>$1.90</td>
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<tr>
<td>Oseltamivir</td>
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<td>75 mg</td>
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<tr>
<td>Valacyclovir</td>
<td>po</td>
<td>500 mg</td>
<td>q12h</td>
<td>$3.13</td>
<td>$6.26</td>
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<tr>
<td>Valganciclovir</td>
<td>po</td>
<td>900 mg</td>
<td>q12h</td>
<td>$44.82</td>
<td>$89.64</td>
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<td><strong>Cephalosporins</strong></td>
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<tr>
<td>CeFAZolin</td>
<td>IV/IM</td>
<td>1 g</td>
<td>q8h</td>
<td>$2.39</td>
<td>$7.17</td>
</tr>
<tr>
<td>CeMALDoxin</td>
<td>po</td>
<td>500 mg</td>
<td>q6h</td>
<td>$0.16</td>
<td>$0.64</td>
</tr>
<tr>
<td><strong>2nd Generation</strong></td>
<td></td>
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<tr>
<td>CeFROXime axetil</td>
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<td>500 mg</td>
<td>q12h</td>
<td>$0.98</td>
<td>$1.96</td>
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<tr>
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<td>1 g</td>
<td>q8h</td>
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<td>$22.20</td>
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<td>CeTDOXSm*</td>
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<td>q6h</td>
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<td>po</td>
<td>400 mg</td>
<td>q24h, x 1</td>
<td>$1.18</td>
<td>$3.18</td>
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<td><strong>Fluoroquinolones</strong></td>
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<td>Ciprofloxacin*</td>
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<td>500 mg</td>
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<td>$0.34</td>
<td>$0.68</td>
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<td>Ciprofloxacin*</td>
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<td>400 mg</td>
<td>q12h</td>
<td>$9.50</td>
<td>$19.00</td>
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<td>Levofloxacin*</td>
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<td>500 mg</td>
<td>q24h</td>
<td>$14.00</td>
<td>$34.00</td>
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*Antimicrobial Handbook*
Antimicrobial Handbook

Antimicrobial Cost Awareness (cont’d)

<table>
<thead>
<tr>
<th>Name</th>
<th>Route</th>
<th>Average Adult Dosage</th>
<th>Regimen</th>
<th>$ per dose</th>
<th>$ per day</th>
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<tbody>
<tr>
<td>Penicillins</td>
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<tr>
<td>Amoxicillin</td>
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<td>500 mg</td>
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<td>Amoxicillin/Clavulanate</td>
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<td>875 mg/125 mg</td>
<td>q12h</td>
<td>$0.61</td>
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<td>Ampicillin</td>
<td>IV/IM</td>
<td>1 g</td>
<td>q6h</td>
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<td>Cloxacillin</td>
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<td>q4h</td>
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<td>$0.08</td>
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<td>Doxycycline</td>
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<td>$0.22</td>
<td>$0.44</td>
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<td>Doxycycline*</td>
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<td>100 mg</td>
<td>q12h</td>
<td>$15.13</td>
<td>$30.30</td>
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<tr>
<td>Tetracycline</td>
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<td>250 mg</td>
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<td>Macrolides</td>
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<td>Azithromycin</td>
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<td>500 mg on day one,</td>
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<td>$1.89</td>
<td>$1.89</td>
</tr>
<tr>
<td></td>
<td></td>
<td>then 250 mg for 4 days</td>
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<tr>
<td>Azithromycin (MAC)</td>
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<td>1200 mg</td>
<td>q weekly</td>
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<td>Miscellaneous</td>
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<td>Chloramphenicol</td>
<td>IV</td>
<td>1000 mg</td>
<td>q6h</td>
<td>$15.63</td>
<td>$62.60</td>
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<tr>
<td>Clararamycin</td>
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<td>300 mg</td>
<td>q6h</td>
<td>$0.31</td>
<td>$1.24</td>
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<td>Chloramphenicol</td>
<td>IV</td>
<td>600 mg</td>
<td>q8h</td>
<td>$4.27</td>
<td>$12.81</td>
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<tr>
<td>Dapsone</td>
<td>po</td>
<td>100 mg</td>
<td>q24h</td>
<td>$0.41</td>
<td>$0.41</td>
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<tr>
<td>Daptomycin</td>
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<td>6-8 mg/kg</td>
<td>q24h</td>
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<td>Linezolid*</td>
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<td>$70.64</td>
<td>$141.28</td>
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<td>Linezolid*</td>
<td>IV</td>
<td>600 mg</td>
<td>q12h</td>
<td>$95.51</td>
<td>$191.02</td>
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<tr>
<td>Imipenem</td>
<td>IV</td>
<td>500 mg</td>
<td>q6h</td>
<td>$6.10</td>
<td>$24.40</td>
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<tr>
<td>Metronidazole</td>
<td>IV</td>
<td>500 mg</td>
<td>12h</td>
<td>$1.57</td>
<td>$3.14</td>
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<td>po</td>
<td>500 mg</td>
<td>q6h</td>
<td>$0.04</td>
<td>$0.12</td>
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<td>Nitrofurantoin</td>
<td>po</td>
<td>50 mg</td>
<td>q6h</td>
<td>$0.11</td>
<td>$0.44</td>
</tr>
<tr>
<td>Trimethoprim/Sulfamethoxazole</td>
<td>po</td>
<td>1.05</td>
<td>q12h</td>
<td>$0.06</td>
<td>$0.12</td>
</tr>
<tr>
<td>Trimethoprim/Sulfamethoxazole (16 mg &amp; 80 mg/5 mL)</td>
<td>IV</td>
<td>10 mL</td>
<td>q12h</td>
<td>$7.55</td>
<td>$30.20</td>
</tr>
<tr>
<td>Trimethoprim/Sulfamethoxazole (16 mg &amp; 80 mg/5 mL)</td>
<td>IV</td>
<td>10 mL</td>
<td>q6h</td>
<td>$7.55</td>
<td>$30.20</td>
</tr>
<tr>
<td>Vancomycin</td>
<td>IV</td>
<td>1 g</td>
<td>q12h</td>
<td>$10.33</td>
<td>$20.66</td>
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<td>Vancomycin*</td>
<td>po</td>
<td>125 mg</td>
<td>q6h</td>
<td>$1.15</td>
<td>$4.59</td>
</tr>
</tbody>
</table>

Costs include additional $1.15/dose for IV minibag; Dose per kg based on a 70 kg adult

* Restricted antimicrobial
# Antibiotic Dosage Guidelines

## Cephalosporins

**PENCILLINS**

<table>
<thead>
<tr>
<th>AMINOGLYCOSIDES</th>
<th>MIC CONSIDERATIONS</th>
<th>Usual Adult Dose(^1)</th>
<th>CCl(_2) 30 to 50 mL/min</th>
<th>CCl(_2) 10 to 30 mL/min</th>
<th>CCl(_2) &lt;10 mL/min</th>
<th>HEMODIALYSIS(^2)</th>
<th>PERITONEAL DIALYSIS</th>
<th>CONTINUOUS RENAL REPLACEMENT (CIRR)(^3)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>AMPCILLIN (PO)</strong></td>
<td>250 to 500 mg q8h</td>
<td>250 to 500 mg q8h</td>
<td>250 to 500 mg q8h</td>
<td>250 to 500 mg q8h</td>
<td>500 mg q12h</td>
<td>500 mg q12h</td>
<td>500 mg q12h</td>
<td>500 mg q12h</td>
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<tr>
<td><em><em>AMPCILLIN</em> (IV)</em>*</td>
<td>1 to 2 g q8-12h</td>
<td>1 to 2 g q8-12h</td>
<td>1 to 2 g q8-12h</td>
<td>1 to 2 g q8-12h</td>
<td>1 to 2 g q8-12h</td>
<td>1 to 2 g q8-12h</td>
<td>1 to 2 g q8-12h</td>
<td>1 to 2 g q8-12h</td>
</tr>
<tr>
<td><strong>CEPHALEXIN (PO)</strong></td>
<td>250 to 750 mg q8-12h</td>
<td>250 to 750 mg q8-12h</td>
<td>250 to 750 mg q8-12h</td>
<td>250 to 750 mg q8-12h</td>
<td>500 mg q12h</td>
<td>500 mg q12h</td>
<td>500 mg q12h</td>
<td>500 mg q12h</td>
</tr>
<tr>
<td><strong>CEPHALEXIN (IV)</strong></td>
<td>1000 mg q8-12h</td>
<td>1000 mg q8-12h</td>
<td>1000 mg q8-12h</td>
<td>1000 mg q8-12h</td>
<td>1 g q12h</td>
<td>1 g q12h</td>
<td>1 g q12h</td>
<td>1 g q12h</td>
</tr>
<tr>
<td><strong>CEPHTRIAZINE (PO)</strong></td>
<td>250 to 500 mg q12h</td>
<td>250 to 500 mg q12h</td>
<td>250 to 500 mg q12h</td>
<td>250 to 500 mg q12h</td>
<td>500 mg q12h</td>
<td>500 mg q12h</td>
<td>500 mg q12h</td>
<td>500 mg q12h</td>
</tr>
<tr>
<td><strong>CEFTAZIDIME (IV)</strong></td>
<td>1 to 2 g q8-12h</td>
<td>1 to 2 g q8-12h</td>
<td>1 to 2 g q8-12h</td>
<td>1 to 2 g q8-12h</td>
<td>1 to 2 g q8-12h</td>
<td>1 to 2 g q8-12h</td>
<td>1 to 2 g q8-12h</td>
<td>1 to 2 g q8-12h</td>
</tr>
<tr>
<td><strong>CETIPIROXIN (IV)</strong></td>
<td>500 mg q12h</td>
<td>500 mg q12h</td>
<td>500 mg q12h</td>
<td>500 mg q12h</td>
<td>1 g q24h</td>
<td>1 g q24h</td>
<td>1 g q24h</td>
<td>1 g q24h</td>
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<tr>
<td><strong>CETIPIROXIN (PO)</strong></td>
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<td>500 mg q12h</td>
<td>500 mg q12h</td>
<td>500 mg q12h</td>
<td>1 g q24h</td>
<td>1 g q24h</td>
<td>1 g q24h</td>
<td>1 g q24h</td>
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<tr>
<td><strong>CETIPIROXIN (IV)</strong></td>
<td>500 mg q12h</td>
<td>500 mg q12h</td>
<td>500 mg q12h</td>
<td>500 mg q12h</td>
<td>1 g q24h</td>
<td>1 g q24h</td>
<td>1 g q24h</td>
<td>1 g q24h</td>
</tr>
<tr>
<td><strong>IMIPENEM (IV)</strong></td>
<td>500 mg q12h</td>
<td>500 mg q12h</td>
<td>500 mg q12h</td>
<td>500 mg q12h</td>
<td>1 g q24h</td>
<td>1 g q24h</td>
<td>1 g q24h</td>
<td>1 g q24h</td>
</tr>
</tbody>
</table>

## Quinolones

| **CEFTRIAXONE (IV)** | Dose 2 g q12h for meningitis | 2 g q12h | 2 g q12h | 2 g q12h | 2 g q12h | 2 g q12h | 2 g q12h | 2 g q12h |
| **CEFOTAXIME (IV)** | Dose 1 g q8h for pneumonia | 1 to 2 g q8h | 1 to 2 g q8h | 1 to 2 g q8h | 1 to 2 g q8h | 1 to 2 g q8h | 1 to 2 g q8h | 1 to 2 g q8h |
| **CEFTRIAZINE (IV)** | Dose 2 g q8h for meningitis | 2 g q8h | 2 g q8h | 2 g q8h | 2 g q8h | 2 g q8h | 2 g q8h | 2 g q8h |
| **LEVOFLOXACIN (PO/IV)** | 500 mg q24h | 500 mg q24h | 500 mg q24h | 500 mg q24h | 500 mg q24h | 500 mg q24h | 500 mg q24h | 500 mg q24h |
| **IMIPENEM (IV)** | Dose 1 g q6h | 1 g q12h | 1 g q12h | 1 g q12h | 1 g q12h | 1 g q12h | 1 g q12h | 1 g q12h |

## Macrolides

| **AZITHROMYCIN (IV)** | 500 mg q24h | 500 mg q24h | 500 mg q24h | 500 mg q24h | 500 mg q24h | 500 mg q24h | 500 mg q24h | 500 mg q24h |
| **CLARITHROMYCIN (PO)** | 500 mg q12h | 500 mg q12h | 500 mg q12h | 500 mg q12h | 500 mg q12h | 500 mg q12h | 500 mg q12h | 500 mg q12h |

## Other Considerations

- **Amoxicillin (PO)**
  - 250 to 500 mg q8h
  - 250 to 500 mg q8h
  - 250 to 500 mg q12h
  - 250 to 500 mg q12h
  - 500 mg q12h
  - 500 mg q12h
  - 500 mg q12h

- **Amoxicillin/clavulanate (PO)**
  - 875 mg q12h
  - 875 mg q12h
  - 500 mg q12h
  - 500 mg q12h
  - 500 mg q24h
  - 500 mg q24h

- **Ampicillin (IV)**
  - 1 to 2 g q4-6h
  - 1 to 2 g q6-8h
  - 1 to 2 g q8-12h
  - 1 to 2 g q12h
  - 1 to 2 g q12h
  - 1 to 2 g q12h

- **Cloxacillin**
  - 2 g q8h
  - 2 g q8h

- **Penicillin G (IV)**
  - 2 to 4 M Units q4h
  - 2 M Units q4h
  - 1 M Units q4h
  - 1 M Units q4h
  - 1 M Units q4h
  - 1 M Units q4h

- **Piperacillin/tazobactam (IV)**
  - 3.375 g q8h
  - 3.375 g q8h
  - 3.375 g q12h
  - 3.375 g q12h
  - 3.375 g q12h

- **Ceftazidime (IV)**
  - 2 g q4h
  - 2 g q6h
  - 2 g q8h
  - 2 g q12-24h
  - 2 g q12-24h

- **Cefazolin (IV)**
  - 1 g q8h
  - 1 g q8h
  - 1 g q12h
  - 1 g q12h
  - 1 g q12h

- **Ceftriaxone (IV)**
  - 2 g q4h for meningitis
  - 1 g q24h
  - 1 g q24h

- **Cefotaxime (IV)**
  - 1 g q8h for pneumonia
  - 1 to 2 g q8h
  - 1 to 2 g q12h
  - 1 to 2 g q12h

- **Ceftazidime (IV)**
  - 1 g q48h
  - 1 g q48h
  - 1 g q48h
  - 1 g q48h

- **Ciprofloxacin (PO)**
  - 200-400 mg q12h
  - 200-400 mg q12h
  - 200-400 mg q24h
  - 200-400 mg q24h

- **Ciprofloxacin (IV)**
  - 200-400 mg q12h
  - 200-400 mg q12h
  - 200-400 mg q24h
  - 200-400 mg q24h

- **Ciprofloxacin (IV)**
  - 200-400 mg q12h
  - 200-400 mg q12h
  - 200-400 mg q24h
  - 200-400 mg q24h

- **Ciprofloxacin (IV)**
  - 200-400 mg q12h
  - 200-400 mg q12h
  - 200-400 mg q24h
  - 200-400 mg q24h
## Antibiotic Dosage Guidelines (cont'd)

<table>
<thead>
<tr>
<th>MIC CONSIDERATIONS</th>
<th>Usual Adult Dose1</th>
<th>CrCL 30 to 50 mL/min</th>
<th>CrCL 10 to 30 mL/min</th>
<th>CrCL &lt;10 mL/min</th>
<th>HEMODIALYSIS2</th>
<th>PERITONEAL DIALYSIS</th>
<th>CONTINUOUS RENAL REPLACEMENT (CRRT)3</th>
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<tbody>
<tr>
<td><strong>ANTIFUNGALS</strong></td>
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<tr>
<td>Amphotericin B (IV)</td>
<td>0.5 to 1 mg/kg q24h</td>
<td>0.5 to 1 mg/kg q24h (consider 500 mL-1 L NS or divided pre- and post-infusion to ↓ risk of nephrotoxicity)</td>
<td>0.5 to 1 mg/kg q24h</td>
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<tr>
<td>Micafungin</td>
<td></td>
<td>100 mg q24h</td>
<td>100 mg q24h</td>
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<tr>
<td>Lipid amphotericin B (IV) (Abelcet)</td>
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<td>5 mg/kg q24h</td>
<td>5 mg/kg q24h</td>
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<tr>
<td>Fluconazole (PO)</td>
<td>Monitor SCR, K+, Mg++, PO4; Administer in D5W over 2 hours</td>
<td>6 mg/kg q24h</td>
<td>6 mg/kg q24h x 2, then 4 mg/kg q24h</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Voriconazole (PO)</td>
<td>Monitor SCR, CBC</td>
<td>50 to 10 mg/kg q24h</td>
<td>50 to 10 mg/kg q24h</td>
<td></td>
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<tr>
<td><strong>ANTIVIRALS</strong></td>
<td></td>
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</tr>
<tr>
<td>Acyclovir (IV)</td>
<td>5 to 10 mg/kg q4h</td>
<td>5 to 10 mg/kg q8h</td>
<td>5 to 10 mg/kg q12h</td>
<td></td>
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</tr>
<tr>
<td>Valacyclovir (PO)</td>
<td>1 g q1-2h</td>
<td>1 g q1-2h</td>
<td>1 g q1-2h</td>
<td></td>
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</tr>
</tbody>
</table>

1 Usual Adult Dose: 1/9/12, 3:05 PM
<table>
<thead>
<tr>
<th><strong>MICROBIALS (cont’d)</strong></th>
<th><strong>GENERAL COMMENTS/CONSIDERATIONS</strong></th>
<th><strong>Usual Adult Dose</strong></th>
<th><strong>CrCL 30 to 50 mL/min</strong></th>
<th><strong>CrCL 10 to 30 mL/min</strong></th>
<th><strong>CrCL &lt; 10 mL/min</strong></th>
<th><strong>PERITONEAL DIALYSIS</strong></th>
<th><strong>HEMODIALYSIS</strong></th>
<th><strong>CONTINUOUS RENAL REPLACEMENT (CRRRT)</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ANTIBIOTICS</strong></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Ganciclovir (IV)</td>
<td>Monitor WBC, PT, LFTs; vision test</td>
<td>3 mg/kg q24h</td>
<td>5 mg/kg q24h</td>
<td>7.5 mg/kg q48h</td>
<td>12.5 mg/kg q24h</td>
<td>12.5 mg/kg q24h</td>
<td>12.5 mg/kg q24h</td>
<td>12.5 mg/kg q24h</td>
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<td>(maintenance)</td>
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<td>(maintenance)</td>
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</tr>
<tr>
<td>Valganciclovir (PO)</td>
<td>Monitor PT, LFTs; vision test</td>
<td>500 mg q24h</td>
<td>1000 mg q24h</td>
<td>1500 mg q24h</td>
<td>2000 mg q24h</td>
<td>2000 mg q24h</td>
<td>2000 mg q24h</td>
<td>2000 mg q24h</td>
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<tr>
<td>(maintenance)</td>
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</tr>
<tr>
<td><strong>ANTITUBERCULOSIS</strong></td>
<td></td>
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</tr>
<tr>
<td>Ethambutol (PO)</td>
<td>Monitor LFTs; vision test</td>
<td>15 to 25 mg/kg q24h</td>
<td>15 to 25 mg/kg q24h</td>
<td>15 to 25 mg/kg q24h</td>
<td>15 to 25 mg/kg q24h</td>
<td>15 to 25 mg/kg q24h</td>
<td>15 to 25 mg/kg q24h</td>
<td>15 to 25 mg/kg q24h</td>
</tr>
<tr>
<td>Isoniazid (PO)</td>
<td>Monitor LFTs; vision test</td>
<td>5 mg/kg q24h</td>
<td>5 mg/kg q24h</td>
<td>5 mg/kg q24h</td>
<td>5 mg/kg q24h</td>
<td>5 mg/kg q24h</td>
<td>5 mg/kg q24h</td>
<td>5 mg/kg q24h</td>
</tr>
<tr>
<td>Pyrazinamide (PO)</td>
<td>Monitor LFTs; vision test</td>
<td>15 to 30 mg/kg q24h</td>
<td>15 to 30 mg/kg q24h</td>
<td>15 to 30 mg/kg q24h</td>
<td>15 to 30 mg/kg q24h</td>
<td>15 to 30 mg/kg q24h</td>
<td>15 to 30 mg/kg q24h</td>
<td>15 to 30 mg/kg q24h</td>
</tr>
<tr>
<td>Rifampin (IV, PO)</td>
<td>Monitor LFTs; vision test</td>
<td>600 mg q24h</td>
<td>600 mg q24h</td>
<td>600 mg q24h</td>
<td>600 mg q24h</td>
<td>600 mg q24h</td>
<td>600 mg q24h</td>
<td>600 mg q24h</td>
</tr>
<tr>
<td><strong>MISCELLANEOUS</strong></td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Clindamycin (IV)</td>
<td>Monitor LFTs; vision test</td>
<td>600 to 900 mg q8h</td>
<td>600 to 900 mg q8h</td>
<td>600 to 900 mg q8h</td>
<td>600 to 900 mg q8h</td>
<td>600 to 900 mg q8h</td>
<td>600 to 900 mg q8h</td>
<td>600 to 900 mg q8h</td>
</tr>
<tr>
<td>Daptomycin (IV)</td>
<td>Monitor LFTs; vision test</td>
<td>6 to 8 mg/kg q24h</td>
<td>6 to 8 mg/kg q24h</td>
<td>6 to 8 mg/kg q24h</td>
<td>6 to 8 mg/kg q24h</td>
<td>6 to 8 mg/kg q24h</td>
<td>6 to 8 mg/kg q24h</td>
<td>6 to 8 mg/kg q24h</td>
</tr>
<tr>
<td>Doxycycline (IV, PO)</td>
<td>Monitor LFTs; vision test</td>
<td>100 mg q24h</td>
<td>100 mg q24h</td>
<td>100 mg q24h</td>
<td>100 mg q24h</td>
<td>100 mg q24h</td>
<td>100 mg q24h</td>
<td>100 mg q24h</td>
</tr>
<tr>
<td>Linezolid (IV, PO)</td>
<td>Monitor LFTs; vision test</td>
<td>600 mg q24h</td>
<td>600 mg q24h</td>
<td>600 mg q24h</td>
<td>600 mg q24h</td>
<td>600 mg q24h</td>
<td>600 mg q24h</td>
<td>600 mg q24h</td>
</tr>
<tr>
<td>Metronidazole (IV, PO)</td>
<td>Monitor LFTs; vision test</td>
<td>500 mg q8-12h</td>
<td>500 mg q8-12h</td>
<td>500 mg q8-12h</td>
<td>500 mg q8-12h</td>
<td>500 mg q8-12h</td>
<td>500 mg q8-12h</td>
<td>500 mg q8-12h</td>
</tr>
<tr>
<td>Metronidazole (PO)</td>
<td>Monitor LFTs; vision test</td>
<td>500 mg q8-12h</td>
<td>500 mg q8-12h</td>
<td>500 mg q8-12h</td>
<td>500 mg q8-12h</td>
<td>500 mg q8-12h</td>
<td>500 mg q8-12h</td>
<td>500 mg q8-12h</td>
</tr>
</tbody>
</table>

**Note:** Adjustments may be necessary based on individual patient factors and laboratory monitoring results.
### Antibiotic Dosage Guidelines

#### General Comments/MIC Considerations

<table>
<thead>
<tr>
<th>Medication</th>
<th>Usual Adult Dose</th>
<th>CrCL &gt;50 mL/min</th>
<th>30 to 50 mL/min</th>
<th>10 to 30 mL/min</th>
<th>&lt;10 mL/min</th>
<th>HEMODIALYSIS</th>
<th>PERITONEAL DIALYSIS</th>
<th>CONTINUOUS RENAL REPLACEMENT (CRRT)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Colistin (IV)</td>
<td>Reduced dose when CrCL &lt;70 mL/min, monitor SCr, electrolytes, neuroactivity</td>
<td>2.5 to 3 mg/kg q24h (can divide dose x 12h)</td>
<td>2.5 to 3 mg/kg load x 1, then 1 to 1.5 mg/kg q24h</td>
<td>2.5 to 3 mg/kg load x 1, then 1 to 1.5 mg/kg q3-5 days</td>
<td>2.5 to 3 mg/kg load x 1, then 1 mg/kg q3-5 days</td>
<td>2.5 to 3 mg/kg load x 1, then 1 mg/kg q3-5 days</td>
<td>2.5 to 3 mg/kg load x 1, then 1 mg/kg q3-5 days</td>
<td>2.5 to 3 mg/kg load x 1, then 1 mg/kg q3-5 days</td>
</tr>
<tr>
<td>Tigecycline (IV)</td>
<td>Severe (Child-Pugh Class C) hepatic impairment: 100 mg x 1, then 50 mg q12h</td>
<td>100 mg x 1, then 50 mg q2h</td>
<td>100 mg x 1, then 50 mg q2h</td>
<td>100 mg x 1, then 50 mg q2h</td>
<td>100 mg x 1, then 50 mg q2h</td>
<td>100 mg x 1, then 50 mg q2h</td>
<td>100 mg x 1, then 50 mg q2h</td>
<td>100 mg x 1, then 50 mg q2h</td>
</tr>
<tr>
<td>Trimethoprim/sulfamethoxazole (IV, PO)</td>
<td>Monitor SCr, WBC, platelet count</td>
<td>2.5 to 5 mg/kg q6-12h (TMP)</td>
<td>2.5 to 5 mg/kg q12h</td>
<td>2.5 to 5 mg/kg q12h</td>
<td>2.5 to 5 mg/kg q24h</td>
<td>2.5 to 5 mg/kg q24h</td>
<td>2.5 to 5 mg/kg q24h</td>
<td>2.5 to 5 mg/kg q24h</td>
</tr>
</tbody>
</table>

1. The dosing recommendations presented here are for >70 kg adults with moderate to severe infections based on published literature and clinical experience. These recommendations should only be used as guidelines and dosing based on pharmacokinetic and clinical evaluation is suggested whenever possible.
2. For antimicrobials dosed every 24 hours in patients on hemodialysis, doses should be administered after dialysis on dialysis days. Alternatively, all doses may be administered once daily in the evening to ensure administration after dialysis on dialysis days.
3. Dosing adjustment may be necessary in patients with severe renal dysfunction.
4. For patients receiving continuous veno-venous hemofiltration (CVVH) or continuous veno-venous hemodiafiltration (CVVHDF) at ≥1 L/h, ND = no data available.
Antibiotic Dosing in Obesity

Obesity can be defined based on the percentage above ideal body weight (% IBW) or based on the body mass index (see Table I). Although several equations have been formulated, the Devine formulas (see Equations 1 and 2) are most frequently used to calculate IBW.

<table>
<thead>
<tr>
<th>Classification</th>
<th>% IBW</th>
<th>Body Mass Index (BMI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal</td>
<td>80 -125% IBW</td>
<td>18.5 -24.9 kg/m²</td>
</tr>
<tr>
<td>Obese</td>
<td>126 -190% IBW</td>
<td>30.0 -39.9 kg/m²</td>
</tr>
<tr>
<td>Morbidly obese</td>
<td>&gt;190% IBW</td>
<td>&gt;40 kg/m²</td>
</tr>
</tbody>
</table>

Equation 1: \( IBW_{(\text{male})} = 50 \text{ kg} + 2.3 \text{ kg} \times (\text{inches over 5ft tall}) \)

Equation 2: \( IBW_{(\text{female})} = 45.5 \text{ kg} + 2.3 \text{ kg} \times (\text{inches over 5ft tall}) \)

Since obesity can impact the distribution and clearance of drugs, changes to the volume of distribution (Vd) and total body clearance (CL) are the key pharmacokinetic parameters that must be considered in calculating the dose of antibiotic necessary to achieve desired serum concentrations. The Vd is physiologically determined by the volume of blood, the volume of body tissues and organs, and the binding of the drug in the tissues relative to the blood. The Vd in obese patients, therefore, depends on the drug’s affinity for and quantity of adipose tissue; a greater affinity for adipose tissue affords a greater volume for drug accumulation. In addition to physiologic determinants, the Vd of antibiotics can be influenced by the drug’s solubility in body water relative to adipose tissue. Most antibiotics are hydrophilic and will distribute into body water better than into adipose tissue (e.g., acyclovir). For these antibiotics, Vd correlates better with lean body mass, or IBW. However, since lean body mass tends to increase along with adipose tissue in obesity, the Vd for some hydrophilic drugs (e.g., aminoglycosides) correlates better with adjusted body weight (ABW). On the other hand, lipophilic compounds (e.g., amphotericin B), may have an
Antibiotic Dosing in Obesity (cont’d)

expanded Vd in obese patients, and thus correlate better with total body weight (TBW). Finally, it should be noted that TBW is also recommended as the basis for dosing certain obese patient populations with hydrophilic antibiotics when (a) the safety of this approach has been demonstrated (e.g., daptomycin), or when (b) clinically significant differences in Vd and CL have not been detected in comparative studies (e.g., dalfopristin-quinupristin).

Calculating the Vd (see Equation 3) can help to determine an appropriate loading dose for obese patients. For this calculation, the Vd determined for a drug in a non-obese population is simply multiplied by a factor that takes into account the excess body weight and corrects for additional distribution of the drug into adipose tissue. A generic correction factor of 0.4 for hydrophilic drugs is an average of factors (0.37-0.58) validated in pharmacokinetic studies of aminoglycosides, but different correction factors are recommended for beta-lactams (0.3) and ciprofloxacin (0.45). Although the generic correction factor of 0.4 is inferred from theoretical data on aminoglycosides, it provides the best current alternative for estimating the parameter for other hydrophilic antibiotics when clinical studies in obese patients are lacking.

**Equation 3:** \( Vd_{(obese)} = Vd_{(non-obese)} \times \text{Adjusted Body Weight} \)

\[ \text{Adjusted Body Weight} = IBW + [(C) \times (TBW - IBW)] \]

*C = correction factor (see explanation in text above and Table III below)*
### Antibiotic Dosing in Obesity

**Literature-Based Antibacterial Dosing Recommendations for Obese Patients**

<table>
<thead>
<tr>
<th>Antibacterial Agent</th>
<th>Primary Considerations</th>
<th>Adult, non-obese, normal renal function</th>
<th>Recommendation(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Vd (L/kg)</td>
<td>t1/2 (h)</td>
<td></td>
</tr>
</tbody>
</table>

#### Aminoglycosides
- **Amikacin**  
  - Aminoglycosides are primarily distributed into extracellular fluids (ECF).  
  - Initial doses should be based on Vd using ABW with correction factor of 0.4 (ABW=IBW+0.4[TBW-IBW]).  
  - Final dosages adjustments should be based on serum concentrations.
  - Final dose: 3 g IV q6h in obese individuals.
  - No dose adjustment recommended.

#### β-Lactam/Penicillins
- **Ampicillin**  
  - Initial dose: 2 g IV q4h to 3 g IV q6h in obese individuals.
  - No dose adjustment recommended.
  - Base dose on diagnosis and CLcr.

#### β-Lactam/Cephalosporins
- **Cefazolin**  
  - In surgical prophylaxis, lower mean serum and adipose tissue concentrations in obese patients.  
  - Higher prophylactic doses needed to achieve serum and tissue concentrations similar to those in non-obese patients.
  - Use 2 g for surgical prophylaxis. - Pories et al. suggest 1 g IV 2h before surgery and at induction of anesthesia, followed by 500 mg IV q6h x 8 doses.

#### β-Lactam/Clavulanate
- **Ticarcillin-Clavulanate**  
  - No data available.  
  - Base dose on CLcr.

#### β-Lactam/Tazobactam
- **Piperacillin-Tazobactam**  
  - Not evaluated in obese patients; multi-center trials studied patients with mean TBW of 73.3 kg, CL and Vd not affected by changes in TBW.
  - No data available.

#### β-Lactam/Cefuroxime
- **Cefuroxime**  
  - Hydrophilic drug, Vd and CL increased 50% and 25%, respectively in patients ranging from 190% to 210% of IBW.
  - No data available.

#### β-Lactam/Ceftazidime
- **Ceftazidime**  
  - No data available.

#### β-Lactam/Ceftriaxone
- **Ceftriaxone**  
  - No data available.

#### β-Lactam/Cefotaxime
- **Cefotaxime**  
  - No data available.

### Notes

In addition to Vd, alterations in total body clearance (CL) should also be considered in determining a maintenance dose and dosing interval necessary to achieve desired steady-state concentrations in obese patients. The Cockcroft and Gault equation is most commonly used in clinical practice to estimate drug clearance, but the accuracy of this method is limited to normal-weight patients. Although obesity generally is associated with an increase in creatinine clearance (CLcr), the original Cockcroft and Gault equation tends to overestimate the parameter, prompting several modifications to the original.

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*Antimicrobial Handbook*
### Antibiotic Dosing in Obesity (cont’d)

Literature-Based Antibacterial Dosing Recommendations for Obese Patients

<table>
<thead>
<tr>
<th>Antibacterial Agent</th>
<th>Primary Considerations</th>
<th>Adult, non-obese, normal renal function (Vd (L/kg) t1/2 (h))</th>
<th>Recommendation(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>β-Lactams/Carbapenems</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ertapenem</td>
<td>AUC, was significantly decreased in obese and morbidly obese patients; however, no dosing adjustment was recommended.</td>
<td>0.11 4</td>
<td>Use standard dose of 1 g/day.</td>
</tr>
<tr>
<td>Meropenem</td>
<td>Increased CL, Vd, and t1/2. Percentage of time the dose was above the MIC during an 8h dosing interval was not significantly different.</td>
<td>0.33-0.43 1</td>
<td>No dose adjustment recommended.</td>
</tr>
<tr>
<td>Imipenem-Cilastatin*</td>
<td>No data available.</td>
<td>0.14-0.33 1</td>
<td>Base dose on CLcr.</td>
</tr>
<tr>
<td><strong>Fluoroquinolones</strong></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Ciprofloxacin</td>
<td>Less distributed to adipose tissue, Vd increased by 23%, increased CL, and lower Cmax, however, concentrations still within recommended therapeutic range.</td>
<td>1.2-2.7 3-6</td>
<td>Dose should be based on Vd using ABW with correction factor of 0.45 (ABW = IBW + 0.45(TBW-IBW)).</td>
</tr>
<tr>
<td>Levofloxacin*</td>
<td>Drug is lipophilic, and widely distributed into body tissues.</td>
<td>1.25 6-8</td>
<td>No information on obesity dosing available. Data suggest obesity may not alter PK. Base dose on CLcr.</td>
</tr>
<tr>
<td>Moxifloxacin*</td>
<td></td>
<td>1.7-2.7 14.8</td>
<td>Use standard dose of 400 mg IV/PO daily.</td>
</tr>
<tr>
<td><strong>Macrolides</strong></td>
<td></td>
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</tr>
<tr>
<td>Azithromycin*</td>
<td>No data available.</td>
<td>23-31 11-68</td>
<td>No information on obesity dosing available.</td>
</tr>
<tr>
<td>Erythromycin</td>
<td>Peak concentrations similar in obese and non-obese adults.</td>
<td>0.57 1-1.5</td>
<td>Base dose on IBW.</td>
</tr>
<tr>
<td><strong>Miscellaneous</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Acyclovir</td>
<td>Pharmacokinetics not significantly different in obese and non-obese groups. Half-life depends on renal function.</td>
<td>0.8 2.2-20</td>
<td>Base dose on IBW.</td>
</tr>
<tr>
<td>Amphotericin B</td>
<td>Drug is lipophilic. Zucker rats with hyperlipoproteinemia: ↓Vd, ↓CL, renal toxicity.</td>
<td>4 360</td>
<td>Use traditional dosing of 0.5-1.5 mg/kg based on TBW.</td>
</tr>
<tr>
<td>Aztreonam*</td>
<td>Drug is lipophilic.</td>
<td>0.1-0.2 1.5-3</td>
<td>Use dose at upper end of range for treating serious infections in morbidly obese adults.</td>
</tr>
<tr>
<td>Clindamycin*</td>
<td>No data available.</td>
<td>0.6-1.2 1.3-5</td>
<td>No information on obesity dosing available.</td>
</tr>
<tr>
<td>Daptomycin</td>
<td>Increased Vd and CL in obese vs. non-obese subjects. Large molecular mass with high polarity, low lipid solubility, and high plasma protein binding. Exposure increased by 25-30% when dose based on TBW, but still safe and tolerated in subjects ranging from 56-147 kg.</td>
<td>0.12 7-11</td>
<td>Base dose on TBW.</td>
</tr>
</tbody>
</table>
Antibiotic Dosing in Obesity (cont’d)

Literature-Based Antibacterial Dosing Recommendations for Obese Patients

<table>
<thead>
<tr>
<th>Antibacterial Agent</th>
<th>Primary Considerations</th>
<th>Adult, non-obese, normal renal function Vd (L/kg)</th>
<th>t1/2 (h)</th>
<th>Recommendation(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Miscellaneous (cont’d)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Doxycycline*</td>
<td>Drug is lipophilic.</td>
<td>0.73</td>
<td>15-24</td>
<td>No information on obesity dosing available.</td>
</tr>
<tr>
<td>Ticarcillin*</td>
<td>Hydrophilic agent, eliminated by kidney.</td>
<td>0.56-0.82</td>
<td>30</td>
<td>A higher dose is recommended (e.g., 1200 mg/day for candida fungemia).</td>
</tr>
<tr>
<td>Linezolid</td>
<td>Prolonged inhibitory activity observed despite ↓ serum concentrations.</td>
<td>0.57-0.86</td>
<td>5</td>
<td>Use standard dose of 600 mg IV/PO q12h.</td>
</tr>
<tr>
<td>Metronidazole*</td>
<td>No data available.</td>
<td>0.23-0.85</td>
<td>6-14</td>
<td>No information on obesity dosing available.</td>
</tr>
<tr>
<td>Sulfamethoxazole-Trimethoprim*</td>
<td>No data available.</td>
<td>0.360 T: 2</td>
<td>5: 8-11 T: 6:17</td>
<td>No information on obesity dosing available.</td>
</tr>
<tr>
<td>Tigecycline*</td>
<td>Study subjects weighed 39-200 kg.</td>
<td>7.9</td>
<td>42</td>
<td>Use traditional dose of 100 mg IV followed by 50 mg IV q12h.</td>
</tr>
<tr>
<td>Vancomycin</td>
<td>Increased Vd and CL in obese patients correlates better with TBW.</td>
<td>0.7</td>
<td>7-9</td>
<td>Base dose on TBW, giving 20-30 mg/kg/day. If necessary, shorten administration interval to maintain serum trough &gt;5 mg/L.</td>
</tr>
<tr>
<td>Voriconazole (oral)</td>
<td>Vd and CL same in obese and non-obese.</td>
<td></td>
<td></td>
<td>Adjustment of oral Voriconazole in patients with Class II obesity is not necessary on the basis of TBW.</td>
</tr>
</tbody>
</table>
## Automatic Therapeutic Interchange

<table>
<thead>
<tr>
<th>Preparation/regimen ordered</th>
<th>Dispensed as</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Ampicillin</strong></td>
<td>Amoxicillin</td>
</tr>
<tr>
<td>• 250 mg po q6h</td>
<td>• 250 mg q8h</td>
</tr>
<tr>
<td>• 500 mg po q6h</td>
<td>• 500 mg q8h</td>
</tr>
<tr>
<td>• 1000 mg po q6h</td>
<td>• 500 mg q8h</td>
</tr>
<tr>
<td><strong>CefAZolin</strong> mg IV q6h</td>
<td>CefAZolin</td>
</tr>
<tr>
<td><strong>Cefuroxime</strong> 1 g IV</td>
<td>Cefuroxime</td>
</tr>
<tr>
<td><strong>Cephalothin</strong> mg IV q6h</td>
<td>CefAZolin</td>
</tr>
<tr>
<td><strong>Ciprofloxacin</strong> 500 mg inj</td>
<td>Ciprofloxacin</td>
</tr>
<tr>
<td><strong>Clindamycin</strong> mg IV q6h</td>
<td>Clindamycin</td>
</tr>
<tr>
<td><strong>Erythromycin IV</strong> all regimens</td>
<td>Azithromycin</td>
</tr>
<tr>
<td><strong>Furazolidone</strong> cap</td>
<td>Furazolidone</td>
</tr>
<tr>
<td><strong>Nitrofurantoin</strong> macrocrystalline formulation</td>
<td>Nitrofurantoin</td>
</tr>
<tr>
<td><strong>Penicillins</strong></td>
<td>Penicillin</td>
</tr>
<tr>
<td>• Penicillin G 500 000 IU (500 mg), oral</td>
<td>Penicillin G inj</td>
</tr>
<tr>
<td>• Penicillin G potassium 250 mg (400 000 IU)</td>
<td>Penicillin G potassium inj</td>
</tr>
<tr>
<td>• Penicillin G potassium 500 mg</td>
<td>Penicillin G potassium inj</td>
</tr>
<tr>
<td><strong>Vancomycin IV inj q3-4h</strong></td>
<td>Vancomycin IV</td>
</tr>
<tr>
<td><strong>Vancomycin cap</strong></td>
<td>Vancomycin cap</td>
</tr>
</tbody>
</table>

See Sequential Antibiotic Therapy (SAT) for information on "pharmacist initiated route of administration" therapeutic interchange.
### Summary of Available Data Evaluating the Compatibility of Ciprofloxacin Coadministered with Enteral Nutrition

<table>
<thead>
<tr>
<th>Study</th>
<th>Patient Population</th>
<th>Study Design and Treatment</th>
<th>Enteral Product (contents mg/100 mL)</th>
<th>Mean Pharmacokinetic Parameters</th>
<th>Study Conclusions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wright et al.</td>
<td>Critically ill intensive care patients</td>
<td>Cipro 500 mg tablet crushed and added to 240 mL of each of the following; Water + calcium, Water + magnesium, Water + sodium, Water</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>De Val et al.</td>
<td>Healthy volunteers, critically ill intensive care patients, and intensive care unit patients</td>
<td>Cipro 750 mg + 60 mL water via nasogastric (NG) tube</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Holmes et al.</td>
<td>Healthy volunteers, critically ill intensive care patients, and intensive care unit patients</td>
<td>Cipro 100 mg IV (1h infusion)</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Cohn et al.</td>
<td>Healthy volunteers, critically ill intensive care patients, and intensive care unit patients</td>
<td>Cipro 750 mg + 120 mL water</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Sheehy et al.</td>
<td>Healthy volunteers, critically ill intensive care patients, and intensive care unit patients</td>
<td>Cipro 750 mg + 60 mL water</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
</tbody>
</table>

**Study Conclusions**
- There is an immediate, and significant loss of FQ bioavailability when mixed with Ensure (average decrease of 82.5 ± 5.1% for ciprofloxacin and 61.3% ± 0.6 for levofloxacin). An explanation for the loss of in vitro fluoroquinolone concentrations after admixture with an enteral feeding for many pathogenic bacteria. Switching from parenteral antibiotics to oral ciprofloxacin in a patient receiving Ensure could result in undesirably low concentrations in serum.
- GI absorption of ciprofloxacin in tube fed critically ill patients was decreased, but well above MIC values those following oral administration on an empty stomach. Co-administered with cipro by the oral or j-tube g-tube.
- GI absorption of ciprofloxacin in tube fed critically ill patients was decreased, but well above MIC values those following oral administration on an empty stomach. Co-administered with cipro by the oral or j-tube g-tube.

**Note:** Concomitant use in all other patients at clinical discretion. If used, space quinolone and feeds by 2-4 hours.
Aminoglycoside Antibiotics – Dosing and Monitoring Guidelines

In spite of recent advances made with the introduction of extended spectrum beta-lactam antibiotics, the aminoglycosides remain a major class of antibiotics for the treatment of serious Gram negative infections.

1. SPECIFIC AMINOGLYCOSIDES
   - Gentamicin
   - Tobramycin
   - Amikacin

2. ADVERSE EFFECTS
   Associated toxicities are primarily those of ototoxicity (evidenced by sometimes irreversible hearing loss in the high and low frequency range, nausea, tinnitus and vertigo) and nephrotoxicity (generally reversible acute tubular necrosis signalled by elevations in serum creatinine). Several factors contribute to the risk of aminoglycoside toxicity:
   - Length of therapy > 10 days
   - Renal insufficiency
   - Elevated aminoglycoside trough serum concentrations
   - Concomitant nephrotoxic and ototoxic drugs
   - Recent prior exposure to nephrotoxic medications (e.g. aminoglycosides, amphotericin B, cyclosporine, etc.)
   - Pre-existing cochlear/vestibular dysfunction
   - Sodium/volume depletion
   - Old age
   - Renal transplants

3. MONITORING
   Certain baseline monitoring parameters should be obtained and followed at the recommended time intervals whenever possible.

<table>
<thead>
<tr>
<th>Baseline Parameter</th>
<th>Follow-up</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weight, height</td>
<td>Weekly as appropriate</td>
</tr>
<tr>
<td>Blood urea nitrogen</td>
<td>Twice weekly</td>
</tr>
<tr>
<td>Serum creatinine</td>
<td>Twice weekly</td>
</tr>
<tr>
<td>(Unstable renal function)</td>
<td>(Daily)</td>
</tr>
<tr>
<td>Intake and output</td>
<td>As required</td>
</tr>
<tr>
<td>Clinical and laboratory parameters of infection (WBC, temperature)</td>
<td>As appropriate</td>
</tr>
</tbody>
</table>
In addition, audiograms are recommended for patients at risk.
- Patients with pre-existing hearing disorders.
- Concurrent ototoxic drugs (e.g. cisplatin).
- Prior exposure to a therapeutic course of an aminoglycoside (within 3 months).
- Aminoglycoside therapy anticipated to exceed 14 days.

Monitoring of serum aminoglycoside concentrations is discussed within the dosing guidelines.

4. ONCE-DAILY DOING GUIDELINES

RECOMMENDATION

Upon the advice of the Antimicrobial Agents Sub-Committee and the District Drugs and Therapeutics Committee, patients receiving aminoglycoside therapy may be prescribed a once-daily dosing schedule. Please see Table 1 for appropriate dosing interval for patients with a CLcr between 20 and 59 mL/min.

a) PATIENT EXCLUSION:
- Dialysis
- Renal failure (CLcr < 20 mL/min)
- Single prophylactic dose before an operative or diagnostic procedure
- Ascites
- Burns (> 20%)
- Low level synergy in which peaks of 3-5 mg/L are required and more frequent dosing preferred (i.e. enterococcus, staph, endocarditis)
- Peritonitis
- Pseudomonas
- Clostridium perfringens

b) DOSAGE
- Determine dosing weight:
  For non-obese patients their actual body weight (ABW) is the dosing weight
  For obese patients (i.e. 20% above ideal body weight (IBW)), calculate dosing weight as follows: Obese dosing weight = IBW + 0.4 (ABW - IBW)
- The recommended dose of gentamicin or tobramycin is 6 mg/kg and 15 mg/kg for amikacin in 100 mL of a compatible intravenous solution infused over 1 hour

  c) DOSING INTERVAL

Determine the patient’s creatinine clearance (CLcr) and choose the corresponding dosing interval from Table 1.

Table 1. Dosing Interval

<table>
<thead>
<tr>
<th>Creatinine Clearance (mL/min)</th>
<th>Dosing Interval</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt; 60</td>
<td>q24h</td>
</tr>
<tr>
<td>40-59</td>
<td>q36h</td>
</tr>
<tr>
<td>20-39</td>
<td>q48h</td>
</tr>
<tr>
<td>&lt; 20</td>
<td>Avoid once daily dosing</td>
</tr>
</tbody>
</table>

Aminoglycoside Antibiotics – Dosing and Monitoring Guidelines (cont’d)
Aminoglycoside Antibiotics – Dosing and Monitoring Guidelines (cont’d)

d)  SERUM DRUG MONITORING

Standard peak and trough concentrations are not necessary. However, some patients should receive a level (6 hours before the end of the dosing interval) to be obtained on the 1st dose and every 4 days thereafter; to assess for adequate clearance. The level for gentamicin/tobramycin should be ≤1 mg/L and amikacin <2.5 mg/L. Levels should be routinely monitored in the following:

- patients with Clcr between 40-59 mL/min (i.e. q36h)
- patients with Clcr between 20-39 mL/min (i.e. q48h)
- patients in the ICU
- aminoglycoside therapy > 5 days
- Clcr decrease from baseline > 25%
- infections involving highly resistant organisms
- patients on concurrent nephrotoxins
- patients > 65 years of age

Levels need not be obtained for patients with all of the following criteria:

- < 65 years old
- Clcr > 60 mL/min
- not receiving concurrent nephrotoxins
- not receiving renal contrast media

CYSTIC FIBROSIS PATIENTS

Tobramycin Dosing

Dose according to estimated CrCl

- CrCl ≥50 mL/min = 10 mg/kg/24 h
- CrCl 30-49 mL/min = 10 mg/kg/36 h
- CrCl 20-29 mL/min = 10 mg/kg/48 h
- CrCl <20 mL/min, ARF = 3 mg/kg x 1 CONSULT PHARMACY

Labs

At the time of writing for Once Daily Dosing, please order:
Pre level (6 hours before next dose)

Dosage Increases

If pre level (drawn 6 hours before the next dose) is undetectable, consider increasing the tobramycin dosage to 12.5 mg/kg/day.
Repeat 6 hours pre level on new dosage.

Maximum Tobramycin Dosage

Maximum dosage is 15 mg/kg/day
When using this dosage >10 mg/kg/day, order peak levels 90 minutes after the end of the infusion, in addition to pre levels.
Peak levels must not exceed 50 mg/L (or 50 ug/mL)
Use of Other Aminoglycosides
There are insufficient data in CF patients for guiding once daily dosing of other aminoglycosides. If other aminoglycoside use is needed, use conventional dosing guidelines (i.e. every 8 to 12 hours with normal renal function). Because of the rapid clearance of aminoglycosides in CF patients, expert assistance from the pharmacokinetics service is suggested if administration of other aminoglycosides is needed.

5. TRADITIONAL DOSING GUIDELINES
For patients falling within the exclusion criteria for once-daily dosing traditional dosing guidelines can be used.

a) DOSING
- Determine dosing weight as in once-daily dosing guidelines. For patients with edema or ascites the patient's actual body weight should be used to account for drug distribution into the large extravascular fluid compartments.
- The recommended loading dose for gentamicin or tobramycin is 1.5 - 2.0 mg/kg followed by 1.5 mg/kg every 8 hours for patients with normal renal function.
- The recommended dose for amikacin is 7.5 mg/kg given every 12 hours for patients with normal renal function.

b) DOSING IN RENAL INSUFFICIENCY
The initial (loading) dose is the same as for adults with normal renal function. However, the maintenance dosage regimen is adjusted based upon the degree of renal insufficiency. See Table 2 for appropriate interval and percentage of loading dose to be used as maintenance dose.
c) SERUM DRUG MONITORING

The purpose of measuring the serum drug concentration at steady state is to confirm that therapeutic concentrations have been achieved and drug accumulation has not taken place. When treatment is anticipated to be >72 hours, pre (trough) and post (peak) pairs should be obtained after steady state conditions are achieved (with 4th or 5th dose).

Table 2. Maintenance Dose Nomogram for Aminoglycoside Antibiotics (Adults)

<table>
<thead>
<tr>
<th>CLcr (mL/min)</th>
<th>Estimated Half-life (h)</th>
<th>Dosing Interval (%)</th>
<th>8 h</th>
<th>12 h</th>
<th>24 h</th>
</tr>
</thead>
<tbody>
<tr>
<td>90</td>
<td>1.5</td>
<td>3.1</td>
<td>84%</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>80</td>
<td>1.33</td>
<td>3.4</td>
<td>80</td>
<td>91%</td>
<td>-</td>
</tr>
<tr>
<td>70</td>
<td>1.17</td>
<td>3.9</td>
<td>76</td>
<td>88%</td>
<td>-</td>
</tr>
<tr>
<td>60</td>
<td>1.0</td>
<td>4.5</td>
<td>71</td>
<td>84%</td>
<td>-</td>
</tr>
<tr>
<td>50</td>
<td>0.83</td>
<td>5.3</td>
<td>65</td>
<td>79%</td>
<td>-</td>
</tr>
<tr>
<td>40</td>
<td>0.67</td>
<td>6.5</td>
<td>-</td>
<td>72%</td>
<td>92%</td>
</tr>
<tr>
<td>30</td>
<td>0.50</td>
<td>8.4</td>
<td>-</td>
<td>63%</td>
<td>86%</td>
</tr>
<tr>
<td>25</td>
<td>0.42</td>
<td>9.9</td>
<td>-</td>
<td>57%</td>
<td>81%</td>
</tr>
<tr>
<td>20</td>
<td>0.33</td>
<td>11.9</td>
<td>-</td>
<td>50%</td>
<td>75%</td>
</tr>
<tr>
<td>17</td>
<td>0.28</td>
<td>13.6</td>
<td>-</td>
<td>46%</td>
<td>70%</td>
</tr>
<tr>
<td>15</td>
<td>0.25</td>
<td>15.1</td>
<td>-</td>
<td>42%</td>
<td>67%</td>
</tr>
<tr>
<td>12</td>
<td>0.20</td>
<td>17.9</td>
<td>-</td>
<td>-</td>
<td>61%</td>
</tr>
</tbody>
</table>

*Target post serum concentrations may need to be in excess of 8 mg/L (> 25 mg/L for amikacin) for patients with severe gram-negative infections (e.g. sepsis, pneumonia, endocarditis).


Table 3. Target Serum Aminoglycoside Concentrations

<table>
<thead>
<tr>
<th>Desired Post* (peak)</th>
<th>Gentamicin mg/L</th>
<th>Tobramycin mg/L</th>
<th>Amikacin mg/L</th>
</tr>
</thead>
<tbody>
<tr>
<td>Urinary tract infections</td>
<td>4-6</td>
<td>16-20</td>
<td></td>
</tr>
<tr>
<td>Serious infections</td>
<td>6-8</td>
<td>20-25</td>
<td></td>
</tr>
<tr>
<td>Synergy for gram positive infections only (e.g. enterococcus)</td>
<td>3-5</td>
<td>-</td>
<td></td>
</tr>
</tbody>
</table>

*Target post serum concentrations may need to be in excess of 8 mg/L (> 25 mg/L for amikacin) for patients with severe gram-negative infections (e.g. sepsis, pneumonia, endocarditis).
Aminoglycoside Antibiotics – Dosing and Monitoring Guidelines (cont’d)

Serum Sampling Technique

- Pre (trough) - Immediately before a dose (within 30 minutes)
- Post (peak) - 30 minutes after a 1/2-1 hour infusion, or
  - 1 hour following an IM injection
- Specimen should be taken from opposite limb to the site of drug infusion.
- The timing of drug administration and sample collection must be carefully documented.

Additional serum drug sampling should be carried out twice weekly for most patients. For patients with stable renal and hydration status showing good clinical response and lack of toxicity once weekly serum drug sampling is sufficient.

Patient Information Sheet - Aminoglycoside Treatment

You have been prescribed an antibiotic which is called an aminoglycoside. Aminoglycoside antibiotics include drugs such as gentamicin, tobramycin and amikacin. Aminoglycosides have been available for the treatment of bacterial infections for over 30 years and are highly effective agents. Your doctor has prescribed an aminoglycoside for you because they consider it to be the best option to treat the infection you have, at this time. Unfortunately, like most medications, there are potential side effects that may occur when aminoglycosides are used. Aminoglycosides may cause reversible kidney damage in 5-10% of patients receiving more than 5 days of treatment with the aminoglycoside, and may cause irreversible hearing loss or imbalance and dizziness in less than 1% of patients receiving more than 10-14 days of therapy.

- To minimize the risk of kidney damage, your care-givers are monitoring your kidney function weekly, with the use of blood tests.
- To minimize the risk of hearing loss, you should report any symptoms of ringing in the ears, feeling of fullness in the ears, earache, or hearing loss to your care-givers immediately, so that your aminoglycoside therapy can be re-evaluated.
- To minimize the risk of problems with your balance, you should report any symptoms of dizziness, unsteady walking, and loss of balance to your care-givers immediately, so that your aminoglycoside therapy can be re-evaluated.
- If it is necessary to treat your infection for more than 14 days, you will undergo a hearing function test. The first test will be done right away and then about 2 weeks after aminoglycoside therapy begins. Additional testing will also be done at any time that you report symptoms of hearing or balance problems.

If you have any additional questions about your aminoglycoside therapy, please speak with your doctors or the ward pharmacist. Your nurse can arrange for either your pharmacist or physician to come and speak with you about your aminoglycoside therapy.
Amphotericin B Deoxycholate Guidelines for Intravenous Administration

Amphotericin B (AMB) is indicated for the treatment of systemic fungal infections and for empiric therapy in febrile neutropenic patients.

ADMINISTRATION

• Reconstitute 50 mg vial with 10 mL of sterile water for injection without preservative. The reconstituted vial is stable for 24 hours at room temperature or if refrigerated.
• Further dilute reconstituted vial in D5W to a maximum concentration of 0.1 mg/mL. If amphotericin B is to be administered via a central line, a concentration of up to 0.25 mg/mL may be administered. (Not compatible with NaCl solutions).
• Infuse over 4-6 hours, however the drug may be given over 2 hours if cardiac and renal status permit.

DOSAGE

• There is no need to administer a test dose as there is no evidence to suggest that a test dose is predictive of a systemic reaction to AMB and may result in a delay of therapy, especially in life threatening situations.
• Begin therapy with 0.25 mg/kg - 0.5 mg/kg depending on the infection and acuity of the problem.
• Monitor pulse, temperature and blood pressure every 15 minutes during the first infusion for one hour.
• On the next day the dose may be increased to 1.0 mg/kg depending on tolerance and the type of infection being treated.
• A dose of 1.0 mg/kg/day should not be exceeded without consulting Infectious Disease.
• It is recommended never to exceed a maximum daily dose of 1.5 mg/kg.

SIDE EFFECTS

For prevention of adverse systemic effects (i.e. fever, chills, myalgias, nausea, vomiting) 25-50 mg hydrocortisone IV, 650 mg oral acetaminophen and 25-50 mg oral diphenhydramine may be administered 30 minutes prior to amphotericin B. (There is no need to premedicate patients not manifesting these adverse reactions).

Severe chills, rigors (refractory to hydrocortisone) 50 mg meperidine IV in 10 mL NS over 5 minutes.

Phlebitis Rotate the infusion sites and/or double the daily dose on alternate days and/or administer over 4-6 hours. Administer via central line.

Hypokalemia Serum potassium daily. Potassium supplements as required, consider amiloride.

Hypomagnesemia Serum magnesium 2 times weekly. Magnesium supplements as required.

Renal toxicity Serum creatinine three times weekly. Maintain adequate hydration. If deemed appropriate, 500 mL NS may be infused before each dose of amphotericin B.

Management/Prevention Measures

Antimicrobial Handbook
Amphotericin B Deoxycholate Guidelines for Intravenous Administration (cont’d)

Management of Adult Patients on Amphotericin B

Fungal infection suspected/documented - Amphotericin B indicated?

Yes

Amphotericin B (See over for Administration and Monitoring)

<table>
<thead>
<tr>
<th>Indication</th>
<th>Dose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Empiric Therapy for Febrile Neutropenia</td>
<td>0.6 mg/kg IV dose</td>
</tr>
<tr>
<td>Invasive Candidiasis</td>
<td>0.5-1 mg/kg IV daily x minimum of 14 days after last (+) blood culture</td>
</tr>
<tr>
<td>Invasive Aspergillosis</td>
<td>1-1.5 mg/kg IV daily</td>
</tr>
<tr>
<td>C. lusitaniae and C. guilliermondii usually resistant to Amphotericin B</td>
<td></td>
</tr>
</tbody>
</table>

Assess fluid status

Overloaded

Normal

Depleted

Assess Na status

High (>146 mmol/L)

Normal (133-146 mmol/L)

Low (<133 mmol/L)

Consider 0.45% NaCl

1 L IV before ± after each Amphotericin B dose

Recommend 0.9% NaCl

500 mL IV before ± after each Amphotericin B dose to prevent Na and intravascular volume depletion and nephrotoxicity

EXCEPTIONS

Patients who cannot tolerate additional Na and/or fluid, e.g. fluid overloaded, CHF, pulmonary edema, renal failure

Assess K and Mg status

High (K > 5.0 mmol/L)

Normal (K 3.5-5.0 mmol/L)

Low (K < 3.5 mmol/L)

Consider Amiloride

5-10 mg PO bid

High-Risk for Hypokalemia/Hypomagnesemia or consequences of same?

- Acute leukemia
- CHF
- Atrial fibrillation
- TIDM
- Moderate-severe hepatic insufficiency
- Receiving loop/thiazide diuretics, long-term steroids, laxatives

CAUTION IN:

- elderly, diabetics, patients with renal or adrenal insufficiency, hyperkalemia, hypermagnesemia, concomitant administration with ACE inhibitors, NSAIDs

Recommend Amiloride

5-10 mg PO bid

No

Yes

1. Monitor K+ closely. May still need to give additional K+ supplementation.
Amphotericin B Deoxycholate Guidelines for Intravenous Administration (cont’d)

Administration of Amphotericin B

**Infusion**
- **Peripheral line** - infuse dose over 4-6 hours
  - maximum concentration 0.1 mg/mL
- **Central line** - infuse dose over 2-4 hours
  - maximum concentration 0.25 mg/mL*
  * (concentrations up to 1.4 mg/mL are soluble in D5W and may be considered in fluid restricted patients)

**Premedication**
Routine premedication NOT recommended. May be given if infusion-related reaction occurs and then as pre-treatment with subsequent doses.

- Fever/chills/rigors: Meperidine 25-50 mg IV
- Fever: Acetaminophen 650 mg PO (max 4 g/day)
- Nausea/vomiting: Diphenhydramine 25-50 mg PO/IV, Metoclopramide 10 mg IV

Give premedication 30 minutes prior to Amphotericin B

AVOID OTHER NEPHROTOXIN (e.g. NSAIDS, aminoglycosides, vancomycin, etc.)

**Routine Monitoring of Amphotericin B Therapy**

| Renal deterioration? | Yes | 1. Ensure sodium supplemented appropriately AND
| e.g. doubling of serum creatinine from baseline while receiving Amphotericin B therapy | No | Further/continued renal deterioration? e.g. tripling of serum creatinine from baseline OR serum creatinine ≥ 250 mmol/L.
| No | Option: 1. Lipid-complex Amphotericin B (ABLC) (Must be prescribed by Infectious Diseases or Hematology) OR
| Continue current therapy and monitoring* | 2. Continuous infusion* of Amphotericin B (same daily dose infused over 24 hours) OR
| | 3. Micafungin (Must be prescribed by Infectious Diseases or Hematology)

*Routine Monitoring:
- Cardiovascular status (HR, BP)
- Respiratory status (RR <20/min dependent upon baseline and underlying illness)
- Body weight (assess fluid status)
- Fluid intake and output (Ins/Outs)
- CBC with differential
- Serum K/Na/Ca/Mg
- Renal Function (i.e. Scr/BUN)
- Liver function tests

*Continuous Infusion - NOT Routinely Recommended.
Amphotericin B Lipid Complex (ABLC) Guidelines for Intravenous Administration

Lipid complex formulations of amphotericin B allow for higher doses to be administered and have lower incidence of adverse events relative to the conventional formulation. However, because lipid complex formulations of amphotericin B are significantly more expensive than the deoxycholate formulation ($500/day vs <$50/day for a 75 kg patient), it is necessary to reserve the drug for patients who meet the following criteria:

Evidence of serious systemic fungal infection
Culture/histology evidence for serious systemic fungal infections and/or evidence of invasive disease in patients at risk for disseminated fungal infections (i.e. BMT patients) with clinical signs of infection despite antimicrobial therapy.

AND/OR

Evidence of deteriorating renal function
Serum creatinine has doubled since baseline at initiation of therapy or creatinine clearance is less than 60 mL/minute (hematological malignancies, BMT patients). Which is sustained for 48 hours or more despite the use of saline boluses and careful attention to K and Mg levels and review of other nephrotoxic medications for possible discontinuation.

AND/OR

The patient is not a candidate for high dose fluconazole or itraconazole because of lack of efficacy or adverse events or in the case of IV itraconazole lack of availability as well.

NOTE:
Previous exposure of lipid complex amphotericin B does not automatically infer that a patient will receive the lipid product during a subsequent treatment for fungal infections (i.e hematologic patients).

Procedure for Obtaining Amphotericin B Lipid Complex

- Initial order by ID or hematology physician in consultation.
- Patient must meet criteria for use.
- Each (ABLC) therapy regimen should be reviewed at least twice weekly by an ID or hematologic physician. If renal function appears to be normalizing, the use of traditional amphotericin B should be strongly considered.
# Recommendations for the Treatment of *Staphylococcus aureus* Bacteremia

<table>
<thead>
<tr>
<th>Category</th>
<th>Criteria</th>
<th>Therapy</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Simple bacteremia</strong></td>
<td>All of the following: 1. TEE on d 5-7 of therapy that was negative for both vegetations and predisposing valvular abnormalities 2. Negative surveillance blood culture obtained 2-4 d after starting appropriate antibiotic therapy and removal of focus 3. Removable focus of infection 4. Clinical resolution (afebrile and no localizing complaints attributable to metastatic infection within 72 h of starting therapy and removal of focus) 5. No indwelling prosthetic devices</td>
<td>7 d IV antibiotics</td>
</tr>
<tr>
<td><strong>Uncomplicated bacteremia</strong></td>
<td>One or more of the following: 1. Predisposing valvular abnormalities (more than mild regurgitation) or no vegetations shown by TEE 2. Positive surveillance blood culture 3. Superficial, non-removable focus of infection 4. Persistent signs of infection after 72 h of antibiotic therapy</td>
<td>14 d IV antibiotics</td>
</tr>
<tr>
<td><strong>Endocarditis</strong></td>
<td>According to Duke criteria</td>
<td>4-8 wk IV antibiotics</td>
</tr>
<tr>
<td><strong>Extracardiac</strong></td>
<td>All of the following: 1. TEE negative for vegetations 2. Deep-tissue infection</td>
<td>4-8 wk IV antibiotic</td>
</tr>
</tbody>
</table>
Management of Peritonitis
(Nephrology)

Patient: ___________________  Allergies: ___________________

1. Investigations
   - Within 48–72h of initiating antibiotic therapy, assess clinical improvement. Consult with physician/nurse practitioner if there is no improvement
   - Repeat peritoneal dialysis (PD) effluent culture as well as profile with differential q48h for the first week and until negative culture result obtained
   - Once negative result obtained, continue sending PD effluent weekly until antibiotic treatment has been completed

2. Medications:
   - Stop empiric antibiotic therapy and choice of subsequent antibiotic therapy based on culture and sensitivity and patient allergy status. See below for antibiotic options. Intraperitoneal (IP) (6h long dwell) preferred. Intravenous (IV) administration only for patients where IP antibiotics cannot be utilized

   i) Gram-positive organisms on culture (Staphylococcus Aureus, Coagulase-Negative Staphylococcus, Streptococcus spp.)
      - CeFAZolin 20 mg/kg IP or IV daily:  (Circle Route of Administration)
        - Weight less than 60 kg = 1 g
        - Weight 60–80 kg = 1.5 g
        - Weight greater than 80 kg = 2 g
      - OR
        - Vancomycin (cephalosporin allergy and/or bacterial resistance to first-generation cephalosporin)
          - 30 mg/kg IP x _______ kg (most recent total body weight) = _______mg IP EVERY 5 DAYS – approximately 3–5 doses
          - 20 mg/kg IV x _______ kg (most recent total body weight) = _______mg IV EVERY 5 DAYS – approximately 3–5 doses

   Duration of therapy
   - Staphylococcus aureus = at least 21 days
   - Other gram-positive organisms = 14 days
   - Peritonitis with exit site or tunnel infection = 14–21 days

Prescriber’s Signature: ___________________  Date (yyyy/mm/dd): __________
Prescriber’s Name: ___________________  Reg. No.: __________

Antimicrobial Handbook
3. Medications continued...

ii) Enterococcus spp. on culture (Duration of therapy 21 days)

Ampicillin (if sensitive)

- Ampicillin 1 g IP daily
- Ampicillin 1 g IV daily

OR

Vancomycin (penicillin allergy and/or ampicillin resistance)

- 30 mg/kg IP x _________ kg (most total body weight) = ________mg IP EVERY 5 DAYS – approximately 3–5 doses
- 20 mg/kg IV x _________ kg (most total body weight) = ________mg IV EVERY 5 DAYS – approximately 3–5 doses

PLUS

Gentamicin

- Gentamicin 0.6 mg/kg IP x _________ kg (IBW) = ________mg IP daily (round to the nearest 20 mg)
- Gentamicin 0.6 mg/kg IV x _________ kg (IBW) = ________mg IV daily (round to the nearest 20 mg)

- See Section 3 for gentamicin monitoring

iii) Culture Negative Peritonitis

- Continue initial empiric antibiotic therapy for 14 days (from PPO0395MR)

- Repeat PD effluent culture and profile with differential

- If culture positive, adjust therapy/duration based on organism identified (see appropriate section i-vii of this PPO for antibiotic options)

- If culture still negative and no clinical improvement, consult physician to consider catheter removal and continue initial empiric antibiotic therapy for at least 14 days after catheter removal.

iv) Pseudomonas spp. on culture

- Select two anti-pseudomonal antibiotics (if feasible) with differing mechanisms that organism is sensitive to and patient is not allergic to (Duration at least 21 days)

- Ciprofloxacin 500 mg po bid
- Ciprofloxacin 400 mg IP daily. Change to po once vomiting resolves
- Ciprofloxacin 400 mg IV daily. Change to po once vomiting resolves

- CeftAZidime 1 g IP daily
- CeftAZidime 500 mg IV daily
- Piperacillin/tazobactam 3.375 g IV q12h
- Imipenem/cilastatin 500 mg IV daily (Restricted– See Capital Health Formulary)

- Gentamicin 0.6 mg/kg IP x _________ kg (IBW) = ________mg IP daily (round to nearest 20 mg)
- Gentamicin 0.6 mg/kg IV x _________ kg (IBW) = ________mg IV daily (round to nearest 20 mg)

- Other Antibiotic Order

- See Section 3 for gentamicin monitoring

Prescriber’s Signature ___________________________ Date (yyyy/mm/dd) __________

Prescriber’s Name ___________________________ Reg. No. __________
2. Medications continued...

v) Single Gram-Negative Organisms on culture

E.coli, Proteus, Klebsiella spp. on culture

- Choose two antibiotics (if feasible) based on sensitivity for 14–21 days
  - CeFAZolin 20 mg/kg IP or IV daily
    - Weight less than 60 kg = 1 g
    - Weight 60-80 kg = 1.5 g
    - Weight greater than 80 kg = 2 g
  - CeftAZIDime 1g IP daily
  - CeftAZIDime 500 mg IV daily
  - Ciprofloxacin 500 mg po bid
    - If vomiting, Ciprofloxacin 400 mg IP daily. Change to po once vomiting subsides
    - If vomiting, Ciprofloxacin 400 mg IV daily. Change to po once vomiting subsides

Other Antibiotic Order:

Stenotrophomonas spp. on culture

- Choose two antibiotics (if feasible) with differing mechanisms based on sensitivity for 21–28 days
  - Trimethoprim/sulfamethoxazole DS (160 mg/800 mg) 1 tablet po daily
  - CeftAZIDime 1 g IP daily
  - CeftAZIDime 500 mg IV daily
  - Ticarcillin/clavulanate 3.1 g IV q6h (Restricted- See Capital Health Formulary)

Other antibiotic order:

Enterobacter, Citrobacter, Serratia, Morganella and Providentia spp. on culture

- Choose two antibiotics (if feasible) with differing mechanisms based on sensitivity
  - Ciprofloxacin 500 mg po bid
    - If vomiting, ciprofloxacin 400 mg IP daily. Change to oral once vomiting resolves for 14 to 21 days
  - Ciprofloxacin 500 mg IV daily
    - If vomiting, ciprofloxacin 400 mg IV daily. Change to oral once vomiting resolves
    - Trimethoprim/sulfamethoxazole DS (160 mg/800 mg) 1 tablet po daily
    - Imipenem/cilastatin 500 mg IV/IV (Restricted- See Capital Health Formulary)

Other Antibiotic Order:

Other Antibiotic Order:

See Section 3 for gentamicin monitoring

Prescriber’s Signature: ___________________ Date (yyyy/mm/dd): ______________
Prescriber’s Name: ___________________ Reg. No. _________

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vi) Polymicrobial Peritonitis on Culture

Multiple gram-negative organisms or mixed gram-negative/gram-positive (high index of suspicion for intestinal origin) (Duration of therapy 14 to 21 days.)

Choose one
- Metronidazole 500 mg po q12h
  - If vomiting, metronidazole 500 mg IV q12h

Pick: Choose one
- Ampicillin (if sensitive) 1 g IP daily
- Ampicillin (if sensitive) 1 g IV daily
- Vancomycin (penicillin allergy and/or ampicillin resistance)
  - 30 mg/kg IP \( \times \) _____ kg (most recent body weight) = _____ mg IP q5days – approximately 3–5 doses
  - 20 mg/kg IV \( \times \) _____ kg (most recent body weight) = _____ mg IV q5days – approximately 3–5 doses

Pick: Choose one
- CeftAZIDime (if sensitive) 1 g IP daily
- CeftAZIDime (if sensitive) 500 mg IV daily
- Ciprofloxacin 500 mg po bid
  - If vomiting, Ciprofloxacin 400 mg IP daily. Change to oral once vomiting resolves
- If vomiting, Ciprofloxacin 400 mg IV daily. Change to oral once vomiting resolves
- Gentamicin 0.6 mg/kg IP \( \times \) _____ kg (IBW) = _____ mg IP daily (round to nearest 20 mg)
- Gentamicin 0.6 mg/kg IV \( \times \) _____ kg (IBW) = _____ mg IV daily (round to nearest 20 mg)

Other Antibiotic Order: _____________________________________________________

vi) Fungal Peritonitis

- Fluconazole (if sensitive) 200 mg po daily for 10 days
- If vomiting, fluconazole 200 mg IV daily for 10 days
- Remove catheter once fungi confirmed by culture

3. Monitoring

- Pre (trough) gentamicin level before the fourth dose. Additional serum gentamicin sampling should be carried out twice weekly. Audiograms are recommended at baseline (right away) and again if aminoglycoside therapy anticipated to exceed 14 days
Empiric Management of Peritonitis
(Nephrology)

Patient: ____________________________
Allergies: ____________________________

1) INVESTIGATIONS:
   - Send cloudy effluent ASAP for gram stain, culture and profile with differential
   - Repeat above q48h for the first week and until negative culture result obtained
   - Once negative result obtained, continue sending PD effluent weekly until antibiotic treatment has been completed

2) MEDICATIONS:
   a) Initiate Empiric Antibiotic Therapy: Intraperitoneal (IP) (6h long dwell) preferred
      IV administration only in patients whom IP antibiotics cannot be utilized
      - CefAZolin: 20 mg/kg IP or IV daily
          - Wt less than 60 kg = 1 g
          - Wt 60–80 kg = 1.5 g
          - Wt greater than 80 kg = 2 g
      OR
      - for patient allergic to cephalosporin:
        - Vancomycin:
          - 30 mg/kg IP x _____ kg (most recent total body weight) = _____ mg IP EVERY 5 DAYS
          - 20 mg/kg IV x _____ kg (most recent total body weight) = _____ mg IV EVERY 5 DAYS
      PLUS All patients should receive one of the following:
        - Ciprofloxacin 500 mg po bid
        - If vomiting, ciprofloxacin 400 mg IP daily. Change to po once vomiting resolves
        - If vomiting, ciprofloxacin 400 mg IV daily. Change to po once vomiting resolves
        - If patient allergic to ciprofloxacin, ceftAZIDime 1 g IP daily
        - If patient allergic to ciprofloxacin, ceftAZIDime 500 mg IV daily

   b) Non-Antibiotic Medication:
      - Hold oral iron, phosphate binders such as calcium carbonate (Tums®) until peritonitis has resolved.
      - Heparin 500 units/L of Dianeal® fluid IP for fibrin in effluent until clear
      - Ultrafiltration problems: use 2.5% Dianeal® exchanges (with short dwell times of 2-3 hours) as opposed to longer dwells with 4.25% Dianeal®

   c) Subsequent Antibiotic Therapy: Based on 48–72h culture results (See Management of Peritonitis Pre-Printed Order PPO0394MR)

Prescriber’s Signature: ____________________________
Date (yyyy/mm/dd): ____________________________

Prescriber’s Name: ____________________________
Reg. No.: ____________________________
Treatment of Candidemia

Suspected or confirmed candidemia

Drug Therapy

1st choice:
- Amphotericin B 0.6-1.0 mg/kg/day IV
  OR
  - Fluconazole 400-800 mg/day IV or PO if tolerated*
  OR
  - Micafungin 100 mg IV daily

Alternate:
- Amphotericin B 0.7 mg/kg/day IV
  OR
  - Fluconazole 800 mg/day IV or PO for 4-7 days, then Fluconazole 800 mg/day IV or PO*
  OR
  - Micafungin 100 mg IV daily

❖ Continue therapy for 14 days after the last positive blood culture and/or resolution of signs and symptoms

No

% is the patient neutropenic?

Yes

❖ Give at least 1 ophthalmologic exam to exclude candidal endophthalmitis at a time when the candidemia is controlled

❖ If the patient was neutropenic wait until they have recovered for eye examination

❖ Failure to respond to therapy

❖ Consider susceptibility testing if there is a failure to respond to therapy as azole resistant C. albicans, C. glabrata and C. krusei are becoming more common

❖ Removal of intravascular catheters if feasible

Drug Therapy

1st choice:
- Amphotericin B 0.7-1.0 mg/kg/day IV
  OR
  - Lipid formulation Amphotericin B 3.0-6.0 mg/kg/day IV

Alternate:
- Fluconazole 6-12 mg/kg/day IV or PO if tolerated*
  OR
  - Micafungin 100 mg IV daily

❖ Continue therapy for 14 days after the last positive blood culture and/or resolution of symptoms and resolution of the neutropenia

❖ May be necessary if lack of recovery from neutropenia with GCSF

❖ If endocarditis is suspected and/or confirmed:

Drug Therapy

1st choice:
- Amphotericin B 0.6-1.0 mg/kg/day IV
  OR
  - Lipid formulation Amphotericin B 3.0-6.0 mg/kg/day IV
    plus 5-flucytosine 25-37.5 mg/kg PO QID*

Alternate:
- Fluconazole 6-12 mg/kg/day IV or PO if tolerated*
  OR
  - Micafungin 100 mg IV daily

❖ Continue therapy for 6 weeks after valve replacement

❖ If valve replacement is contraindicated continue fluconazole long term

❖ See also guidelines for fungal infections

References:
1. CID 2004:38, 161.
2. Medical Letter 2008:6(65), 1

Antimicrobial Handbook

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UPDATED November 2018
Cellulitis Guidelines

Definition:
Acute spreading inflammation involving the soft tissue, excluding muscle, characterized by recent onset soft-tissue erythema, warmth, swelling and tenderness, considered to be of infective origin, and acquired in the community. This does not include infected surgical wounds or previously treated (<3 months) deep diabetic infections.

A four level grading system to guide the intensity of treatment according to the clinical presentation and underlying predisposition of the patient.

Grading scale:

Grade I - Symptoms/signs restricted to superficial swelling, erythema, warmth, mild lymphadenopathy, & mild pain; absence of systemic symptoms in patients without high risk factors\(^1\).

Grade II - Dominant systemic signs – fever, chills lymphangitis &/or rapidly advancing edge.
- Mild cellulitis (as defined in Grade I) in high-risk patients\(^1,2\) without frank immunocompromise\(^2\).

Grade III - Failure to respond to >48 h of adequate oral antibiotic therapy, severe facial involvement or extensive skin involvement (i.e. if any dimension of the area of skin involved is greater than the distance between the patient’s median wrist crease and the point of the elbow).
- History of episodes of cellulitis requiring prolonged intravenous therapy.
- Co-morbid conditions necessitating inpatient therapy.

Grade IV - Orbital, joint, or deep hand involvement.
- Cellulitis in immunocompromised patients\(^2\).
- Suspicion of necrotizing, deep-seated infection or severe sepsis\(^3\).

\(^1\) Age ≥16 years
\(^2\) High risk patients\(^4\), neutropenia, asplenia, active cancer and/or chemotherapy, SLE, transplant, prosthetic joint or valve, HIV with CD4 count <200, chronic venous insufficiency, chronic lymphedema etc. affecting the infected body part
\(^3\) Severe sepsis = systemic signs/symptoms with evidence of end organ dysfunction or hypoperfusion
Figure 1: Nova Scotia Adult Cellulitis Algorithm

Infected bite or infected natural water injury?  

Use the same grading system for disposition, but use Table I for antibiotic choice.

Diagnosis of Cellulitis*  

Suspicion of Abscess?  

Uncertain or unripe or purulent cellulitis  

No

Grade I

Cephalexin 500 mg QD po x 7 days or, Clindamycin 500 mg QD po x 7 days Or, Clarithromycin 500 mg po bid x 7 days.

Yes  

Family doctor and reliable Patient/Family

Follow-up with FD in 48-72 h

Return to ED in 36-48 h for improvement

Grade II

Initial dose of Cefazolin 2 g IV & Probenecid 1-2 g po²  

Cephalexin 500 mg QD po x 7 days. Or, Clindamycin 500 mg QD po x 7 days. Or, Clarithromycin 500 mg po bid x 7 days.

Candidate for home IV therapy ²

Yes

Cefazolin 2 g IV & Probenecid 1-2 g po² daily

Change to po regime as for Grade 1, if Grade 1 features obtained for > 24 hours. Follow with FD in 5 days.

No

Candidate for home IV therapy ²

Cefazolin 1-2 g IV or Clindamycin 1-2 g²  

Return to ED in 36-48 h if no improvement

Refer to Gen. Med or Fam. Med for admission

Grade III

Cefazolin 2 g IV or Clindamycin 1-2 g²


Blood Cultures - only in complex infections, immunocompromised or sepsis  

CBC & ‘Lytes - only if indicated for reasons other than cellulitis. Chem-strips (not lab glucose - to screen for Diabetes Mellitus)

GRADE IV

Immediate give Clindamycin 600 mg IV and Cefazolin 1 g IV IMMEDIATE REFERRAL

Yes

Cefazolin 2 g IV or Clindamycin 1-2 g²

Or, Cloxacillin 1-2 g²

Or, Clarithromycin 500 mg po bid x 7 days.

Candidate for home IV therapy ²

Family doctor and reliable Patient/Family

Follow-up with FD in 48-72 h

Return to ED in 36-48 h for improvement

*For cellulitis unresponsive to conventional treatment or that involves an accompanying abscess or furuncle consider Ca-MRSA (rates in NS purulent SSTI’s ~ 20%). Appropriate treatment includes incision and drainage and non B-lactam antibiotics such as doxycycline or trimethoprim/sulfamethoxazole.

¹See definition.

²Antibiotic treatment must be initiated immediately upon suspicion of diagnosis in patients grade II to IV.

³If patient reports shortness of breath or hives within 24 hours of penicillin use, substitute Cefazolin/Probenecid with Clindamycin 600 mg or Levofloxacin 500 mg IV.

⁴Clinical decision by attending physician (patient too sick), or logistical decision (home support or patient compliance concerns).

⁵Consults to several different disciplines may need to be made simultaneously.
Nova Scotia Adult Cellulitis Guidelines

Recommendations for Antibiotic Prophylaxis of Bite Wounds
(the use of this algorithm presumes thorough irrigation and debridement of the wound)

1 Treat as per Grade III on Cellulitis algorithm.
2 Refer to nearest facility with IV capability, or, if appropriate, contact EHS NS for emergency home administration of IV antibiotics and splinting.
3 If evidence of active infection at follow-up, apply cellulitis (mammal bite) guidelines.
4 CFI = clenched fist injury.
5 High Risk patients—see foot note #2 on page 27.

Uninfected Bite Wounds

Dog

Consult ID (Hands/face)

Human

Consult ID

Cat

High risk pt or injury

Low risk pt or injury

> 3 h

< 3 h: Bandage OK

Amox/Clav x 5-7 days, follow in 24 h

Ceftriaxone 1-2 g IV and Flagyl 500 mg tid po, splint as appropriate, see in 24 h

Ceftriaxone 1-2 g IV and Flagyl 500 mg tid po, splint as appropriate, see in 24 h

Amox/Clav x 5-7 days, follow in 24 h

No Antibiotics. Follow in 24 h

Amox/Clav x 5-7 days, follow in 24 h

No

Yes

No

Yes

Grade III

Antimicrobial Handbook
## Infections of injuries sustained in natural water or as a result of bite wounds

<table>
<thead>
<tr>
<th>Circumstance of Original Injury:</th>
<th>Grade</th>
<th>Mammal Bite</th>
<th>Salt Water</th>
<th>Fresh Water</th>
</tr>
</thead>
<tbody>
<tr>
<td>I Amox/Clav&lt;sup&gt;2&lt;/sup&gt; 875 mg po BID x 7-10 days If Pen. Allergy, Ciprofloxacin 500 mg po BID plus Clindamycin 300 mg QID x 7 days or Moxifloxacin 400 mg po once daily</td>
<td>I</td>
<td>Doxycycline 200 mg po OD +/- Ciprofloxacin 500 mg po BID x 7-10 days</td>
<td>TMP-Sulpha&lt;sup&gt;3&lt;/sup&gt; DS x 1 tab po BID or Ciprofloxacin 500 mg po BID x 7-10 days</td>
<td></td>
</tr>
<tr>
<td>II Ceftriaxone 1 g IV, then po regime as above</td>
<td>II</td>
<td>Ciprofloxacin 400 mg IV, then po as above</td>
<td></td>
<td></td>
</tr>
<tr>
<td>III&lt;sup&gt;4&lt;/sup&gt; Ceftriaxone 1-2 g IV OD + Metronidazole 500 mg BID x 7-10 days</td>
<td>III&lt;sup&gt;4&lt;/sup&gt;</td>
<td>Ciprofloxacin 400 mg IV BID (Step down to PO if functioning gut)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<sup>1</sup> Consult ID if pregnant.
<sup>2</sup> Amoxicillin/Clavulanate
<sup>3</sup> Sulfamethoxazole/Trimethoprim
<sup>4</sup> Nova Scotia Adult Cellulitis Guidelines
Clindamycin Intervention Project

Due to the frequency of the development of antibiotic associated diarrhea and the high cost associated with the use of clindamycin, the Antimicrobial Agents Sub-Committee encourages physicians to consider the following:

Intra-Abdominal and Other Anaerobic Infections

• Unless contraindicated it is suggested that metronidazole 500 mg PO/IV q12 hours be employed with adjunctive antimicrobials in place of clindamycin.
• Metronidazole has superior coverage of \textit{B. fragilis} and therefore is the drug of choice.

If \textit{staphylococcal/streptococcal} coverage is also required,

• Metronidazole can be used in combination with cefazolin as an alternative to clindamycin.
• Compared to clindamycin the \textbf{combined} use of these agents offers:
  i) equivalent staph/strep coverage
  ii) better coverage for \textit{B. fragilis}
  iii) additional coverage of \textit{E. Coli} and \textit{Klebsiella}
  iv) cost savings.

Cautions:

• To avoid the risk of adverse effects, metronidazole should not be administered with \textit{ALCOHOL}-containing products or for 48 hours after discontinuation of metronidazole.
• If metronidazole and \textit{WARFARIN} are administered concomitantly, the INR should be monitored more frequently.
• Administration of metronidazole in pregnant patients should be avoided especially during the first trimester.
• Dosage adjustment for cefazolin is indicated in patients with renal dysfunction.
• Use cefazolin with caution in patients with a history of penicillin allergy.
Treatment of Clostridium Difficile-Associated Disease (CDAD)

CDAD is an infectious disorder that can develop when toxin-producing *C. difficile* is acquired as a component of the colonic microflora. If a patient harbouring the organism is then exposed to certain antimicrobials, *C. difficile* is able to evade eradication by spore formation, while many of the bacteria that help maintain normal ecology in the colon are destroyed. This can result in the uncontrolled overgrowth of *C. difficile* and the production of endotoxins that can cause inflammation and cellular damage. When CDAD occurs it can range from self-limiting diarrhea to life threatening enterocolitis and toxic megacolon.

**Diagnosis:** Mild to moderate to severe diarrhea accompanied by a positive *C. difficile* cytotoxin test result.

**Agents implicated in the development of CDAD:** All antimicrobials and certain antineoplastics with antimicrobial activity have in implicated in the precipitation of CDAD.

Most commonly implicated agents: Clindamycin, ciprofloxacin

Second and third-generation cephalosporins

**Onset of development of CDAD:** Ranges from one to two days after initiation of therapy to 10 weeks after drug discontinuation. Most cases occur after several days of therapy with the offending agent.

**Initial Management of CDAD:** Stop the offending agent if feasible and restore fluids and electrolytes if needed. With mild cases in those who are not elderly or debilitated, the patient can be monitored for symptomatic improvement for 48 hours before oral treatment for CDAD is initiated. If symptomatic deterioration occurs, antibiotic therapy for CDAD should begin immediately.

**Drug treatment of CDAD:**

<table>
<thead>
<tr>
<th>Agent</th>
<th>Dose/Duration</th>
<th>Efficacy</th>
<th>Cost for 7 days</th>
</tr>
</thead>
<tbody>
<tr>
<td>Metronidazole (first line)</td>
<td>500 mg tid for 10 to 14 days</td>
<td>Rapid resolution of symptoms within 5 days Response rate = 95% Relapse rate = 5 to 15%</td>
<td>$0.84 to 1.26</td>
</tr>
<tr>
<td>Vancomycin (second line)</td>
<td>125 mg qid for 10 to 14 days</td>
<td>Rapid clinical and bacteriological improvement within 5 days Response rate = 97% Relapse rate = 5 to 15%</td>
<td>$53.67</td>
</tr>
</tbody>
</table>

Evidence has shown that oral metronidazole to be equivalent to oral vancomycin for the treatment of mild-moderate CDAD. There appears to be little or no difference in either response or relapse rates between the two agents. Vancomycin is more costly and the indiscriminate use of vancomycin may have a role in the emergence of vancomycin-resistant enterococci (VRE). Thus oral vancomycin is reserved when CDAD fails to respond to metronidazole or is severe or potentially life-threatening. Vancomycin is also the preferred agent for pregnant and nursing mothers. Vancomycin may also be considered for patients who are currently receiving warfarin, alcohol-containing products and are allergic to or highly intolerant of metronidazole.
Treatment of Clostridium Difficile-Associated Disease (CDAD) (cont’d)

Non-oral therapies: Oral therapy is always preferable for the treatment of CDAD, but the oral route is sometimes not feasible because of gastrointestinal obstruction or megacolon. Intravenous metronidazole (500 mg q 12h) is recommended for these patients. An alternative is vancomycin administered via an nasogastric tube or enemas (with or without therapy with intravenous vancomycin or metronidazole). Monotherapy with intravenous vancomycin is almost never recommended because of unacceptably low concentrations of vancomycin in the gastrointestinal lumen.

Additional strategies:
Antiperistaltic agents such as loperamide should be avoided as they predispose the patient retention of the C. difficile toxins and possible toxic megacolon or enhance the absorption of metronidazole and result in treatment failure. The routine use of bile-sequestering agents such as cholestyramine should be avoided in the initial management of CDAD. There is lack of evidence to support its role and the drug may bind oral vancomycin, causing treatment failure. Cholestyramine may have a role in the treatment of patients with multiple relapse.

The treatment of asymptomatic carriers of C. difficile is not necessary.

Treatment of relapse, reinfection and failure:
15 to 30% of patients will relapse within two months after completing initial therapy. Relapse is defined as a return of symptoms and positive diagnostic test results after successful antimicrobial therapy for CDAD. Since relapse is unrelated to antimicrobial resistance, the same agent used to treat CDAD initially can be used to treat the relapse. Thus, a patient with relapse treated with oral metronidazole initially should receive a second 10-day course of metronidazole. Reinfection is difficult to distinguish from relapse and reusing oral metronidazole is appropriate.

Relapse should be distinguished from treatment failure. Relapses generally manifest within one to four weeks after cessation of therapy and treatment failure is indicated by a lack of response. However all patients (unless severely ill) should be treated with a minimum of 72 hours with oral metronidazole before switching to oral vancomycin.

Prevention:
Appropriate antimicrobial selection:
The optimal use of clindamycin, poorly absorbed agents (i.e. cefuroxime) or those with high biliary tract excretion (i.e. ceftriaxone) is essential for the prevention of CDAD.

Appropriate infection control measures – contact Infection Control
Suggested Guidelines for the Treatment of *Clostridium difficile*-Associated Diarrhea

**Diarrhea**

History of prior (1-8 weeks) or concurrent exposure to antimicrobials

- Yes
  - Order assay for *C. difficile* toxin
  - Look for other cause
  - No treatment
  - (consider flexible sigmoidoscopy or other investigations to determine cause if persistent diarrhea)

- No
  - Is diarrhea moderate/severe?
    - Yes
      - Metronidazole 500 mg IV q12h
      - +/– Vancomycin via rectal enema (500 mg diluted in 1 L of 0.9% NaCl injection) or through pigtail catheter directly into cecum or ileostomy (200 mg or 500 mg of vancomycin [400 or 1000 ug/ml] in 0.5 L) QID if tolerated
    - No
      - Metronidazole 125 mg po qid x 10-14 days
      - +/– Vancomycin 125 mg po qid x 10-14 days

- No
  - Is patient able to tolerate po med? Is patient elderly or debilitated?
    - Yes
      - Metronidazole 500 mg IV q12h +/– Vancomycin via rectal enema (500 mg diluted in 1 L of 0.9% NaCl injection) or through pigtail catheter directly into cecum or ileostomy (200 mg or 500 mg of vancomycin [400 or 1000 ug/ml] in 0.5 L) QID if tolerated
      - No
      - Monitor patient for 48 hrs
    - No
      - Repeat Initial Course of Antibiotic Therapy

Patient Responds

- No Relapse
  - Relapse after Therapy
    - Recommit diagnosis with *C.difficile* cytotoxin test
    - Further work-up
      - Is *CDAD* moderate/severe?
        - Yes
          - Repeat Initial Course of Antibiotic Therapy
        - No
          - Manage without further antimicrobial therapy

- No further studies

Responds & No further Relapse

Repeat Initial Course of Antibiotic Therapy

Response to *antimicrobials* is exceedingly rare

- Yes
  - Consider treatment
  - No further studies

Responds & Later Relapses

- Yes
  - Consider treatment
  - No further studies

- No
  - Manage without further antimicrobial therapy

**Patient History**

- Discontinue causative antibiotics, if feasible
- +/– substitute with antibiotic less predisposing to *CDAD*
- Restore fluids & electrolytes as needed
- Avoid antispasmodics

**Diagnosis & Laboratory**

- Order assay for *C. difficile* toxin
- Look for other cause

**Management**

- Metronidazole 500 mg po qid x 10-14 days
- Vancomycin 125 mg po qid x 10-14 days

**Anti-microbial Therapy**

- Vancomycin 500 mg QID x 10 days + B. subtilis 500 mg po BID beginning on day 7 of vancomycin therapy (see below)
- Caution in immunocompromised patients

**Resolution & Persistence**

- Patient responds & no further relapse
- Patient responds & later relapses

**Antimicrobial Handbook**
Prevention of Bacterial Endocarditis

Dental procedures that involve manipulation of gingival tissue or the periapical region of teeth or perforation of the oral mucosa expose patients with the following cardiac conditions to a risk of developing endocarditis:

i) serious congenital, heart conditions (CHD) - unrepaired or incompletely repaired cyanotic congenital heart diseases (including palliative shunts and conduits), any repaired CHD with residual defect at the site or adjacent to the site of prosthetic patch/device; a completely repaired CHD with prosthetic material, device during the first 6 months after procedure;

ii) cardiac transplant that develops cardiac valvulopathy;

iii) prosthetic cardiac valve or prosthetic material used for cardiac valve repair;

iv) prior episode(s) of endocarditis.

The following table was adapted from the American Heart Association recommendations published. Circulation April 19, 2007.

DENTAL AND UPPER RESPIRATORY PROCEDURES

<table>
<thead>
<tr>
<th>ORAL 2</th>
<th>DOSAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amoxicillin 3</td>
<td>2 g 1 hour before the procedure</td>
</tr>
<tr>
<td>Penicillin allergy:</td>
<td></td>
</tr>
<tr>
<td>Clindamycin</td>
<td>600 mg 1 hour before the procedure</td>
</tr>
<tr>
<td>OR</td>
<td></td>
</tr>
<tr>
<td>Azithromycin or clarithromycin</td>
<td>500 mg 1 hour before the procedure</td>
</tr>
<tr>
<td>OR</td>
<td></td>
</tr>
<tr>
<td>Cephalaxin 4</td>
<td>2 g 1 hour before the procedure</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>PARENTERAL 2</th>
<th>DOSAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ampicillin</td>
<td>2 g IM* or IV 30 minutes before the procedure</td>
</tr>
<tr>
<td>Penicillin allergy:</td>
<td></td>
</tr>
<tr>
<td>Clindamycin</td>
<td>600 mg 30 minutes before the procedure and 150 mg IM/PO 6 hours later</td>
</tr>
<tr>
<td>OR</td>
<td></td>
</tr>
<tr>
<td>Cefazolin 4</td>
<td>1 g 30 minutes before procedure</td>
</tr>
</tbody>
</table>

4 Should not be used in individuals with immediate type 1 hypersensitivity reaction to penicillins (urticaria, angioedema, or anaphylaxis).

* IM administration should be avoided in patients receiving anticoagulation therapy.
Prevention of Bacterial Endocarditis (cont’d)

1. For patients with previous endocarditis, valvular heart disease, prosthetic heart valves, most serious forms of congenital heart disease, viridans streptococci are the most common cause of endocarditis after dental or upper respiratory procedures; enterococci are the most common cause of endocarditis after gastrointestinal or genitourinary procedures.*

2. Oral regimens are more convenient and safer. Parenteral regimens are more likely to be effective; they are recommended especially for patients with prosthetic heart valves, those who have had endocarditis previously, or those taking continuous oral penicillin for rheumatic fever prophylaxis.

3. Amoxicillin is recommended because of its excellent bioavailability and good activity against streptococci and enterococci.

* Antibiotic prophylaxis against infective endocarditis is recommended in the aforementioned patients for dental procedures that involve manipulation of gingival tissue or the periapical region of teeth or perforation of the oral mucosa, procedures on respiratory tract involving incision or biopsy of respiratory mucosa and procedures in patients with infected skin, skin structures or musculoskeletal tissue; however, antibiotic prophylaxis against infective endocarditis is not recommended for genitourinary or gastrointestinal tract procedures [Circulation 2007; 116: 1736-1754].
Treatment of Bacterial Endocarditis

Preface

Bacterial endocarditis is a serious, sometimes life-threatening infection that may require surgical, as well as medical therapy, for optimal outcome.

Management requires a multidisciplinary approach involving infectious disease specialists, cardiologists, and cardiac surgeons, with other specialists as dictated by the specific clinical situation.

These CDHA guidelines for the antimicrobial therapy of bacterial endocarditis have been arrived at by consensus among ID Division members based upon the evidence in the literature and our local epidemiology and susceptibility patterns.
## Treatment of Bacterial Endocarditis

### Anatomic Site/Diagnosis/Modifying Circumstances

<table>
<thead>
<tr>
<th>Infective endocarditis - Native valve - culture positive</th>
<th>Etiologies (usual)</th>
<th>Suggested Regimens*</th>
<th>Adjunct Diagnostic or Therapeutic Measures and Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Viridans strep, S. bovis with penicillin MIC &lt;0.1 μg/mL</td>
<td>[Pen G 18-30 mg (IV q4d IV, q2h IV) x 4-6 weeks] PLUS (gentamicin 1 mg/kg q8h IV x 4-6 weeks) OR ([AMP 12-18 mg (IV, q2h IV) x 2 weeks] PLUS (gentamicin 1 mg/kg IV q8h IV x 2 weeks)]</td>
<td>Vancomycin 30 mg/kg/d in 2 div. doses x 4 weeks</td>
<td>4 weeks of tx if symptoms &lt;3 months; 6 weeks of tx if symptoms &gt;3 months. Do not give gent once-daily for enterococcal endocarditis. Target gent levels: peak 3 μg/mL, trough &lt;1 μg/mL.</td>
</tr>
</tbody>
</table>

### Etiologies (usual)

- Viridans strep 30-40%
- Other strep 15-25%
-  5-18%
-  5-18%
- 20-35%  

### Suggested Regimens*

| Viridans strep, S. bovis with penicillin MIC <0.1 μg/mL | [Pen G 18-30 mg (IV q4d IV, q2h IV) x 4-6 weeks] PLUS (gentamicin 1 mg/kg q8h IV x 4-6 weeks) OR ([AMP 12-18 mg (IV, q2h IV) x 2 weeks] PLUS (gentamicin 1 mg/kg IV q8h IV x 2 weeks)] | Vancomycin 30 mg/kg/d in 2 div. doses x 4 weeks | 4 weeks of tx if symptoms <3 months; 6 weeks of tx if symptoms >3 months. Do not give gent once-daily for enterococcal endocarditis. Target gent levels: peak 3 μg/mL, trough <1 μg/mL. |

### Adjunct Diagnostic or Therapeutic Measures and Comments

- If patient not acutely ill or not in heart failure, we prefer to wait for blood culture results. If initial 3 blood cultures neg, obtain 3-3 more blood cultures before empiric rx started. Coadmin = gentamicin may not be adequate coverage of enterococci, hence addition of penicillin G pending cultures. When blood cultures +, modify regimen from empiric to specific based on organism, in vitro susceptibilities, clinical experience. |

*[Baseline and weekly audiometry recommended if aminoglycosides used > 2 weeks.*}
Antimicrobial Handbook

Treatment of Bacterial Endocarditis

<table>
<thead>
<tr>
<th>Anatomic Site/Diagnosis</th>
<th>Etiologies (usual)</th>
<th>Suggested Regimens*</th>
<th>Adjunct Diagnostic or Therapeutic Measures and Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Enterococci MIC streptomycin &gt;200 μg/mL, MIC gentamicin &gt;500-2000 μg/mL; no resistance to penicillin</td>
<td>Enterococci, high-level aminoglycoside resistance</td>
<td>If prolonged pen G/AMP fails, consider surgical removal of infected valve. 10-25% E. faecalis and 45-50% E. faecium resistant to high gent levels.</td>
<td>May be sensitive to streptomycin, check MIC. Case report of success with combination of AMP, MER, and vanc (Stan J Invest 28: 162, 1999).</td>
</tr>
<tr>
<td>Enterococci pen G MIC &gt;16 μg/mL, no gentamicin resistance</td>
<td>Enterococci, intrinsic pen G/AMP resistance</td>
<td>Vanc 15 mg/kg q12h Plus gent 1-1.5 mg/kg q12h (no single dose)</td>
<td>Consultation suggested</td>
</tr>
<tr>
<td>Enterococci Pen/AMP resistant + high-level gentamicin resistant + vancomycin resistant; usually VRE</td>
<td>Enterococci, vancomycin-resistant, usually E. faecium</td>
<td>No reliable effective rr. Can try linezolid 600 mg IV or po q12h</td>
<td></td>
</tr>
<tr>
<td>Staphylococcal endocarditis Aortic and/or mitral valve infection</td>
<td>Staph. aureus, methicillin-sensitive</td>
<td>Dose/kill 2 g q4-6d IV x 4-4 weeks += gentamicin 10 mg/kg/d IV x 3-5 d.</td>
<td>Avoid cephalosporins in patients with immediate allergic reaction to penicillin; cefazolin failures reported (CID 37: 1194, 2003).  No definite data, pro or con, on once-daily gentamicin for S. aureus endocarditis. At present, favor q8h dosing x 3-5 d. 1 recognition of IV catheter-associated S. aureus endocarditis. May need TEE to detect endocarditis. 23% of S. aureus bacteremia in association with IV catheter had endocarditis (CID 115: 106 &amp; 115, 1999); if TEE neg, only need 2 weeks of therapy for IV-related S. aureus bacteremia.</td>
</tr>
<tr>
<td>Aortic and/or mitral valve infection-MRSA</td>
<td>Staph. aureus, methicillin-resistant</td>
<td>Vancomycin 1 g IV x 12h x 4-6 weeks += gentamicin or aminoglycoside</td>
<td>2-week regimen not recommended if metastatic infection (e.g., osteo), left-sided endocarditis, or MRSA. 2 reports of success with 4-week oral regimen: CIP 750 mg bid + RIF 300 mg bid. Less than 10% pts had MRSA (JAX 2: 1071, 1989; JAM 101: 68, 1989).</td>
</tr>
<tr>
<td>Tricuspid valve infection (usually IVDs): MRSA</td>
<td>Staph. aureus, methicillin-sensitive</td>
<td>Dose/kill 2 g q4-6d IV plus gentamicin 1 mg/kg q8h IV x 2 weeks.</td>
<td>2-week regimen not recommended if metastatic infection (e.g., osteo), left-sided endocarditis, or MRSA. 2 reports of success with 4-week oral regimen: CIP 750 mg bid + RIF 300 mg bid. Less than 10% pts had MRSA (JAX 2: 1071, 1989; JAM 101: 68, 1989).</td>
</tr>
<tr>
<td>S. pneumoniae</td>
<td>S. pneumoniae</td>
<td>Test penicillin susceptibility and consult with ID</td>
<td></td>
</tr>
<tr>
<td>S. pyogenes</td>
<td>S. pyogenes</td>
<td>Penicillin G 18 mu/24 h (q6h) X 4 weeks</td>
<td></td>
</tr>
<tr>
<td>B. C. and G Streptococci</td>
<td>B. C. and G Streptococci</td>
<td>Penicillin G 18 mu/24 h (q6h) X 4-6 weeks += gentamicin for 2 weeks</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Anatomic Site/Diagnosis Modifying Circumstances</th>
<th>Etiologies (usual)</th>
<th>Suggested Regimen*</th>
<th>Adjunct Diagnostic or Therapeutic Measures and Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Methicillin resistance (MRSA)</td>
<td>Staph. aureus, methicillin-resistant</td>
<td>Vancomycin 10 mg/kg q12h x 4-6 weeks</td>
<td>For MRSA, no difference in duration of bacteremia or fever between patients with vancomycin or vancomycin + rifampin.</td>
</tr>
<tr>
<td>Slow-Growing fastidious/Gm-neg. bacilli</td>
<td>HACEK group (see Comments)</td>
<td>Ceftriaxone 2.0 g qd IV x 4 weeks + gentamicin 1.0 mg/kg q8h IV x 4 weeks</td>
<td>HACEK (acronym for Hemophilus parainfluenzae, H. aphrophilus, Actinobacillus, Cardiobacterium, Eikenella, Kingella). H. aphrophilus resistant to vancomycin, ciprofloxacin and methicillin. For Hemophilus, see CID 24:1087, 1997.</td>
</tr>
<tr>
<td>Bartonella species</td>
<td>B. henselae, B. quintana</td>
<td>Optimal: Retrospective &amp; open prospective trials support vancomycin 3.0 mg/kg q8h IV once daily x minimum of 14 days + doxycycline 100 mg po q12h x 44 weeks.</td>
<td>Dx: Immunofluorescent antibody titer ≥ 1:800; blood cultures only occasionally positive, or PCR. Surgery: Over 50% of patients require valve surgery; relation to cure unclear. B. quintana transmitted by body lice among homeless; asymptomatic colonization of RBCs described.</td>
</tr>
<tr>
<td>Infective endocarditis - culture negative</td>
<td>Fever, valvular disease, and ECHO vegetations + emboli and negative cultures</td>
<td>Optimal: Retrospective &amp; open prospective trials support vancomycin 3.0 mg/kg q8h IV once daily x minimum of 14 days + doxycycline 100 mg po q12h x 44 weeks.</td>
<td>Optimal: Retrospective &amp; open prospective trials support vancomycin 3.0 mg/kg q8h IV once daily x minimum of 14 days + doxycycline 100 mg po q12h x 44 weeks.</td>
</tr>
<tr>
<td>Infective endocarditis - positive culture</td>
<td>Staphylococci, S. aureus, viridans strep, enterococci, S. epidermidis</td>
<td>Vancomycin 15 mg/kg q24h IV + gentamicin 1.0 mg/kg q8h IV</td>
<td>Early surgical consultation advised. Watch for evidence of heart failure.</td>
</tr>
</tbody>
</table>

**Etiologies**: C. burnetii 48%, Bartonella sp. 28%, and rarely A. laidlawii. M. hominis, Legionella pneumophila, Tropheryma whipplei — together 1% & real without etiology identified (most on antibiotics). Emphasis is on diagnosis. See specific organism for treatment regimens.
Outpatient Treatment

Patients with organisms susceptible to Ceftriaxone would benefit from once daily dosing of Ceftriaxone 2 g to facilitate home IV therapy once discharged from hospital.
Febrile Neutropenia - High Risk Inpatient

Temp (po) ≥ 38.5°C or >38°C X 2 in 12 hours and ANC ≤ 0.5

1. Clinical assessment
2. Microbiological assessment cultures of blood, urine, sputum and other obvious sites of infection
3. Radiological assessment (CXR)

Imipenem 500 mg IV q 6h

Antimicrobial Handbook
High Risk Febrile Neutropenia

Footnotes
1. ANC: Absolute Neutrophil Count.

2. Clinically defined infections: It is important to remember that patients with chemotherapy induced febrile neutropenia need both broad spectrum coverage, as well as coverage for specific infections. For initial management of clinically defined infections. In addition to meropenem, consider:
   (i) Severe Mucositis/Oral Lesions: Yeast/fungal, and HSV cultures.
   (ii) Documented Line Infection or Sepsis: Vancomycin 1 g IV q12h if Coagulase-negative staphylococcus (CNST) or MRSA isolated. If suspected line infection, may consider adding Vancomycin. Discontinue if cultures are negative after 48 hours and/or decrease in clinical suspicion.
   (iii) C. difficile diarrhea suspected or documented, ADD metronidazole.
   (iv) Pulmonary Infiltrates: Consider BAL: for RSV, CMV, PCP, Legionella & fungus.

3. Documented Hypersensitivity to B-Lactam Antibiotics: Ciprofloxacin 400 mg IV q12h +/- gentamicin 6 mg/kg IV q24h. Vancomycin should be added for broader gram positive coverage. Consider an ID consult.

4. Deterioration: Patients who deteriorate (e.g. become hypotensive or confused) while still neutropenic and on any combination of antibiotics need careful reassessment for a source of infection, as well as the addition/change of antibiotics. Vancomycin may be added empirically in this instance pending culture results. If culture(s) negative after 48 hours, discontinue.

5. Pathogen Isolated (microbiologically defined infection): Maintain initial broad-spectrum regimen, unless sensitivities indicate that a pathogen is inadequately covered. Culture documented Pseudomonas infections should always be treated with two agents to which the bacteria is susceptible. Add Vancomycin for documented gram positive infections until susceptibility confirmed.

6. Renal Function: Monitor serum creatinine at least 3x per week while on an aminoglycoside. If baseline SCr >200 mmol/L or estimated CIcr <70 mL/min avoid adding an aminoglycoside; add ceftazidime to meropenem if double coverage required (ie Pseudomonas).

7. Clinically or Microbiologically Defined Infection and Afebrile at Day 4: Continue broad spectrum coverage until afebrile 5-7 days OR ANC ≥0.5 x 10⁹/L. Continue coverage for specific infection for at least 7-10 days AND until clinical symptoms have resolved AND ANC >0.5 x 10⁹/L, AND afebrile for 5 days. Duration of antibiotics should be assessed on an individual basis.

8. If still persistently febrile and ANC >0.5, antimicrobials may be stopped after 4-5 days of treatment and patient reassessed.

9. Amphotericin B: Consult hospital guidelines for the use of amphotericin B.

10. Consider stopping antimicrobials after 2 weeks of treatment for ANC 0.2-0.5 if no infectious etiology identified and condition is stable.
Low Risk Febrile Neutropenia


The treatment of fever and neutropenia has evolved with the development of both new antimicrobial drugs and new strategies for using them. The first effective treatment for patients with fever and neutropenia was the combination of an antipseudomonal penicillin, carbenicillin, and gentamicin in a strategy of early empirical therapy triggered by fever alone.

In the 1980's, the options for antibiotic treatment improved. A large, randomized study demonstrated that a single broad-spectrum drug, ceftazidime, could safely replace the standard combination of an antipseudomonal penicillin and an aminoglycoside. Despite this finding, because of their previous experience with rapidly fatal pseudomonas infections, wary clinicians were reluctant to use ceftazidime alone in patients who often were very ill from intensive chemotherapy.

However, risk-assessment studies began to refine clinicians intuitions about the medical instability of their patients. A retrospective study by Talcott et al. of 261 episodes of fever and neutropenia treated in the hospital provided justification, in part, for the anxiety of clinicians. In one of five episodes, serious, potentially life-threatening medical complications developed, such as hypotension, respiratory failure and altered mental status. However, not all patients were at similarly high risk. Within 24 hours of hospitalization, three high-risk groups, could be identified: 1. Patients who were already inpatients when fever and neutropenia developed; 2. Outpatients who needed acute hospital care for problems in addition to the fever and neutropenia; and 3. Clinically stable outpatients with uncontrolled cancer (those with acute anticancer therapy). All the remaining patients - a group that comprised 70 percent of the outpatients - were by default at low risk. The validity of these risk groups was later confirmed. For patients in the three high-risk groups, the rate of medical complications was 36 percent, and 20 percent of such patients died. For the low-risk patients, the complication rate was 2 percent, and none died.

The ability to make distinctions about risk offered new possibilities for treatment. If fever and neutropenia do not always have the same clinical significance, then the strategy for treating them may vary according to circumstance. For example, clinicians who initially were wary of single-drug therapy with ceftazidime often were more comfortable using it for low-risk patients. But there were other possible innovations with important economic implications. If a single intravenous antibiotic could be used to treat low-risk patients, why not still cheaper and more convenient oral antibiotics? Even more radically, why not send apparently stable patients home for treatment and avoid incurring the cost of an inpatient bed? A more recent paper validated a scoring system to predict risk.

Attached are two recent reports from the N Engl J Med which involve large, prospective, randomized studies of low-risk patients (defined variously by the investigators) that expand our options for the management of fever and neutropenia in patients with cancer. The results of these studies show that oral antibiotics may be safely substituted for intravenous antibiotics in low-risk patents with fever and neutropenia. Now that these studies have provided us with more convenient, versatile antibiotic strategies for treating low-risk patients with fever and neutropenia, when should we use them? Do these studies of oral therapy justify our using outpatient treatment? The authors of
Both of these rigorous, careful studies, which were designed to assess the relative efficacy of antibiotic regimens given to inpatients, caution that they do not. Although clinical experience with the treatment of patient with fever and neutropenia on an outpatient basis has grown in the past decade, this approach has yet to be validated in large, randomized studies designed to assess this critical question: Is outpatient treatment of fever and neutropenia, away from the watchful eyes and readily available emergency equipment of the hospital, as safe as inpatient treatment, or at least safe enough?

In the largest study conducted to date, Malik and colleagues examined 169 episodes of fever and neutropenia and found that inpatients and outpatients treated with ofloxacin alone were equally likely to have their fever and neutropenia resolve without requiring a change in their antibiotic regimen. Although this finding indicates that identical regimens have equal efficacy in inpatients and outpatients, it says little about the safety of outpatient treatment. Three patients in the outpatient group died; at least one of these deaths was apparently preventable.

A Potential Step by Step Management Program for Low-Risk Febrile Neutropenia

This protocol should only be activated after discussion with the medical oncologist or hematologist on call

Outpatient Management of the Low Risk Febrile Neutropenic (FN) Patient
Safe management of the FN patient relies on a careful risk assessment to identify those individuals who can be treated in the outpatient setting. Outpatient management is intended only for stable patients who can be expected to do well. Patients with acute leukemia are not candidates for outpatient management of febrile neutropenia.

Definitions:
- Fever is an oral temperature ≥38°C on 2 occasions at least 12 hours apart or a single oral temperature ≥38.5°C.
- Neutropenia is an absolute neutrophil count (ANC) ≤0.5x10⁹/L as determined by an automated differential.

Patient Assessment:
If the patient will be compliant with outpatient management recommendations AND
Lives within 30 minutes of a hospital and has 24 hour live-in support, AND
Can be assessed daily by a physician, he/she may be eligible for outpatient therapy.
Answer all of the following questions about the patient:

<table>
<thead>
<tr>
<th>Question</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. The patient has hypotension (systolic BP &lt;90 mmHg systolic or 40 mmHg less than patient's normal)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. The patient has a compromised mental status or is incompetent</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. The patient has respiratory distress</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. The patient has abdominal pain, vomiting, mucositis or diarrhea</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. The patient has gross bleeding or severe bruising</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. The patient needs parental fluid therapy or pain control</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. The ANC is expected to take &gt;10 days to recover</td>
<td></td>
<td></td>
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<tr>
<td>8. There is evidence of deep organ or tissue infection (e.g.: pneumonia, pyelonephritis)</td>
<td></td>
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<tr>
<td>9. The temperature is &gt;39°C and the ANC &lt; 0.1x10⁹/L</td>
<td></td>
<td></td>
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<tr>
<td>10. There is a coexistent medical condition requiring admission</td>
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<td></td>
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<tr>
<td>11. The patient has recently received prophylactic or therapeutic antibiotics (other than sulfamethoxazole-trimethoprim)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

If the answer to any of the above is "YES", the patient is NOT a candidate for outpatient antibiotic therapy for febrile neutropenia.

Patient Scoring:
If the patient is a candidate for outpatient antibiotic therapy, complete the following checklist:

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Burden of illness: no or mild symptoms</td>
<td>5</td>
</tr>
<tr>
<td>• No hypotension</td>
<td>5</td>
</tr>
<tr>
<td>• No chronic obstructive lung disease</td>
<td>4</td>
</tr>
<tr>
<td>• Solid tumour or no previous fungal infection</td>
<td>4</td>
</tr>
<tr>
<td>• No dehydration</td>
<td>3</td>
</tr>
<tr>
<td>• Burden of illness: moderate symptoms</td>
<td>3</td>
</tr>
<tr>
<td>• Outpatient status</td>
<td>3</td>
</tr>
<tr>
<td>• Age &lt;60 years</td>
<td>2</td>
</tr>
</tbody>
</table>

If the score adds to ≥21 the patient may be considered for outpatient antibiotic therapy.
Management
1. Order a CBC and differential, BUN, creatinine, urinalysis, blood and urine cultures, and chest XRAY.
2. The patient should be given the first dose of antibiotics and observed in the medical day unit (MDU) or Emergency Department (ED) for 4 hours, monitoring heart and respiratory rates, blood pressure with orthostatic measurements, temperature, and pulse oximetry every 2 hours at a minimum.
3. If the patient remains clinically stable and fulfills all criteria, the patient can be discharged to home with the appropriate prescription (5 day supply with 1 repeat) and specific instructions on how to take the antibiotics and on follow up with the MDU at 10AM the following day.
4. Dose adjustments are required for ciprofloxacin and amoxicillin clavulanate in the presence of renal insufficiency. Give the first doses and contact pharmacy for advice on further dosing recommendations.
5. The patient will be seen daily by the physician or physician clinical associate for the patient’s service until afebrile and asymptomatic, or hospitalized if necessary.
6. If the patient remains febrile for more than 5 days, admission is required and antibiotics reassessed.
7. Antibiotics will be continued for 5-10 days and until the ANC is >0.5x10^9/L and the patient afebrile for ≥72 hours. Oral antibiotics should replace IV as soon as tolerated.
8. The patient should have a CBC with differential and creatinine every 48 hours at a minimum.

Prepared by the Divisions of Infectious Diseases, Medical Oncology, and Hematology and the Pharmacy Department, CDHA
March 2005/Revised 07/05, 12/05, 05/06, 05/06, 06/06

* consider potential for drug interactions

Outpatient Antibiotic Therapy

Oral

Ciprofloxacin* 750 mg BID and Amoxicillin-Clavulanate 875 mg BID

If penicillin allergic

Moxifloxacin* 400 mg OD

Antimicrobial Handbook
### Empiric Therapy of Fungal Infections

<table>
<thead>
<tr>
<th>Infection</th>
<th>Usual Pathogens</th>
<th>Recommended Empiric Therapy</th>
<th>Recommended Dose</th>
<th>Recommended Duration</th>
<th>Comments</th>
</tr>
</thead>
</table>
| **Candida Candidurias** | Candida spp*                     | Asymptomatic               | Treatment not recommended unless high risk† | 200 mg PO daily | 7-14 days | • Usually associated with foreign body in urinary tract. Removal of urinary catheter or stent results in 40% eradication of candiduria but only 20% if subsequently replaced.  
* Fluconazole may not be effective against C. krusei and some strains of C. glabrata.  
† C. lusitaniae may be resistant to amphotericin B.  
** Bladder irrigation with amphotericin B has been used to treat candidal cystitis but does not treat infections beyond the bladder.  
- Persistent candiduria in immunocompromised patients warrants US or CT of kidney.  
† High Risk:  
• neutropenia  
• renal transplant patients  
• patients undergoing urological procedures. |
| **Esophageal Candidiasis** | Candida albicans  
Occasionally non-albicans spp | Fluconazole                | 200 mg PO first day then 100 mg PO daily  
0.3-0.5 mg/kg IV | 7-14 days | Always indicative of immunosuppression. |
| **Invasive Candidiasis/ Candidemia** | General Management  
- Removal of central venous and/or peritoneal dialysis catheters generally recommended in non-neutropenic patients but controversial for neutropenic patients as source often from GI tract.  
- Discontinue broad spectrum antibiotics if possible.  
- Serial blood cultures (minimum daily x 3) to ensure sterilization every 2-3 days until blood cultures negative.  
- Fundoscopic examination should be done.  
- For positive Candida spp cultures:  
  • C. glabrata - some resistance with low dose fluconazole but can be overcome with high dose therapy.  
  • C. krusei - resistant to fluconazole  
  • C. lusitaniae, C. guilliermondii - usually resistant to amphotericin B. | Fluconazole  
400-800 mg po daily-bid  
0.3-0.5 mg/kg IV  
100 mg IV daily | 2-3 weeks after clinical improvement |
<table>
<thead>
<tr>
<th>Infection</th>
<th>Usual Pathogens</th>
<th>Recommended Empiric Therapy</th>
<th>Recommended Dose</th>
<th>Recommended Duration</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Empiric Therapy of Fungal Infections (cont'd)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Candida albicans</td>
<td></td>
<td>Fluconazole or Amphotericin B</td>
<td>800 mg IV loading dose then 400-800 mg IV/PO daily 0.6-1 mg/kg/d IV 100 mg IV daily</td>
<td>minimum 14 days after last positive blood culture and resolution of signs and symptoms</td>
<td>* Usually associated with prosthetic device, especially central venous catheters. - Amphotericin B or caspofungin recommended empirically if: • hemodynamically unstable • neutropenic (ANC &lt;0.5 x10^9/L) • suspect non-albicans Candida spp.</td>
</tr>
<tr>
<td>Candida tropicalis*</td>
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<td></td>
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<tr>
<td>Candida parapsilosis*</td>
<td></td>
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<td></td>
<td></td>
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<tr>
<td>Candida glabrata</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Candida krusei</td>
<td></td>
<td>Amphotericin B or Caspofungin</td>
<td>0.6-0.7 mg/kg/d IV 100 mg IV daily 5 mg/kg/d IV</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Candida glabrata</td>
<td></td>
<td>Micafungin</td>
<td>100 mg IV daily</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Candida parapsilosis*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Candida krusei</td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Empiric Treatment of Persistent Febrile</td>
<td>Candida spp</td>
<td>Fluconazole or Amphotericin B</td>
<td>400 mg IV/PO daily 100 mg IV daily 5 mg/kg/d IV</td>
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<tr>
<td>Neutropenia Protocol</td>
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<td></td>
<td></td>
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<tr>
<td>(High Risk)</td>
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</tr>
<tr>
<td>Empiric Treatment of Persistent Febrile</td>
<td>Candida spp</td>
<td>Fluconazole or Amphotericin B</td>
<td>400 mg IV/PO daily 100 mg IV daily 5 mg/kg/d IV</td>
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<tr>
<td>Neutropenia Protocol</td>
<td></td>
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<td></td>
<td></td>
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<tr>
<td>(Low Risk)</td>
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<tr>
<td>Candida Hepatosplenic Candidiasis</td>
<td>Candida spp</td>
<td>Amphotericin B or Fluconazole</td>
<td>0.6-0.7 mg/kg/d IV 400-800 mg daily</td>
<td>3-6 months and resolution or calcification of radiologic lesions</td>
<td>- Fluconazole may be given after 1-2 weeks of amphotericin B if clinically stable and improved.</td>
</tr>
<tr>
<td>Invasive Aspergillosis</td>
<td>Aspergillus fumigatus or Aspergillus flavus Other Aspergillus spp</td>
<td>Voriconazole or ABLC</td>
<td>6 mg/kg IV q12h first day then 4 mg/kg IV q12h then 200 mg PO bid* 5 mg/kg/d IV 100 mg IV daily</td>
<td>≥10 weeks**</td>
<td>- Infectious Diseases consult recommended. - For central nervous system infection, voriconazole recommended and neurosurgery often required. *** Combination antifungal therapy may be needed. Consult Infectious Diseases.</td>
</tr>
<tr>
<td>Infection</td>
<td>Usual Pathogens</td>
<td>Recommended Empiric Therapy</td>
<td>Recommended Dose</td>
<td>Recommended Duration</td>
<td>Comments</td>
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</tr>
<tr>
<td><strong>Fungal Sinusitis</strong></td>
<td>Aspergillus spp</td>
<td>Immune competent Antifungal therapy not routinely recommended</td>
<td>- Voriconazole 6 mg/kg IV q12h first day then 4 mg/kg IV q12h or 200 mg PO bid</td>
<td></td>
<td>- In immunocompetent host, fungi in sinuses may be associated with nasal polyps and do not routinely require antifungal therapy.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Immune compromised Aspergillus</td>
<td>or Amphotericin B 1.25 mg/kg/d IV</td>
<td></td>
<td>- In immunocompromised patients/diabetic ketoacidosis, a fungal infection can present as a cellulitis that may rapidly progress and be fatal. Surgical debridement is necessary.</td>
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<td></td>
<td>or Amphotericin B 0.8-1.5 mg/kg/d IV</td>
<td></td>
<td>* Use the higher dose if neutropenic. * Other Azoles and micafungin not active against Rhizopus/Mucor spp.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Posaconazole (NF) 200 mg PO qid</td>
<td></td>
<td>* Use the higher dose if neutropenic. * Other Azoles and micafungin not active against Rhizopus/Mucor spp.</td>
</tr>
<tr>
<td></td>
<td>Rhizopus/Mucor**</td>
<td></td>
<td></td>
<td></td>
<td>* Use the higher dose if neutropenic. * Other Azoles and micafungin not active against Rhizopus/Mucor spp.</td>
</tr>
</tbody>
</table>

**Cryptococcus spp** - Infectious Diseases consult strongly recommended.
**Histoplasma spp** - Therapy/dose/duration dependent on clinical picture.
**Caspofungin not active against Cryptococcus spp.**
**Coccidioides spp** - Treatment less effective than itraconazole against Histoplasma spp.
Immunization for Adults

Childhood immunization programs have proven to be an effective and safe method of preventing many infectious diseases. The delivery and implementation of adult immunization programs have not matched the successes achieved in the pediatric population. However, given increased emphasis on disease prevention, healthcare providers must be made aware of the need to improve immunization among adults. Immunization status should be considered an integral part of the health assessment of any adult. Opportunities to provide vaccines to adults are being missed in the healthcare setting. Prevention of infection by immunization is a lifelong process that should be tailored to meet individual variations in risk resulting from age, illness, travel, occupation and lifestyle.

Canadian recommendations for vaccination can be found in the Canadian Immunization Guide, sixth edition 2006 or at http://phac-aspc.gc.ca/publicat/cig-gci/index.html or e-CPS-Clin-Info "vaccines".

Opportunities for Immunization in Acute Care Institutions

A vaccination history taken on admission to hospital provides an important opportunity to ensure that up-to-date immunization is maintained in all individuals.

In acute care hospitals, the admission of elderly patients and others at risk for complications from influenza and other diseases should be seen as an opportunity to ensure protection against these diseases. All routine vaccines should be up to date and consideration should be given to other vaccines as needed.

(see next page for more information on individual vaccines, toxoids)

Opportunities for Immunization in Long-Term Health Care Facilities

Annual vaccination against influenza is strongly recommended for individuals in nursing homes and chronic care institutions. Pneumococcal vaccine is recommended for the elderly and chronically ill, particularly in closed populations. A single dose should be administered to all unvaccinated individual admitted to such facilities. All routine vaccines should be up to date and consideration should be given to other vaccines as needed.

(see next page for more information on individual vaccines, toxoids)
<table>
<thead>
<tr>
<th>Vaccine or toxoid</th>
<th>Indication</th>
<th>Timing</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diphtheria (IM)</td>
<td>All adults</td>
<td>Every 10 years, as Td</td>
<td>Adverse events: Transient local and febrile reactions (usually mild and self-limiting)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Contraindications: Allergy to any component of the vaccine</td>
</tr>
<tr>
<td>Tetanus (IM)</td>
<td>All adults</td>
<td>Every 10 years, as Td</td>
<td>Adverse events: Local erythema and swelling. Severe local reactions are associated with high levels of antitoxin, often as a result of over vaccination</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Contraindications: Allergy to any component of the vaccine. No booster dose in the last five years or 10 years if major local reaction or avoid use at all if previous major systemic reaction</td>
</tr>
<tr>
<td>Pertussis</td>
<td>Adults who have not previously received a dose of acellular Pertussis vaccine</td>
<td>Give once as dTap if pertussis recommended that a single Td booster be replaced with the combined dTap vaccine</td>
<td>Adverse events: Transient, local pain, erythema and swelling were generally mild</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Contraindications: Hypersensitivity to any component of the vaccine</td>
</tr>
<tr>
<td>Influenza (IM, SC)</td>
<td>Adults ≥65 yrs or &lt;65 yrs with chronic medical conditions</td>
<td>Give yearly between September and December</td>
<td>Contraindications: Anaphylaxis to eggs, previous allergic reaction to influenza vaccine</td>
</tr>
<tr>
<td>Pneumococcal (polyvalente) (IM, SC)</td>
<td>Adults ≥65 yrs or &lt;65 yrs with chronic medical conditions</td>
<td>Once in a lifetime, Re-vaccination once in 5 years for the following: patients with asplenia, sickle cell disease, severe cardiopulmonary disease, cirrhosis, chronic renal failure, HIV infection, or immunosuppression</td>
<td>Adverse events: Local soreness and erythema are common</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Contraindications: Previous allergic reaction to pneumococcal vaccine</td>
</tr>
<tr>
<td>Measles (preferable to give as MMR) (SC)</td>
<td>Adults born in 1970 or later who are susceptible to measles</td>
<td>All adults born in 1970 or later who are susceptible to measles (by serology)</td>
<td>Adverse events: Fever, transient thrombocytopenia and very rarely encephalitis</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Contraindications: Immunosuppression. Previous allergic reaction to measles or MMR vaccines, neomycin allergy</td>
</tr>
<tr>
<td>Rubella (SC)</td>
<td>Susceptible women of childbearing age and health care workers</td>
<td>Once dose, no further doses needed</td>
<td>Adverse events: Rash, lymphadenopathy, transient arthralgia</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Contraindications: Pregnancy, immunosuppression, allergy to neomycin</td>
</tr>
<tr>
<td>Mumps (SC)</td>
<td>Adults born in 1970 or later</td>
<td>Once dose, no further doses needed</td>
<td>Adverse events: Fever, parotitis, rash</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Contraindications: Pregnancy, immunosuppression, allergy to neomycin</td>
</tr>
<tr>
<td>Vaccine</td>
<td>Susceptible health care workers, and certain patient populations</td>
<td>Adverse events</td>
<td>Contraindications</td>
</tr>
<tr>
<td>-----------------------</td>
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</tr>
<tr>
<td>Varicella (SC)</td>
<td>Two doses separated by 4 to 8 weeks</td>
<td>Fever, local reactions</td>
<td>Hypersensitivity to any vaccine component including neomycin, malignant neoplasms affecting the bone marrow, immunosuppression, active untreated TB, pregnancy</td>
</tr>
<tr>
<td>Heptatitis B (DM)</td>
<td>Occupational, life-style or environmental exposure</td>
<td>Fever, local reactions</td>
<td>Hypersensitivity to any vaccine component</td>
</tr>
<tr>
<td>Haemophilus B (HIB)</td>
<td>Patients with anatomic or functional asplenia and other immunosuppressed patients at risk for invasive HIB infection</td>
<td>Fever, local reactions</td>
<td>Hypersensitivity to any vaccine component</td>
</tr>
<tr>
<td>Menacuta A,C,Y and W-135 (conjugate) (DM)</td>
<td>One dose preferred to give dose x 1 instead of C-conjugate followed by A, C, Y, W-135 polysaccharide</td>
<td>Fever, local reactions</td>
<td>Hypersensitivity to any vaccine component</td>
</tr>
<tr>
<td>Meningococal A,C,Y and W-135 (polysaccharide) (SC)</td>
<td>One dose (2 weeks after conjugate)</td>
<td>Fever, local reactions</td>
<td>Hypersensitivity to any vaccine component</td>
</tr>
<tr>
<td>Meningococal C (conjugate) (DM)</td>
<td>Give dose (2 weeks prior to polysaccharide vaccine)</td>
<td>Fever, local reactions</td>
<td>Hypersensitivity to any vaccine component</td>
</tr>
<tr>
<td>Hepatitis A (DM)</td>
<td>Occupational, life-style or environmental exposure</td>
<td>Fever, local reactions</td>
<td>Hypersensitivity to any vaccine component</td>
</tr>
</tbody>
</table>

1. Cardiorespiratory disease, diabetes mellitus, hepatic renal disease, cancer, immunosuppression, alcoholism, residence in an institution
2. Cardiorespiratory disease (except asthma), diabetes mellitus, alcoholism, cirrhosis, renal disease, cancer, asplenia, sickle cell disease, CSF leak, HIV infection, homelessness, IVDU
3. There is combination Hepatitis A/B vaccine available
4. Please call Pharmacy or refer to Canadian Immunization Guideline 7th ed 2006 for more information.
Capital Health
PRE-PRINTED ORDER
Department of Medicine, Infectious Diseases
**Pneumococcal & Influenza Vaccination**

**Patient:** Allergies:

**THE FOLLOWING ORDERS:**
- May be used on any nursing unit and will be carried out by a qualified health professional ONLY ON THE AUTHORITY OF A PHYSICIAN
- All orders to be carried out must be checked/completed as appropriate.
- All dates must be written yyyy/mm/dd. All times must be on the 24-hour clock (hh:mm).

1. **Risk assessment for INFLUENZA:** At **high** risk due to: (check all applicable)
   a. ☐ Age 65 or older
   b. ☐ Chronic cardiovascular or pulmonary disease (i.e. asthma*, COPD)
   c. ☐ Resident in nursing home
   d. ☐ Chronic condition such as diabetes mellitus, cancer, immunodeficiency, immunosuppression, renal disease, anemia or hemorrhagic/bleeding
   e. ☐ HIV
   f. ☐ Foreign travel to destination where influenza is likely circulating
   g. ☐ Health care occupation or contact with people at high risk

2. **Risk assessment for PNEUMONOCOCCAL disease:** At **high** risk due to: (check all applicable)
   ☐ At risk for influenza (any of box a. through e. above checked; exception – box f. or g.)
   ☐ Asplenia, splenic dysfunction, sickle cell disease, cardiac disease, alcoholism or chronic leak of cerebrospinal fluid
   * Asthma alone has not been associated with increased risk for pneumococcal disease

3. **Contraindications (check all applicable)**
   ☐ Anaphylactic reaction to a previous dose
   ☐ Hypersensitivity to eggs (influenza only) or other components of the vaccine
   ☐ Acute febrile illness
   ☐ Previously received pneumococcal vaccine. (Some sub-groups require re-immunization (See Canadian Immunization Guide))

4. ☐ Administer pneumococcal vaccine (0.5 mL intra-muscularly or subcutaneously in deltoid)

5. ☐ Administer influenza vaccine (0.5 mL intramuscularly in deltoid; subcutaneously also permissible)

6. ☐ Do not administer vaccines

---

**Physician's Signature:** ___________________________ **Date (mm/dd/yr):** __________

**Physician's Name:** ___________________________ **CPNS No.:** __________

CG086084 10/05 **Top copy – chart**  **Bottom copy – pharmacy**  **Page 1 of 1**

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Antimicrobial Handbook
Risk assessment and administration of pneumococcal and influenza vaccine

Risk assessment for pneumococcal vaccine only (as all patients are at risk for influenza disease and qualify for vaccine unless there is a contraindication)

Assess contraindications

Obtain Informed Consent

Discuss:
- Benefits of vaccine(s)
- Risks of not getting vaccinated
- Common and expected side effects of the vaccine(s)
- Possible serious adverse effects and their frequency
- Potential need and consent for anaphylaxis management
- Provide opportunity for questions
- Patient appears to understand and knowingly consents

Administer vaccine(s)

Document administration of vaccine including lot number and site of injection(s) either in MAR
### Guidelines for the Empiric Treatment of Intra-abdominal Infections

<table>
<thead>
<tr>
<th>Infection</th>
<th>Patient Criteria</th>
<th>Usual Pathogens</th>
<th>Recommended Empiric Therapy</th>
<th>Alternatives</th>
<th>Duration</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acute Cholecystitis</td>
<td>Mild</td>
<td>Usually does not require antimicrobial therapy</td>
<td>Cefazolin + metronidazole</td>
<td>Penicillin-allergic</td>
<td>7-10 days</td>
<td><em>Enterococci should be treated only if isolated</em></td>
</tr>
<tr>
<td></td>
<td>Moderate to severe</td>
<td>E. coli</td>
<td>Cefazolin + metronidazole</td>
<td>Ciprofloxacin + Gentamicin</td>
<td>3-5 days</td>
<td><em>Cefoxitin is interchanged to cefazolin + metronidazole</em></td>
</tr>
<tr>
<td></td>
<td></td>
<td>E. coli</td>
<td>Ampicillin + gentamicin + metronidazole</td>
<td>Gentamicin</td>
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<td></td>
<td></td>
<td>B. fragilis</td>
<td>Metronidazole</td>
<td>Clindamycin</td>
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<td></td>
<td></td>
<td>Enterococci</td>
<td>Penicillin-allergic</td>
<td>Ciprofloxacin + Gentamicin</td>
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<td></td>
<td></td>
<td>Penicillin-allergic</td>
<td>Ciprofloxacin + Gentamicin</td>
<td>Clindamycin</td>
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<td></td>
<td></td>
<td>Ciprofloxacin +</td>
<td>Ciprofloxacin + Metronidazole</td>
<td>Clindamycin</td>
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<td>Metronidazole</td>
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<td>Clindamycin + Metronidazole</td>
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<td></td>
<td></td>
<td>Metronidazole</td>
<td>Metronidazole</td>
<td>Clindamycin + Metronidazole</td>
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</tr>
</tbody>
</table>

**Notes:**
- *Cefoxitin is considered in the elderly, critically ill, or those with renal impairment.*
- *Cefoxitin is interchanged to cefazolin + metronidazole.*
- *Aminoglycosides should be avoided in the elderly, critically ill, or those with renal impairment.*

---

* Cultures and sensitivities should always be used to guide antimicrobial therapy when available.
## Antimicrobial Handbook

### Guidelines for the Empiric Treatment of Intra-abdominal Infections (cont'd)

<table>
<thead>
<tr>
<th>Infection</th>
<th>Patient Criteria</th>
<th>Usual Pathogens</th>
<th>Recommended Empiric Therapy</th>
<th>Alternatives</th>
<th>Duration</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acute Diverticulitis</td>
<td>Mild-moderate</td>
<td><em>E. coli</em> &amp; <em>B. fragilis</em> &amp; <em>Enterococcus</em></td>
<td>Oral Therapy: <em>Amoxicillin-clavulanate</em> OR <em>Tazobactam</em> + <em>Metronidazole</em></td>
<td><em>Penicillin-allergic: Ciprofloxacin</em> + <em>Metronidazole</em></td>
<td>7-10 days, according to clinical response.</td>
<td><em>Only amoxicillin-clavulanate covers Enterococcus.</em> <em>Oral therapy in appropriate for mild uncomplicated infections.</em></td>
</tr>
<tr>
<td></td>
<td>Severe</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Acute Pancreatitis</td>
<td>Complicated- abscess, infected pseudocyst, infected necrotic pancreas</td>
<td><em>E. coli</em> &amp; <em>Enterococcus spp</em> &amp; <em>S. aureus</em> &amp; <em>Coagulase negative Staph</em> &amp; <em>Anaerobes</em> &amp; <em>Candida spp</em></td>
<td>Oral Therapy: <em>Piperacillin/tazobactam</em> OR <em>Meropenem</em></td>
<td><em>Penicillin-allergic: Ciprofloxacin</em> + <em>Metronidazole</em></td>
<td>Dependent on clinical response, may be prolonged.</td>
<td>Tailor antimicrobials to CaS results.</td>
</tr>
<tr>
<td>Infection</td>
<td>Patient Criteria</td>
<td>Usual Pathogens</td>
<td>Recommended Empiric Therapy</td>
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</tr>
<tr>
<td>Acute Appendicitis</td>
<td>Uncomplicated</td>
<td></td>
<td></td>
<td>Empiric therapy not required</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Complicated (gangrene, perforation, abscess or peritonitis)</td>
<td></td>
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<tr>
<td></td>
<td>Set Secondary Peritonitis</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Liver Abscess</td>
<td>Bacterial</td>
<td>E. coli</td>
<td>Drainage and Cefazolin + metronidazole</td>
<td>Piperacillin/ tazobactam</td>
<td>4 weeks or until CT resolution</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>R. fragilis</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>Enterococcus</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>Streptococcus anginosus/millien group</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spontaneous Bacterial Peritonitis</td>
<td>S. pneumoniae</td>
<td>E. coli</td>
<td>Colistin and Ceftriaxime</td>
<td>Piperacillin-allergic Ciprofloxacin</td>
<td>10-14 days</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Bacteroidetes</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Streptococcus spp</td>
<td></td>
<td></td>
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</tbody>
</table>
### Guidelines for the Empiric Treatment of Intra-abdominal Infections (cont’d)

<table>
<thead>
<tr>
<th>Infection</th>
<th>Patient Criteria</th>
<th>Usual Pathogens</th>
<th>Recommended Tharpy</th>
<th>Alternatives</th>
<th>Duration</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Secondary Peritonitis (e.g. bowel perforation, ruptured appendix)</td>
<td>Community-acquired</td>
<td><em>E. coli</em>&lt;br&gt;<em>B. fragilis</em>&lt;br&gt;Enterococcus&lt;br&gt;S. epidermis</td>
<td>Ampicillin + gentamicin + metronidazole OR Cefoxitin + metronidazole OR Ciprofloxacin + Amoxicillin-clavulanate</td>
<td>Ceftriaxone + metronidazole&lt;br&gt;Penicillin-allergic: Clindamycin + gentamicin OR metronidazole</td>
<td>Dependent on clinical picture</td>
<td>Treat if isolated. Aminoglycosides should be avoided in the elderly, critically ill, or those with renal impairment. Cefoxitin is interchange for ceftriaxone + metronidazole. Pseudomonal isolates should be treated with a different antimicrobial class and consider Infectious Diseases consult.</td>
</tr>
<tr>
<td>Hospital-acquired and no previous antimicrobial therapy, or intra-abdominal abscesses</td>
<td><em>E. coli</em>&lt;br&gt;<em>B. fragilis</em>&lt;br&gt;Enterococcus spp&lt;br&gt;Klebsiella spp&lt;br&gt;Proteus spp&lt;br&gt;<em>P. aeruginosa</em>&lt;br&gt;Candida spp</td>
<td>Cefuroxime + metronidazole 2</td>
<td>Piperacillin/tazobactam&lt;br&gt;Penicillin-allergic: Ciprofloxacin + metronidazole</td>
<td></td>
<td>Dependent on clinical picture</td>
<td></td>
</tr>
<tr>
<td>Hospital-acquired, previous antimicrobial therapy, or ICU admission</td>
<td><em>E. coli</em>&lt;br&gt;<em>B. fragilis</em>&lt;br&gt;Enterococcus spp&lt;br&gt;Klebsiella spp&lt;br&gt;Proteus spp&lt;br&gt;<em>P. aeruginosa</em>&lt;br&gt;Streptococcus spp&lt;br&gt;Acinetobacter spp&lt;br&gt;S. epidermis&lt;br&gt;Candida spp</td>
<td>Piperacillin/tazobactam</td>
<td>Metronem&lt;br&gt;Penicillin-allergic: Ciprofloxacin + metronidazole</td>
<td></td>
<td>Dependent on clinical picture</td>
<td></td>
</tr>
</tbody>
</table>

*Ciprofloxacin + metronidazole does not cover enterococcus*
<table>
<thead>
<tr>
<th>Infection</th>
<th>Patient Criteria</th>
<th>Usual Pathogens</th>
<th>Recommended Therapy</th>
<th>Alternatives</th>
<th>Duration</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tertiary Peritonitis</td>
<td></td>
<td>P. aeruginosa</td>
<td>Treat according to C&amp;S results</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

References available upon request from Pharmacy.
Pelvic Inflammatory Disease

<table>
<thead>
<tr>
<th>Etiologies</th>
<th>Treatment</th>
<th>Alternative Regimens</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Inpatient</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Sexually Transmitted:</strong></td>
<td>A) Ceftriaxone 1 g IV q24h + doxycycline 100 mg IV or PO* q12h. IV therapy can be discontinued 24 h after clinical improvement, and doxycycline 100 mg BID PO should continue for a total of 14 days of treatment.</td>
<td>A) Ofloxacin 400 mg IV q12h = metronidazole 500 mg IV q12h</td>
</tr>
<tr>
<td></td>
<td>B) Clindamycin 900 mg IV q6h + gentamicin 6 mg/kg IV q24h. IV therapy can be discontinued 24 h after clinical improvement, and doxycycline 100 mg BID PO or clindamycin 450 mg QID PO should continue for a total of 14 days of treatment.</td>
<td>B) Levofloxacin 500 mg IV q24h = metronidazole 500 mg IV q12h</td>
</tr>
<tr>
<td></td>
<td>C) Ertapenem 1 g IV every 24 h + doxycycline 100 mg IV or PO* every 12 h.</td>
<td>C) Ertapenem 1 g IV every 24 h + doxycycline 100 mg IV or PO* every 12 h. Note: Due to concerns of anaerobic coverage of quinolones, metronidazole should be added to quinolone regimen.</td>
</tr>
<tr>
<td></td>
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<tr>
<td></td>
<td>A) Ceftriaxone 250 mg IM single dose + doxycycline 100 mg BID PO x 14 d.</td>
<td>A) Ofloxacin 400 mg PO BID x 14 d = metronidazole 500 mg PO BID for 14 d.</td>
</tr>
<tr>
<td></td>
<td>B) Other parenteral 3rd generation cephalosporin (i.e., cefotaxime) + doxycycline 100 mg PO BID x 14 d.</td>
<td>B) Levofloxacin 500 mg PO QD = metronidazole 500 mg PO BID x 14 d.</td>
</tr>
<tr>
<td></td>
<td>(Metronidazole 500 mg PO BID x 14 d may be added to these regimens for more anaerobic coverage)</td>
<td></td>
</tr>
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<td></td>
</tr>
<tr>
<td></td>
<td>A) Ofloxacin 400 mg IV q12h = metronidazole 500 mg IV q12h.</td>
<td>B) Levofloxacin 500 mg IV q24h = metronidazole 500 mg IV q12h</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>A) Ceftriaxone 250 mg IM single dose + doxycycline 100 mg BID PO x 14 d.</td>
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</tr>
<tr>
<td></td>
<td>B) Clindamycin 900 mg IV q6h + gentamicin 6 mg/kg IV q24h. IV therapy can be discontinued 24 h after clinical improvement, and doxycycline 100 mg BID PO or clindamycin 450 mg QID PO should continue for a total of 14 days of treatment.</td>
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</tr>
<tr>
<td></td>
<td>C) Ertapenem 1 g IV every 24 h + doxycycline 100 mg IV or PO* every 12 h.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
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<tr>
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</tr>
<tr>
<td></td>
<td>B) Clindamycin 900 mg IV q6h + gentamicin 6 mg/kg IV q24h. IV therapy can be discontinued 24 h after clinical improvement, and doxycycline 100 mg BID PO or clindamycin 450 mg QID PO should continue for a total of 14 days of treatment.</td>
<td>B) Levofloxacin 500 mg PO QD = metronidazole 500 mg PO BID x 14 d.</td>
</tr>
<tr>
<td></td>
<td>C) Ertapenem 1 g IV every 24 h + doxycycline 100 mg IV or PO* every 12 h.</td>
<td></td>
</tr>
</tbody>
</table>

Note: Quinolones are considered as an alternative only if susceptibility testing is available and has demonstrated susceptibility or a test of cure can be completed.

*Most experts recommend doxycycline can be administered orally in hospitalized patients due to painful and costly IV administration. Oral and IV administration also have similar bioavailability.

Efficacy and complication rates are not significantly different between parenteral versus oral therapy or inpatient versus outpatient treatment.

If patient does not recover, consider differential diagnosis and laparoscopy.

Improvement in pain and tenderness from acute PID should begin within 2-3 days after initiating therapy.

Penicillin Allergy – An Overview

Clinical situations for which penicillin is indicated as the sole effective treatment arise frequently in hospital practice. The evaluation of suspected penicillin allergy is therefore essential in making decisions about alternative antibiotic therapy versus penicillin. Up to 20% of hospitalized individuals claim allergy to penicillin. However, penicillin can also cause non-allergic intolerance (most commonly manifested as GI effects) and it is this intolerance that is often misinterpreted as allergy by many patients. Other reasons for misdiagnosis of penicillin allergy may include a patient’s faulty recall or natural declining hypersensitivity over time. Up to three to seven percent of patients taking ampicillin or amoxicillin develop maculopapular rashes. These rashes are not IgE-mediated however, and develop more commonly (up to 100%) in a patient with mononucleosis or with concurrent allopurinol therapy (up to 30%).

After a careful review of past penicillin usage and subsequent outcomes, all patients with suspected allergies can be classified into one of three categories represented in the following table:

<table>
<thead>
<tr>
<th>ALLERGIC</th>
<th>POSSIBLY ALLERGIC</th>
<th>ALLERGY NOT LIKELY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anaphylactic reactions: swelling of throat, lips, tongue, difficulty breathing wheezing; urticaria</td>
<td>Mild skin rash Itchiness alone without rash</td>
<td>Nausea, vomiting, diarrhea Negative rechallenge</td>
</tr>
<tr>
<td>Serum sickness</td>
<td>Unknown reaction</td>
<td>Injection site reactions: pain, phlebitis</td>
</tr>
<tr>
<td>Stevens-Johnson</td>
<td></td>
<td>Seizures</td>
</tr>
</tbody>
</table>

- Those patients found to be “Allergic” should avoid penicillins.
- There is less chance of a serious reaction in the “Possibly Allergic” category because these symptoms are consistent with reactions to the drug’s primary metabolites, not minor determinants, and are less likely to result in anaphylaxis.
- An “Allergy Not Likely” patient implies that the effects previously experienced, are GI or infusion-related and not allergy-related; penicillin and related drugs may be considered.
- Patients with chronic urticaria may have urticaria exacerbated by any antimicrobials or infection - patient can be referred to Immunology.
Penicillin Allergy (cont’d)

**Reaction to any penicillin**

- History of urticarial rash, angioedema, bronchospasm, or hypotension
- History of other type of reaction
- Challenge with a penicillin, cephalosporin*, or carbapenem**

**Do penicillin skin test before giving any penicillin (consult Immunology)**

**Consider cephalosporin*, consider carbapenem**, or other class of antibiotics

**Positive skin test result**

- Avoid penicillin
- Desensitize patient (see PPO)

**Negative skin test result**

- Challenge with a penicillin

---

In the general population, the risk of serious allergic reactions to cephalosporins appears to be <0.02%; the risk is lowest for third-generation cephalosporins (possibly because free drug competes with bound drug or antibodies to the side chain). Therefore, even if patients with a history of penicillin allergy have twice as great a risk of having a serious reaction to cephalosporins that do control subjects, this risk may be lower than the risk that they will have a serious reaction to any alternative antibiotic.1

**Patients with a history of a reported or documented penicillin allergy appeared to demonstrate an 11% incidence of hypersensitivity when treated with a carbapenem, compared with an incidence of 2.7% for patients without a reported history of penicillin allergy.**2 However, it is important to note these statistics are based on a variety of reaction severities, and lower rates have been observed in other studies (1.5-5%).3

---

**References**


Antimicrobial Handbook 75
PRE-PRIINTED ORDER
Department of Medicine, Immunology
BETA-LACTAM DESENSITIZATION PROTOCOL

Patient: ___________________________ Allergies: ___________________________

THE FOLLOWING ORDERS:
• May be used ONLY IN THE ICU/MCU and will be carried out by a qualified health professional ONLY ON THE
  AUTHORITY OF A PHYSICIAN
• All orders to be carried out must be checked/completed as appropriate.
• All dates must be written yyy/mm/dd. All times must be on the 24-hour clock (hhmm hr).
• To be initiated (DATE) ___________________________ (preferably during weekend/after hours).
• Notify Pharmacy once decision of desensitization has been made and data placed.
• Page Dr. ___________________________ when protocol to be initiated (Page)

1. MONITORING
   • Vital signs q15 minutes throughout procedure and for 30 minutes after completion.
   • Airway hit at bedside

2. MEDICATIONS
   • Erythromycin 1/1000 0.3 mL IM x 1 at bedside
   • Diphenhydramine 50 mg IVIM x 1 at bedside
   • Ceftriaxone 20 mg po x 2 at bedside
   • Cefotaxime OR Neomycin OR Ceftriaxone OR Other

<table>
<thead>
<tr>
<th>Dose</th>
<th>Strength/Route</th>
<th>Dose</th>
<th>Strength/Route</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.01 mg IV</td>
<td>11</td>
<td>30 mg IV</td>
</tr>
<tr>
<td>2</td>
<td>0.02 mg IV</td>
<td>12</td>
<td>40 mg IV</td>
</tr>
<tr>
<td>3</td>
<td>0.04 mg IV</td>
<td>13</td>
<td>50 mg IV</td>
</tr>
<tr>
<td>4</td>
<td>0.06 mg IV</td>
<td>14</td>
<td>60 mg IV</td>
</tr>
<tr>
<td>5</td>
<td>0.08 mg IV</td>
<td>15</td>
<td>70 mg IV</td>
</tr>
<tr>
<td>6</td>
<td>0.10 mg IV</td>
<td>16</td>
<td>80 mg IV</td>
</tr>
<tr>
<td>7</td>
<td>0.12 mg IV</td>
<td>17</td>
<td>85 mg IV</td>
</tr>
<tr>
<td>8</td>
<td>0.14 mg IV</td>
<td>18</td>
<td>90 mg IV</td>
</tr>
<tr>
<td>9</td>
<td>0.16 mg IV</td>
<td></td>
<td>100 mg IV</td>
</tr>
<tr>
<td>10</td>
<td>0.18 mg IV</td>
<td></td>
<td>150 mg IV</td>
</tr>
<tr>
<td></td>
<td>0.20 mg IV</td>
<td></td>
<td>200 mg IV</td>
</tr>
<tr>
<td></td>
<td>0.30 mg IV</td>
<td></td>
<td>300 mg IV</td>
</tr>
</tbody>
</table>

   Dose each dose in 20 mL of saline and use smaller syringes. Increase dose q30 minutes.

3. IF PATIENT REACTS:
   • Stop IM/IV.
   • Notify Dr.

   FOR SUCH REACTIONS OMG: cough, pruritus, angioedema, hives:
   • Give Hydrocortisone 20 mg IVIM x 1
   • Give Diphenhydramine 50 mg IVIM x 1
   • Give ceftriaxone 20 mg IVIM x 1

   FOR SYSTEMIC REACTIONS OMG: respiratory, hypotension, laryngeal edema:
   • Give Epinephrine 1/1000 0.3 mL IM x 1

Physician’s Orders: ___________________________ Date (yy/mm/dd):
Physician’s Name: ___________________________ OR/NS Rx:

Top copy – chart  Bottom copy – pharmacy  Page 1 of 1
Pentamidine
– Suggested Dosing Guidelines

Pentamidine Therapy:
Pentamidine, 3-4 mg/kg/d IV as a single daily dose, infused over at least 1 hour (preferably over 2-3 hours).

Side Effects of Pentamidine Therapy:
The use of injectable pentamidine is associated with a variety of serious adverse effects in approximately 50% of treated patients. Medical staff should be consulted when abnormalities in laboratory data occur or if questions concerning change in management arise.

<table>
<thead>
<tr>
<th>Side Effect</th>
<th>Incidence (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Skin rash or thrombophlebitis</td>
<td>1–2</td>
</tr>
<tr>
<td>Hypotension (positioning patient in a supine position during administration may decrease incidence)</td>
<td>9 – 10</td>
</tr>
<tr>
<td>Arrhythmias (ventricular tachycardia)</td>
<td>1 – 2</td>
</tr>
<tr>
<td>Hypoglycemia, usually after first 5-7 days of treatment</td>
<td>6 – 40</td>
</tr>
<tr>
<td>Hyperglycemia may occur up to months after treatment, in about 5% of patients with a history of hypoglycemia</td>
<td></td>
</tr>
<tr>
<td>Hypocalcemia</td>
<td>1 – 2</td>
</tr>
<tr>
<td>Myelotoxicity, neutropenia, pancytopenia</td>
<td>14 – 15</td>
</tr>
<tr>
<td>Nephrotoxicity, possibly progressing to acute renal failure including hyperkalemia, hypomagnesemia</td>
<td>23 – 25</td>
</tr>
<tr>
<td>Acute Pancreatitis</td>
<td>rare, but serious</td>
</tr>
<tr>
<td>Elevated Liver Enzymes</td>
<td>9 – 11</td>
</tr>
</tbody>
</table>

Management of Pentamidine Therapy:
• prior to therapy and daily: glucose (by chemstrip or blood) anytime of the day.
• prior to therapy and twice weekly: CBC with differential and platelets; calcium, magnesium; liver function tests; urea, creatinine, electrolytes,
• vitals: beginning, and at end of infusion. Ambulatory patients should have BP checked sitting at the completion of infusion to check for postural hypotension.
• assure adequate fluid status before administering pentamidine, preloading with 500 ml. of NaCl 0.9% may decrease the incidence of nephrotoxicity/hypotension.
• avoid other nephrotoxic drugs (amphotericin B, aminoglycosides, vancomycin) whenever possible.
• counsel patient on signs and symptoms of acute pancreatitis i.e. acute abdominal pain, nausea and vomiting.

Antimicrobial Handbook
Empiric Therapy of Pneumonia

EMPIRIC ANTIBIOTIC THERAPY OF PNEUMONIA IS DETERMINED BY THREE MAIN FACTORS:

1. Where was the infection acquired?
   • Community vs Chronic Care Facility vs Acute Care Hospital vs Intensive Care Unit.

2. What are the patient’s age and underlying conditions?
   • Alcoholism, COPD, chronic bronchitis, altered level of consciousness or impaired swallowing, influenza, chronic debilitating conditions (malignancy, chronic renal failure, etc.), cystic fibrosis.

3. What is the severity of the illness?
   • Respiratory function (blood gases, need for ventilatory support, degree of distress).
   • Progression of the illness (stable vs deteriorating).

An assessment of the first two factors will help determine the most likely pathogen. Empiric therapy should be initiated based on the above factors pending results of Gram stain and cultures. Therapy must be modified to the most effective and least costly therapy, once culture results are known.

The greatest cost savings are achieved by an early switch from intravenous to oral therapy. See Sequential Antibiotic Therapy and Pharmacist Initiation Route of Administration Therapeutic Interchange.

The following guidelines will assist in selecting the most cost-effective empiric therapy for most clinical situations.
Suggested Guidelines for the Treatment of Community-Acquired Pneumonia

1. Patient with community acquired pneumonia
   - CXR, CBC, lyses, urea, glucose, O₂ sat (if <90% ABG)

2. Pneumonia severity scoring system
   - ≤ 70 points
   - 71-90 points
   - ≥ 91 points

3. Fits extra discharge criteria
   - 1st dose IV/PO antibiotic in emergency dept.
   - Admit to hospital

4. D/C home
   - Suggested antibiotic choices:
     - Clarithromycin 500 mg po bid x 10 days
     - Azithromycin 500 mg po once then 250 mg po od x 4 days
     - Pts >65yrs can use Cefuroxime 500 mg po BID
     - likelihood mycoplasma, chlamydia pneumoniae
   - All patients should follow-up with their Family Physician

5. Follow-up CXR if:
   - Patient ≥ 55yrs old
   - Patient ≥ 45yrs old and smokes

6. Pneumonia education booklet

Organisms

<table>
<thead>
<tr>
<th>No Comorbidity</th>
<th>Comorbidity</th>
</tr>
</thead>
<tbody>
<tr>
<td>S.pneumoniae</td>
<td>Legionella species</td>
</tr>
<tr>
<td>H.influenzae</td>
<td>Mycoplasma pneumoniae</td>
</tr>
<tr>
<td>S.aureus</td>
<td>Chlamydia pneumoniae</td>
</tr>
<tr>
<td></td>
<td>Oral anaerobes</td>
</tr>
<tr>
<td></td>
<td>Legionella species</td>
</tr>
</tbody>
</table>

Extra Discharge Criteria
1. The patient's O₂ sat >90% on RA (or if COPD paO₂ >55) yes or no
2. Will the patient tolerate oral medications? yes or no
3. Will the patient likely be compliant? yes or no
4. Are home supports sufficient? yes or no

If you have answered NO to any of these questions, consider admission.

Antimicrobial Handbook
Treatment of Community-Acquired Pneumonia (cont’d)

**Drug Therapy**

* Levofloxacin 500 mg IV/PO Once daily*
  
  OR
  
  * Ceftriaxone 1g IV once daily + Azithromycin 500 mg IV/PO Once daily

* If patient has received a fluoroquinolone in the past 3 months, then choose an antibiotic from another class.
Suggested Guidelines for the Management of Hospital-Acquired Pneumonia

Definitions

Hospital-acquired pneumonia (HAP): Pneumonia that occurs 48 hours or more after admission, which was not incubating at the time of admission.

Diagnosis

Common Causative Pathogens:

- **Gram negative rods**: Haemophilus influenzae, Escherichia coli, Klebsiella pneumoniae, Proteus species, Enterobacter species, Serratia marcescens, Pseudomonas aeruginosa and Acinetobacter species.
- **Gram positive cocci**: Staphylococcus aureus, Streptococcus pneumoniae.
- **Anaerobes**: May play a role when there has been macroaspiration.

Clinical Strategy:

- Diagnostic investigations (sputum and blood cultures) should be obtained prior to antibiotic initiation or change.

<table>
<thead>
<tr>
<th>TABLE 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Centers for Disease Control and Prevention criteria for nosocomial pneumonia</td>
</tr>
<tr>
<td><strong>Pneumonia must meet one of the criteria (only in patients &gt;12 months of age)</strong></td>
</tr>
<tr>
<td>1. Rales or dullness to percussion on physical examination of chest and any of the following:</td>
</tr>
<tr>
<td>- new onset of purulent sputum or change in character of sputum;</td>
</tr>
<tr>
<td>- organism isolated from blood culture;</td>
</tr>
<tr>
<td>- isolation of pathogen from specimen obtained by transtracheal aspirate, bronchial brushing or biopsy.</td>
</tr>
<tr>
<td>2. Chest radiographic examination shows new or progressive infiltrate, consolidation, cavitation or pleural effusion and any of the following:</td>
</tr>
<tr>
<td>- new onset of purulent sputum or change in character of sputum;</td>
</tr>
<tr>
<td>- organism isolated from blood culture;</td>
</tr>
<tr>
<td>- isolation of pathogen from specimen obtained by transtracheal aspirate, bronchial brushing or biopsy;</td>
</tr>
<tr>
<td>- isolation of virus or detection of viral antigen in respiratory secretions;</td>
</tr>
<tr>
<td>- diagnostic single antibody titre (IgM) or four-fold increase in paired serum samples (IgG) for pathogen.</td>
</tr>
</tbody>
</table>

Ig Immunoglobulin. Adapted from reference 3.
Treatment

Empiric Therapy:
• The treatment of HAP is usually empirical. Studies have shown that delayed or inappropriate administration of empiric antimicrobial therapy is associated with increased mortality. Therefore it is imperative that optimal treatment be initiated as soon as possible.
• Choice of agent should be based on our local patterns of susceptibility, anticipated side effects, and what antibiotics the patient has recently received, striving not to repeat the same antimicrobial class if possible.
• Intravenous therapy should be used in all patients initially. A switch to oral/enteral therapy can be made in patients with good clinical response and functioning gastrointestinal tract.
• Legionnaires’ Disease
  • *Legionella pneumophila should be suspected in severe or rapidly progressing pneumonia. Sputum for *Legionella culture should be specifically requested in this situation.
  • Patients with suspected or diagnosed legionnaires’ disease should be treated with IV azithromycin, or a fluoroquinolone.

Ward patient (No risk factors for multi-drug resistant (MDR) pathogens*):
• Initial Treatment: Ceftriaxone
• Stepdown: Amoxicillin/clavulanic acid, cefuroxime, or ciprofloxacin

*Risk factors for MDR pathogens:
(ANTIbiotic therapy should be tailored to reflect individual patient's risk factors.)
• Current hospitalisation of 4 days or more;
• Antimicrobial therapy in preceding 30 days;
• Patients hospitalized in an acute care hospital for 2 or more days within 90 days of the infection;
• Recent ICU admissions.

De-escalation:
• Clinical improvement usually takes 48–72 hours, and thus therapy should not be changed during this time unless there is rapid clinical decline.
• Broad spectrum empiric antibiotic therapy should be accompanied by a commitment to streamline antibiotics, on the basis of clinical microbiologic data, to limit the emergence of resistance in the hospital and the potential for adverse effects.

Duration of Therapy:
• If patients receive an initially appropriate antibiotic regimen, duration of therapy may be shortened from 10-14 days to as short as 7 days, provided that the pathogen is not *P. aeruginosa, S. aureus and that the patient has a good clinical response with resolution of clinical features of infection.

References:
Diagnostic Algorithm HAP/VAP

Screen patient for clinical features: Does patient have two or more of the following features that are suggestive of an infection?

1. Temperature >38°C or <36°C
2. Leukopenia/leukocytosis
3. Purulent tracheal secretions
4. Decreased PaO2

YES

No further investigation is required; however, it is recommended that the patient be monitored for any changes to their condition.

NO

Order chest x-ray

Review patient’s chest x-ray: Were any of the abnormalities listed below observed on the patient’s chest x-ray?

1. Evidence of alveolar infiltrates
2. Evidence of air bronchograms
3. New or worsened infiltrates

YES

Recommended that the patient be monitored and that an investigation into other possible causes be conducted.

NO

Is the patient in the ICU?

YES

Is the patient mechanically ventilated?

YES

Calculate patient’s CPIS

Is the CPIS ≤ 6? Is the CPIS ≤ 6?

YES

Stop therapy if started

NO

Recalculate CPIS

Is the CPIS < 4?

YES

Initiate therapy

NO

NO

Are tracheobronchial secretions available for Gram stain?

YES

Are pus cells and organisms present?

YES

Are tracheobronchial secretions available for Gram stain?

NO

Is the CPIS < 4?

YES

Stop therapy

NO

Recalculate CPIS

Continue therapy if CPIS < 4 on day 3

NO

Are pus cells and organisms present?

YES

Are pus cells and organisms present?

NO

Stop therapy if started

Recalculate CPIS

Continue therapy if CPIS < 4 on day 3

Initialize therapy

Diagnostic algorithm for hospital-acquired pneumonia and ventilator-associated pneumonia. Please note that there is no definitive scientific evidence or expert consensus that quantitative testing produces better clinical outcomes than empirical treatment. Scientific evidence of improved specificity, supplemented by expert opinion, supports the performance of invasive tests to avoid the use of antibiotics for clinically insignificant organisms, but there is no direct evidence or consensus regarding the superiority of one invasive test over another. Factors to consider in choosing an appropriate test include sensitivity and specificity, ability to improve patient outcome, potential adverse effects, test availability and cost. CPIS Clinical pulmonary infection score; ICU Intensive care unit; PaO2 Partial pressure of oxygen in arterial blood.1

Antimicrobial Handbook
Treatment Guidelines for the Management of Ventilator-Associated Pneumonia

Summary

Prompt appropriate therapy for critically ill patients with VAP and other infections reduces mortality. However, antibiotic resistant organisms are an increasing threat to the health care system. Within the hospital environment, critical care areas have the highest incidence of antibiotic resistant organisms. It is important therefore, to minimize the use of antibiotics whenever possible. This must be balanced with the fact that prompt adequate therapy for critically ill patients with VAP affects clinical outcome.

Developing this approach to the management of VAP was based on the following points from the literature:

1. Mortality is lower in patients who initially receive the correct antimicrobial for their pneumonia, as shown in a number of studies. Initial treatment should be based on local flora and antibiotic susceptibility patterns, the duration of prior hospital and ICU stay (“early” or “late”), and history of previous antibiotic therapy.

2. There is to date no “gold standard” for the diagnosis of VAP. Clinical criteria for diagnosing VAP are not very specific and often patients have non-infectious causes of their pulmonary infiltrates. As a result, antibiotics may be prescribed unnecessarily, with the potential for increased costs, adverse effects, and the future development of infection with resistant organisms. Prior receipt of antibiotics is a risk factor for infection with resistant organisms in studies of VAP. Bacteriological sampling is usually required to confirm clinically suspected pneumonia and direct therapy.

3. Although not consistently done, various studies have shown that antibiotics can safely be stopped in patients with negative bronchoscopic specimen cultures.

4. In selected patients with VAP, a 7 or 8 day course of treatment is as effective as longer courses, and does not result in adverse patient outcomes.

5. A comprehensive evaluation or algorithmic approach to VAP incorporating formal reassessment of the need or tailoring of antibiotic therapy based on culture results, results in decreased antibiotic use, a decreased length of ICU stay, and a decreased rate of secondary infections.

Conclusion

The optimization of the management of VAP (i.e. improved diagnosis, prompt, adequate initiation of antibiotics, reassessment or narrowing of antibiotic therapy based on cultures and shorter duration of therapy) should lead to improved patient outcomes and a decreased risk of antibiotic resistance.
**CDHA Algorithm for the Diagnosis and Management of VAP**

**Infection Suspected**

**VAP Criteria:** New pulmonary infiltrate after 48 hrs of intubation, not otherwise explainable, with at least one of: T >38°C, ↑ WBC and two or more of: new change in sputum purulence or volume, rales or bronchial breath sounds, worsening gas exchange

**Pneumonia Diagnosed**

**Draw Cultures:** Blood and pulmonary secretions for culture should be sent on every patient with VAP

**START ANTIBIOTICS:** Early (≤4 days in hosp): cefotaxime; Late (>4 days in hosp): pip/tazo or cipro + cefazolin; if prev abx course: pip/tazo or cefazidime with either an AG or cipro

**Pathogen isolated**

**Cultures Negative, and no abx within 72 hrs of specimen**

**Check culture results in 48-72 hours**

**D/C Abx**

**Patient responding clinically, initial abx covered organism(s)**

**D/C abx after 8 days**

**Cultures Negative, pt had severe sepsis &/or abx prior to obtaining culture**

**Continue or adjust abx, look for alternate source of infection**

**Treat for 10-14 days, or 3 days after clinical improvement**

* If tracheal aspirate cultures performed, use CPIS (who is going to do this; can we do this regularly when VAP suspected?) score and re-evaluate after cultures available; D/C abx if CPIS ≤ 6

* # change to narrowest spectrum agent which will adequately cover organism; use 2 agents for *Pseudomonas aeruginosa*, for Serratia, Acinetobacter, Citrobacter or Enterobacter, use separta or cipro, or change to piperacillin + gentamicin


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**Antimicrobial Handbook**
SEPSIS
Suspect SEVERE SEPSIS or SEPTIC SHOCK

Suspect Severe Sepsis Or Septic Shock In A Patient Who Has:

1. A suspected infection (bacterial, fungal or viral)
2. Two or more vital sign abnormalities*
3. A lactate equal to or greater than 4 mmol/L and/or MAP less than 55 mmHg after a 2 L bolus

“Vital Sign Abnormalities

a) Temp less than 36°C or greater than 38°C
b) HR greater than 90 BPM
c) RR greater than 20 or PaCO₂ less than 32
d) WBC less than 4x10⁹/L or greater than 12x10⁹/L, or greater than 10% bands

Evidence of Organ Dysfunction:

1. Lactate equal to or greater than 4
2. Alteration in level of consciousness
3. Urine less than 0.5 mL/kg/h x 6h or increased creatinine 1.5 x baseline
4. Elevation of AST, ALT

Empiric Antibiotic Therapy For Patients With Suspected Severe Sepsis Or Septic Shock

Note: Every effort should be made to ensure that antibiotics are administered WITHIN 1 HOUR of the diagnosis of severe sepsis or septic shock

If possible, obtain appropriate cultures prior to antibiotic administration; however, DO NOT DELAY ANTIBIOTICS FOR CULTURES

<table>
<thead>
<tr>
<th>Sepsis Origin</th>
<th>Empiric Initial Intravenous Antibiotic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unknown</td>
<td>Vancomycin 20 mg/kg IV AND piperacillin/tazobactam 3.375 g IV</td>
</tr>
<tr>
<td>Lung (pneumonia)</td>
<td></td>
</tr>
<tr>
<td>A) Community Acquired / Nursing Home</td>
<td>cefTRIAXone 1 g IV AND azithromycin 500 mg IV OR levofoxacin 750 mg IV</td>
</tr>
<tr>
<td>B) Hospital Acquired</td>
<td>piperacillin/tazobactam 3.375 g IV</td>
</tr>
<tr>
<td>**MRSA suspected (homeless/incarceration/IV drug use)</td>
<td>ADD vancomycin 20 mg/kg IV</td>
</tr>
<tr>
<td>Intra-abdominal</td>
<td>piperacillin/tazobactam 3.375 g IV</td>
</tr>
<tr>
<td>Urinary Tract</td>
<td>ampicillin 2 g IV AND gentamicin 4 mg/kg IV</td>
</tr>
<tr>
<td>Skin (rapidly progressing necrotizing fasciitis)</td>
<td>cefTRIAXone 1 g IV AND minocycline 500 mg IV</td>
</tr>
<tr>
<td>Central Nervous System</td>
<td>cefTRIAXone 2 g IV AND vancomycin 20 mg/kg IV **ADD dexamethasone 10 mg IV before antibiotic</td>
</tr>
<tr>
<td>Pediatic Neutropenia</td>
<td>piperacillin/tazobactam 3.375 g IV</td>
</tr>
</tbody>
</table>
Severe Sepsis / Septic Shock Resuscitation

1. Intravenous Fluid Resuscitation
   - Insert 2 large bore peripheral IV cannulas (#16 and #18 gauge)
   - Administer 1 L 0.9% sodium chloride IV rapid infusion over 15–30 min IMMEDIATELY
   - After 1 L 0.9% sodium chloride, if MAP is equal to or less than 55 mmHg, then repeat 1 L 0.9% sodium chloride IV infusion over 15–30 min IMMEDIATELY
   - After 2 L 0.9% sodium chloride, if MAP is still equal to or less than 55 mmHg and/or the patient has evidence of organ dysfunction (see reverse), physician to assess need for:
     - Repeat IV fluid bolus
     - Insertion of central venous catheter (check platelets, INR and patient’s FIO2)
     - Insertion of arterial catheter
     - Initiation of vasopressor medications
     - Consultation to ICU
   - Maintenance IV fluids (after IV Fluid Bolus) __________ mL/hr

2. Antibiotics (see reverse for Antimicrobial Section)
   Every effort should be made to have blood cultures collected before the initiation of antibiotics. However, DO NOT DELAY ANTIBIOTICS IF UNABLE TO COLLECT CULTURES FIRST
   Antibiotics should be given within 1 h of diagnosis of severe sepsis/septic shock
   - " "
   - " 
   - " 
   - " 

3. Vital Signs
   - Attach patient to a cardiac monitor. Arrange transfer to a step-down or ICU bed if patient on the floor or in the emergency department
   - BP, HR, RR, O2 saturation q15min. Temperature q4hr
   - Inr and Co2 q/hr
   - Foley to urometer

4. Investigations- STAT
   - ABG and lactate
   - Profile and differential, BUN, creatinine, blood glucose
   - Sodium, potassium, chloride, magnesium
   - CK and troponin, EKG
   - AST, ALT, alkaline phosphatase, bilirubin and amylase
   - Type and screen
   - Blood cultures x 2 using two sites. First site both aerobic and anaerobic vials
   - Urine dip, microscopy, culture and susceptibility
   - Sputum for culture and sensitivity
   - Cultures (other)
     - Special culture (Viral)
     - Chest x-ray
     - Other x-ray
     - Other investigation (e.g., CT)

Prescriber’s Signature: ___________________________ Date (yyyy/mm/dd): ___________________________
Prescriber’s Name: ___________________________ Reg. No.: ___________________________
**Splenectomy Vaccination Guidelines**

Splenectomy Vaccine Kit (all items go up to floor for patient)

1) Post-splenectomy vaccinations Pre-Printed Order.
2) One dose of each vaccine plus package insert
   - Pneumococcal polysaccharide vaccine (Pneumovax®)
   - Meningococcal ACYW conjugate (Menactra®)
   - Hemophilus influenzae B (Act-Hib®)
3) Splenectomy vaccines - Documentation for Family Physicians form.
4) Splenectomy - Information for Patients sheet.
5) Wallet card for Asplenic Patients sheet.
Splancetomy Vaccination Guidelines

Capital Health

PRE-PERPRINTED ORDER
Department of Medicine, Infectious Diseases

Post-Splenectomy Vaccinations

Patient: ____________________ Allergies: ____________________

THE FOLLOWING ORDERS:

- May not be used on any nursing unit and will be carried out by a qualified health professional ONLY ON THE AUTHORITY OF AN AUTHORIZED PRESCRIBER
- All orders must be completed as appropriate
- All doses must be written and completed. All times must be in 24-hour clock format

1. Contraindications (check all that apply)
   - Hypersensitivity to any vaccine component
   - Anaphylactic reaction to any of the vaccines listed below

2. Vaccinations (If not received pre-operatively or elective surgery and not otherwise noted)
   - Administer Pneumococcal polysaccharide vaccine 0.5 ml intramuscularly in each deltoid
   - Administer meningococcal C, A, Y, W-135 conjugate vaccine 0.5 ml intramuscularly in each deltoid
   - Administer Hib conjugate vaccine 0.5 ml intramuscularly in each deltoid
   - Vaccinations should be given two weeks post-operatively (if patient remains hospitalized) or on hospital discharge
   - Do not administer vaccines

All vaccinations may be administered simultaneously. Separate syringes and separate injection sites should be used if more than one vaccine is administered on the same day.

_____________________________  ________________________________
Preparer’s Signature  Date/Day/month/year

_____________________________  ________________________________
Prescriber’s Name  Reg. No.

PPS 0124 NR February 22 2008  Two copies: chart  Bottom copy: pharmacy  page 1 of 1

Antimicrobial Handbook 89
Splenectomy Vaccination Guidelines

Role of the spleen:
- The spleen has many functions, including removal of damaged blood cells. It also plays an important role in removal of certain types of bacteria.
- The spleen may be removed if it becomes overactive, stops working or is ruptured in an accident.

Life without a spleen:
- Adults can live a normal life without a spleen. However, you are at risk for developing infections caused by certain types of bacteria which are normally removed by the spleen.
- The most serious possible infection is called overwhelming post-splenectomy infection (OPSI). This is rare, but may result in loss of limbs or life.

How to reduce the risk of infection:
- Inform all doctors, dentists and other health care professionals that you do not have a spleen.
- Vaccinations are recommended for patients who have their spleen removed. These vaccines are meningococcal conjugate vaccine, polysaccharide pneumococcal vaccine, and haemophilus influenzae type b conjugate vaccine.
- You should receive a yearly flu shot.
- Your family doctor will monitor your progress and make sure you receive vaccinations you need.

Identification:
- Wallet card (if provided) includes information on vaccinations you have received.
- Medical alert bracelet should be worn. It should indicate that you had your spleen removed.

When to seek medical attention:
- If you develop an unusual or neck pain. You may be at risk of developing a serious infection.
- If you develop any signs of infection, including fever, sore throat, chills, unexplained cough. Contact your primary doctor as soon as possible for further instructions.
Spleneectomy vaccines
Documentation for Family Physician

Please complete and forward to patient's family physician on discharge.

From:
Phone: ___________________ Fax: ___________________

To: ___________________
Fax #: ___________________

Re. Patient Name: ___________________
BCN: ___________________
D.O.B: ___________________

Asplenic patients are known to be at risk of infection, and are particularly susceptible to encapsulated organisms. Vaccinations are recommended to reduce the risk of infection in this patient population.

Your patient received the following vaccinations during hospital after spleneectomy. Please update your records, and note these vaccinations for future vaccinations.

- Meningococcal ACYW vaccine (Menactra®) Date given: ___________________
- Haemophilus influenzae type b (ActHib®) vaccine Date given: ___________________
- Pneumococcal 7-valent vaccine (Pneumovax-23®) Date given: ___________________
- Influenza vaccine administered after 5 years.

- Yearly influenza vaccine is also recommended.

If you have any questions regarding these vaccinations please call the numbers above, or contact the Department of Public Health for further information.

Thank you.
Capital Health

Wallet card for Asplenic Patients
Please complete card and give to patient on hospital discharge.

Medical Alert
Asplenic Patient

Patient Name: ____________________________
Physician Name: _________________________
Physician Phone: _________________________

Patient is at risk of potentially fatal, overwhelming infection.
Medical attention required for:
• Signs of infection: fever > 38°C, sore throat, chills, unexplained cough.
• Animal and tick bites.

Vaccination Record:
Patient has received the following vaccinations:
□ Meningococcal A,C,W-135 conjugate (Menactra®)
□ Date given: _______________________
□ Pneumococcal polysaccharide (pneumovax®)
□ Date given: _______________________
□ Pneumococcal polysaccharide booster
□ Date due: _______________________
□ Date given: _______________________
□ Hib conjugate vaccine (ActHib®)
□ Date given: _______________________

Antimicrobial Handbook
Surgical Prophylaxis

PRINCIPLES OF ANTIMICROBIAL PROPHYLAXIS

The accepted principles of antimicrobial prophylaxis for surgical procedures involve:

• Surgical procedures for which antimicrobial prophylaxis has been demonstrated to be beneficial.

• Antimicrobial prophylaxis for “clean” surgical procedures is generally unnecessary. For the majority of surgical procedures in which antimicrobial prophylaxis is indicated, a single 2 g dose of cefazolin given immediately prior to induction of anaesthesia is appropriate.

• Timing and duration of the administration of the antimicrobial is important. In general, a single dose of a parenteral antimicrobial given within 30 minutes before skin incision (i.e. immediately prior to induction of anaesthesia) provides adequate tissue concentrations for several hours. “On call” dosing is not acceptable, as it may result in premature administration of the antibiotic regimen and insufficient tissue concentrations of the drug during surgery. An intra-operative dose of antibiotics should be given when surgery is prolonged (i.e. more than 3 hours when the antibiotic, such as cefazolin, has a reasonably long half-life or sooner for an antibiotic with shorter half-life). If massive blood loss occurs, a second dose should be given promptly. Post-operative doses of prophylactic antibiotics are generally unnecessary. However, dosing beyond the operative period is still recommended in such areas as cardiac surgery.
## Peri-operative Antibiotic Prophylaxis Table

<table>
<thead>
<tr>
<th>Patient selection</th>
<th>Pre-op IV antibiotic</th>
<th>Post-op IV antibiotic</th>
<th>Antibiotic duration</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Appendectomy</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>All patients</td>
<td>Metronidazole 500 mg</td>
<td>Metronidazole 500 mg</td>
<td>No antibiotic</td>
</tr>
<tr>
<td></td>
<td>Plus Cefazolin 2 g</td>
<td>Plus Gentamicin 2 mg/kg</td>
<td></td>
</tr>
<tr>
<td><strong>Breast</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High risk patients only</td>
<td>Cefazolin 2 g</td>
<td>Vancomycin 1 g</td>
<td>No antibiotic</td>
</tr>
<tr>
<td>(recent neoadjuvant chemotherapy or radiation therapy)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(prosthetic material or mesh)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(re-operation or recent prior breast surgery)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(reconstruction surgeries)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(operation duration ≥2 hours)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(immunocompromised patients) (diabetics, steroids, etc)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Cardiac</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>All patients</td>
<td>Cefazolin 2 g</td>
<td>Vancomycin 1 g</td>
<td>24 hours</td>
</tr>
<tr>
<td><strong>Colorectal</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>All patients</td>
<td>Metronidazole 500 mg</td>
<td>Metronidazole 500 mg</td>
<td>No antibiotic</td>
</tr>
<tr>
<td></td>
<td>Plus Cefazolin 2 g</td>
<td>Plus Gentamicin 2 mg/kg</td>
<td></td>
</tr>
<tr>
<td><strong>Gastroduodenal</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High risk patients only</td>
<td>Cefazolin 2 g</td>
<td>Clindamycin 600 mg</td>
<td>No antibiotic</td>
</tr>
<tr>
<td>(decreased gastric acidity and GI motility)</td>
<td></td>
<td>Plus Gentamicin 2 mg/kg</td>
<td></td>
</tr>
<tr>
<td>(obstruction)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(hemorrhage)</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>(gastric ulcer or malignancy)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(therapy with H2 blocker or PPI)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(morbid obesity)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Hand</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Complex Clean Procedures:</td>
<td>Cefazolin 2 g</td>
<td>Vancomycin 1 g</td>
<td>24 hours</td>
</tr>
<tr>
<td>(mutilating and crushing injuries from home &amp; industrial source)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(bone, joint, tendon (except open flexor tendon injuries - see below) and nerve involvements)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(implants/prosthesis)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(flap reconstruction)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(injuries require amputations)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(high risk patients with medical comorbidities and/or immunosuppressive drugs)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Peri-operative Antibiotic Prophylaxis Table (cont’d)

<table>
<thead>
<tr>
<th>Patient selection</th>
<th>Pre-op IV antibiotic</th>
<th>Post-op IV antibiotic</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Standard Regimen</td>
<td>Penicillin</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Allergy</td>
</tr>
</tbody>
</table>

#### Hand (cont’d)

- **Clean-contaminated and Contaminated Procedures:**
  - Multumilating and crushing injuries from farm environment
  - Grossly contaminated and dirty injuries
  - Animal and human bites
  - Open fractures
  - Use of leeches

#### Simple Clean Procedures:

- Clean simple soft tissue lacerations
- Open flexor tendon injuries

**Exception:**

- Beyond zone IV

#### Head and Neck (Major)

- **Clean procedures:**
  - no incision of the oral or pharyngeal mucosa
  - no implantation of prosthetic material

**Exceptions (no antibiotics):**

- thyroidectomy
- parotidectomy
- submandibular gland excision
- all of above with no neck dissections and/or skull base involvement

- **Clean-contaminated procedures:**
  - Require penetration of the oral or pharyngeal mucosa
  - Complex resection with reconstruction procedures
  - Revision and salvage surgeries

#### Hepatic Pancreatic Biliary Tract (HPB)

- **Minor Procedures** (Cholecystectomy etc.):
  - High risk patients only
    - age >70
    - acute cholecystitis
    - non-functioning gall bladder
    - obstructive jaundice
    - common bile duct stones

- **Oncology patients**
  - Benign patients
  - 24 hours
  - No antibiotics

- **Acute Cholecystitis:**
  - 2-5 days
  - Empysematous acute cholecystitis:
  - 3-7 days
  - Gangrene or perforated gallbladder:
  - change to a broad spectrum antibiotic for treatment

### Antimicrobial Handbook
### Peri-operative Antibiotic Prophylaxis Table (cont’d)

<table>
<thead>
<tr>
<th>Patient selection</th>
<th>Pre-op IV antibiotic</th>
<th>Post-op IV antibiotic</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Hepatic Pancreatic Biliary Tract (HPB) (cont’d)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Major Procedures</td>
<td>Metronidazole 500 mg Plus Cefazolin 2 g ✔</td>
<td>Metronidazole 500 mg Plus Gentamicin 2 mg/kg* No antibiotics</td>
</tr>
<tr>
<td><strong>Hernia Repair</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High risk patients only</td>
<td>Cefazolin 2 g ✔</td>
<td>Vancomycin 1 g No antibiotic 16,17</td>
</tr>
<tr>
<td>• prosthetic material or mesh</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• age ≥70</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• immune compromised patients (diabetes, neoplasm, HIV/AIDS)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• corticosteroid use</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• recurrent repairs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• operative time ≥2 hours</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• routine use of drainage and prosthesis</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Neurosurgery</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Craniotomy</td>
<td>Cefazolin 2 g ✔</td>
<td>Vancomycin 1 g No antibiotic</td>
</tr>
<tr>
<td>• clean, non-implant</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• clean-contaminated</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• crosses sinuses or naso/oropharynx</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• emergency surgery</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• operation ≥2 hours</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• CSF leakage</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Subsequent operation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Transsphenoidal surgery</td>
<td>Cefazolin 2 g ✔</td>
<td>Vancomycin 1 g 24 hours 46,47</td>
</tr>
<tr>
<td>• all patients</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CSF Shunting</td>
<td>Cefazolin 2 g ✔</td>
<td>Vancomycin 1 g 24 hours 46,47</td>
</tr>
</tbody>
</table>

| Obstetrics and Gynaecology¹² | | |
| Abortion | | |
| • First trimester | | |
| • Chlamydia - positive or suspected | | |
| • Previous pelvic inflammatory disease, gonorrhoea or multiple sex partners | | |
| Oral to be given 1 h pre-op: Azithromycin 1 g po Or Doxycycline 100 mg po | | |
| • Bacterial vaginosis - positive or suspected | | |
| ADD Metronidazole 500 mg po All other patients: Cefazolin 2 g ✔ | | |
| • Chlamydia - positive or suspected | | |
| • Previous pelvic inflammatory disease, gonorrhoea or multiple sex partners | | |
| Oral to be given 1 h pre-op: Azithromycin 1 g po Or Doxycycline 100 mg po | | |
| • Bacterial vaginosis - positive or suspected | | |
| ADD Metronidazole 500 mg po All other patients: Clindamycin 600 mg po Plus Gentamicin 2 mg/kg* | | |

**Note:** Except where indicated otherwise, choices should be given as a single dose IV prior to surgery.
### Peri-operative Antibiotic Prophylaxis Table (cont’d)

<table>
<thead>
<tr>
<th>Patient selection</th>
<th>Pre-op IV antibiotic</th>
<th>Post-op IV antibiotic</th>
<th>Standard Regimen</th>
<th>Penicillin Allergy</th>
<th>Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Obstetrics and Gynaecology (cont’d)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Radical and total hysterectomy (abdominal, laparoscopic or vaginal)</td>
<td>Cefazolin 2 g</td>
<td>Clindamycin 600 mg</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Caesarean section - administer antibiotics prior to skin incision NOT after cord clamping</td>
<td></td>
<td>Gentamicin 2 mg/kg*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vulvectomy with or without lymphadenectomy</td>
<td></td>
<td>No antibiotic</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vaginectomy</td>
<td></td>
<td>7</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Urogynaecological procedures - laparoscopic Burch - 2-Team sling</td>
<td>Gentamicin 2 mg/kg*</td>
<td>No antibiotic</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Endometriosis (laparoscopy and open)</td>
<td></td>
<td>8</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Oral and Maxillofacial</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No oral or sinus cavity involvement</td>
<td>Cefazolin 2 g</td>
<td>Clindamycin 600 mg</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Oral cavity or sinus cavity involvement</td>
<td></td>
<td>Gentamicin 2 mg/kg*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Comminuted and compounded fractures</td>
<td>Metronidazole 500 mg</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Implants/prosthesis; bone graft</td>
<td>Cefazolin 2 g</td>
<td>Metronidazole 500 mg</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Orthognathic</td>
<td></td>
<td>Clindamycin 600 mg</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gun shot wound</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grossly contaminated and dirty injury</td>
<td>Metronidazole 500 mg</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Orthopedic</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Major procedures:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Difficult fracture reconstruction</td>
<td>Cefazolin 2 g</td>
<td>Clindamycin 600 mg</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total hip &amp; knee replacement</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other procedures requiring prophylaxis</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Minor procedures:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Arthroscopy</td>
<td>No antibiotics</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Procedures not involving implantation or prosthesis material</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spine</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fusion</td>
<td>Cefazolin 2 g</td>
<td>Vancomycin 1 g</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Decompression</td>
<td></td>
<td>No antibiotic</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## Peri-operative Antibiotic Prophylaxis
### Table (cont’d)

<table>
<thead>
<tr>
<th>Patient selection</th>
<th>Pre-op IV antibiotic</th>
<th>Post-op IV antibiotic</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Thoracic</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pulmonary resection only</td>
<td>Cefazolin 2 g</td>
<td>Vancomycin 1 g</td>
</tr>
<tr>
<td><strong>Trauma (Orthopedics)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gun shot fracture wound</td>
<td>Cefazolin 2 g</td>
<td>Vancomycin 1 g</td>
</tr>
<tr>
<td>Gun shot fracture wound with</td>
<td>Cefazolin 2 g</td>
<td>Vancomycin 1 g</td>
</tr>
<tr>
<td>large soft tissue defects or cavitary lesions AND/OR</td>
<td>Gentamicin 2 mg/kg*</td>
<td>Gentamicin 2 mg/kg*</td>
</tr>
<tr>
<td>fracture of the extremities (about the hand, foot and ankle)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gun shot fracture wound with</td>
<td>Cefazolin 2 g</td>
<td>Vancomycin 1 g</td>
</tr>
<tr>
<td>large soft tissue defects or cavitary lesions</td>
<td>Gentamicin 2 mg/kg*</td>
<td>Gentamicin 2 mg/kg*</td>
</tr>
<tr>
<td>AND/OR</td>
<td></td>
<td></td>
</tr>
<tr>
<td>fracture of the extremities (about the hand, foot and ankle) PLUS</td>
<td></td>
<td></td>
</tr>
<tr>
<td>gross contamination of the wound and environment</td>
<td></td>
<td></td>
</tr>
<tr>
<td>occurred in rural/wooded area</td>
<td></td>
<td></td>
</tr>
<tr>
<td>grossly dirty skin and clothes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>bowel communication</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Trauma (Abdomen)**

<table>
<thead>
<tr>
<th>Penetrating abdominal trauma</th>
<th>Pre-op IV antibiotic</th>
<th>Post-op IV antibiotic</th>
</tr>
</thead>
<tbody>
<tr>
<td>hollow viscus injury</td>
<td>Metronidazole 500 mg</td>
<td>Metronidazole 500 mg</td>
</tr>
<tr>
<td>Penetrating abdominal trauma</td>
<td>Metronidazole 500 mg</td>
<td>Metronidazole 500 mg</td>
</tr>
<tr>
<td>non hollow viscus injury</td>
<td>Metronidazole 500 mg</td>
<td>Metronidazole 500 mg</td>
</tr>
</tbody>
</table>

**Urinary Diversion Procedures Involving Bowel Segments**

(assuming all patients have urine culture performed and all positive urine culture patients are treated before surgery)

<table>
<thead>
<tr>
<th>Ileal conduit procedures or procedures involving bowel segments</th>
<th>Oral antibiotics</th>
<th>Oral antibiotics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oral AND IV antibiotics</td>
<td>metronidazole 500 mg po x 3 doses at 1, 2 &amp; 4 hours</td>
<td>metronidazole 500 mg po x 3 doses at 1, 2 &amp; 4 hours</td>
</tr>
<tr>
<td>Plus</td>
<td>erythromycin 500 mg po x 3 doses at 1, 2 &amp; 4 hours after gastric lavage</td>
<td>Plus</td>
</tr>
<tr>
<td>AND IV antibiotics</td>
<td>Metronidazole 500 mg</td>
<td>Metronidazole 500 mg</td>
</tr>
<tr>
<td>Plus</td>
<td>Cefazolin 2 g</td>
<td>Cefazolin 2 g</td>
</tr>
</tbody>
</table>

**Antimicrobial Handbook**
## Peri-operative Antibiotic Prophylaxis Table (cont’d)

<table>
<thead>
<tr>
<th>Patient selection</th>
<th>Pre-op IV antibiotic</th>
<th>Post-op IV antibiotic</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Standard Regimen</td>
<td>Penicillin Allergy</td>
</tr>
<tr>
<td>Urology^1 (assuming all patients have urine culture performed and all positive urine culture patients are treated before surgery)</td>
<td>Oral to be given</td>
<td>Oral to be given</td>
</tr>
<tr>
<td>• TURP and retropubic total prostatectomy</td>
<td>1. Ciprofloxacin 500 mg po</td>
<td>1. Cefazolin 2 g</td>
</tr>
<tr>
<td>• Transrectal and core biopsy of the prostate</td>
<td>2. Co-trimoxazole DS - 1 tab po</td>
<td>2. Gentamicin 2 mg/kg*</td>
</tr>
<tr>
<td>• Ureteroscopy &amp; percutaneous stone surgery</td>
<td>OR IV regimen;</td>
<td></td>
</tr>
<tr>
<td>• Implantation of prosthetic device</td>
<td>1. Cefazolin 2 g</td>
<td></td>
</tr>
<tr>
<td>• Impaired immune status</td>
<td>2. Gentamicin 2 mg/kg*</td>
<td></td>
</tr>
<tr>
<td>• Other open and laparoscopy procedures</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Clean-contaminated procedures (open and/or entry via urinary tract)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>➢ All patients</td>
<td></td>
<td></td>
</tr>
<tr>
<td>➢ Clean procedures (no urinary tract entry)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>➢ High risk patients only^3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>✦ Advanced age</td>
<td></td>
<td></td>
</tr>
<tr>
<td>✦ Poor nutritional status</td>
<td></td>
<td></td>
</tr>
<tr>
<td>✦ Diabetes mellitus</td>
<td></td>
<td></td>
</tr>
<tr>
<td>✦ Smoking</td>
<td></td>
<td></td>
</tr>
<tr>
<td>✦ Obesity</td>
<td></td>
<td></td>
</tr>
<tr>
<td>✦ Coexisting infection at a remote body site</td>
<td></td>
<td></td>
</tr>
<tr>
<td>✦ Colonization with microorganisms</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Oral OR IV antibiotics</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Ureteroscopy</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Cystoscopy</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Open and laparoscopy procedures</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Clean (no urinary tract entry)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Exception: High risk patients – see above risk factors^3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vascular Surgery^4,44</td>
<td>Cefazolin 2 g</td>
<td>Vancomycin 1 g</td>
</tr>
<tr>
<td>• Lower limb amputation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Abdominal and lower limb vascular surgery</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Procedures involving groin incision or prosthetic material</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Carotid endarterectomy and brachial arterial repair with prosthetic graft only</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*References: 1-3.*
## Intra-operative Antibiotic Prophylaxis

### Table 42

<table>
<thead>
<tr>
<th>Antibiotic</th>
<th>Duration of operation &gt; 3 hours</th>
<th>Blood loss &gt; 1.5L</th>
<th>Pre-op administration time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cefazolin (except: Cefazolin 1g q3h)</td>
<td>Repeat 1g q3h (38, 39, 40)</td>
<td>Repeat 1 g x 1 dose only (39, 40)</td>
<td>0-60 minutes prior to skin incision</td>
</tr>
<tr>
<td>Ciprofloxacin po</td>
<td>Operation &gt;6 hours, administer Cefazolin 1g q3h</td>
<td>No data – no recommendation</td>
<td>60-120 minutes prior to skin incision</td>
</tr>
<tr>
<td>Cefazolin</td>
<td>No data – no recommendation</td>
<td>60-120 minutes prior to skin incision</td>
<td></td>
</tr>
<tr>
<td>Ciprofloxacin po</td>
<td>No data – no recommendation</td>
<td>60-120 minutes prior to skin incision</td>
<td></td>
</tr>
<tr>
<td>Clindamycin</td>
<td>Repeat q6h</td>
<td>No data – no recommendation</td>
<td></td>
</tr>
<tr>
<td>Co-trimoxazole Ds po</td>
<td>Operation &gt;6 hours, administer Cefazolin 1g q3h</td>
<td>No data – no recommendation</td>
<td>60-120 minutes prior to skin incision</td>
</tr>
<tr>
<td>Gentamicin*</td>
<td>Repeat 1 dose only intra-op at 3h after initial dose 37 (except: Cefazolin 1g q3h)</td>
<td>Repeat 1 dose only (38, 39, 40)</td>
<td>60 minutes prior to skin incision</td>
</tr>
<tr>
<td>Metronidazole</td>
<td>Repeat q12h</td>
<td>No data – no recommendation</td>
<td></td>
</tr>
<tr>
<td>Vancomycin</td>
<td>Repeat q12h (except: Cefazolin 1g q3h)</td>
<td>No intra-op dose needed (39)</td>
<td>60-120 minutes prior to skin incision</td>
</tr>
</tbody>
</table>

* All gentamicin doses will be rounded to the nearest 20 mg.

+ Cefazolin 2g is for pre-operative dosing only. Intra-operative and post-operative dosing for cefazolin will remain 1g.

Post-operatively resume regular treatment frequency. Adjust as needed for renal impairment patients.

---

100 Antimicrobial Handbook
References


Antimicrobial Handbook
42. Micromedex Healthcare Series on Cefazolin, Clindamycin, Gentamicin, Ciprofloxacin, Cotrimoxazole, Metronidazole and Vancomycin

Adapted from Sunnybrook Health Sciences Centre
### Patient

**Allergies:**

### The Following Orders

- May be used on any nursing unit and will be carried out by a qualified health professional ONLY ON THE AUTHORITY OF AN AUTHORIZED PRESCRIBER.
- All orders to be carried out must be checked/completed as appropriate.
- All times must be written in standard time format. All times must be on 24-hour clock (i.e., 1:00 AM not 1 AM).

1. Baseline vital signs, then blood pressure and pulse every 4 hours.
2. In case of reaction: Clavulanic acid 50 mg IV as needed (glucose anaphylaxis: diluted an anaphylaxis: containing 1 mg of anaphylaxis in 0.9% normal saline and administer 1-2.5 mL (0.1-2.5 mg) IV over 5-10 minutes every 5-10 minutes).

### Day 1

<table>
<thead>
<tr>
<th>Time</th>
<th>Actual Time</th>
<th>Dose #</th>
<th>Description</th>
<th>Bottle #</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 min</td>
<td>3</td>
<td>1</td>
<td>0.5 mL = 1 micromgram of TMP/SMX solution (0.002 mg SMX/mL)</td>
<td>1</td>
</tr>
<tr>
<td>15 min</td>
<td>2</td>
<td>2</td>
<td>0.5 mL = 2 micromgram of TMP/SMX solution (0.004 mg SMX/mL)</td>
<td>2</td>
</tr>
<tr>
<td>30 min</td>
<td>3</td>
<td>3</td>
<td>0.5 mL = 3 micromgram of TMP/SMX solution (0.006 mg SMX/mL)</td>
<td>3</td>
</tr>
<tr>
<td>60 min</td>
<td>4</td>
<td>4</td>
<td>0.5 mL = 4 micromgram of TMP/SMX solution (0.008 mg SMX/mL)</td>
<td>3</td>
</tr>
<tr>
<td>90 min</td>
<td>5</td>
<td>5</td>
<td>0.5 mL = 5 micromgram of TMP/SMX solution (0.01 mg SMX/mL)</td>
<td>3</td>
</tr>
<tr>
<td>120 min</td>
<td>6</td>
<td>6</td>
<td>0.5 mL = 6 micromgram of TMP/SMX solution (0.012 mg SMX/mL)</td>
<td>3</td>
</tr>
<tr>
<td>180 min</td>
<td>7</td>
<td>7</td>
<td>0.5 mL = 7 micromgram of TMP/SMX solution (0.014 mg SMX/mL)</td>
<td>3</td>
</tr>
<tr>
<td>240 min</td>
<td>8</td>
<td>8</td>
<td>0.5 mL = 8 micromgram of TMP/SMX solution (0.016 mg SMX/mL)</td>
<td>3</td>
</tr>
<tr>
<td>360 min</td>
<td>9</td>
<td>9</td>
<td>0.5 mL = 9 micromgram of TMP/SMX solution (0.018 mg SMX/mL)</td>
<td>3</td>
</tr>
<tr>
<td>480 min</td>
<td>10</td>
<td>10</td>
<td>0.5 mL = 10 micromgram of TMP/SMX solution (0.02 mg SMX/mL)</td>
<td>3</td>
</tr>
<tr>
<td>720 min</td>
<td>11</td>
<td>11</td>
<td>0.5 mL = 11 micromgram of TMP/SMX solution (0.022 mg SMX/mL)</td>
<td>3</td>
</tr>
</tbody>
</table>

### Day 2

- SeptaZev (TMP/SMX) 15 mg tablets q.d. thereafter

- Dosage: TMP/SMX 50 mg tablet x 1

- Dispense TMP/SMX 50 mg tablet x 1

- Discontinue the following TMP/SMX solutions:
  - Bottle #1: TMP/SMX solution 0.002 mg SMX/mL, x 10 mL
  - Bottle #2: TMP/SMX solution 0.004 mg SMX/mL, x 50 mL
  - Bottle #3: TMP/SMX solution 2 mg SMX/mL, x 90 mL
Urinary Tract Infections (UTIs)

UTI Classifications

Lower urinary tract
• Urethritis
• Cystitis
• Prostatitis

Upper urinary tract
• Pyelonephritis

Infection Type
• Acute: recent onset of UTI symptoms
• Chronic: ongoing, unresolved infection, may be due to structural defects or obstructions and/or resistant or multiple organisms
• Recurrent: symptomatic infection that recur within 2 weeks of a prior infection with the same organism or re-infection with a new organism
• Complicated: Acute or chronic UTI with complicating factors such as relapsing infection, obesity, pregnancy, altered immune status, structural abnormalities, or catheterization
• Uncomplicated: UTI without presence of complicating factors

Diagnosis
Must be confirmed by laboratory tests because of the unreliability of symptoms.

Urinalysis
The presence of leukocytes is non-specific and may be indicative of inflammation only
• WBC casts may indicate pyelonephritis
• The following degrees of bacteriuria are often considered to be clinically significant:
  Greater than $10^2$ CFU coliforms/mL in symptomatic women
  Greater than $10^3$ CFU coliforms/mL in asymptomatic women
  Greater than $10^5$ CFU coliforms/mL in asymptomatic patients on two consecutive specimens
  Greater than $10^2$ CFU coliforms/mL in a catheterized patient with symptoms

Nitrite test is used as a marker for bacteriuria, but not all uropathogens reduce nitrates to nitrites. (i.e. Enterococci, S. Saprophyticus and Acinetobacter do not and thus give false-negative results.)

Culture and sensitivity allows identification of the infecting organism(s) and the determination of antibiotic sensitivities

Blood cultures should be considered with pyelonephritis and severe complicated UTIs

Asymptomatic Bacteriuria
• Presence of bacteria in voided urine with no symptoms of urinary tract infection
• Treatment is not recommended in the non-catheterized elderly, unless the patient is symptomatic
• Pregnant women, patients about to undergo urological surgery, immunocompromised patients should be treated for asymptomatic UTIs.
## Management of UTIs

<table>
<thead>
<tr>
<th>Category</th>
<th>Potential pathogens</th>
<th>First line therapy (cost)</th>
<th>Second line therapy (cost)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acute uncomplicated cystitis</td>
<td>E.coli, S. saprophyticus,</td>
<td>Sulfamethoxazole/Trimethoprim DS tab q12h x 3 days</td>
<td>Ciprofloxacin* 250 mg q12h x 3 days</td>
</tr>
<tr>
<td></td>
<td>Proteus, Klebsiella</td>
<td>Acute cystitis in men requires 7 days of therapy no matter what agent is used</td>
<td></td>
</tr>
<tr>
<td>Acute cystitis (pregnant women)</td>
<td>E.coli, Proteus, Klebsiella, Amoxicillin 250-500 mg q8h x 7 days</td>
<td>Sulfamethoxazole/Trimethoprim DS tab q12h or Cephalexin 500 mg qid x 7 days</td>
<td>Fosfomycin 3 g x 1 dose</td>
</tr>
</tbody>
</table>
| Acute pyelonephritis        | E.coli, Proteus, Klebsiella,         | Severe:                                                                                 | Ceftriaxone 1 g q24h or Ampicillin 1-2 g q6h IV + Gentamicin 6 mg/kg IV daily (adjusted to renal function) 1,4 Step down to oral therapy for a total of 14 days 3: Amoxicillin/Clavulanate 875 mg q12h or Ciprofloxacin 500 mg q12h x 10-14 days 1,4 Consider the use of blood cultures 1,4 Remove catheter if catheter-related UTI 3: Consider the use of blood cultures 3:  

*If due to resistant organisms, patient allergies, or contraindications to other agents (as per Antimicrobial Order Form).  

Note for multidrug resistant, E. coli, fosfomycin can be used.
### Management of UTIs (cont’d)

<table>
<thead>
<tr>
<th>Severity</th>
<th>Potential pathogens</th>
<th>First line therapy (cost)</th>
<th>Second line therapy (cost)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Recurrent cystitis</td>
<td><em>E. coli</em>, <em>Proteus</em>, <em>Klebsiella</em>, <em>Enterococci</em>, <em>Enterobacter</em>, <em>S. saprophyticus</em></td>
<td>Early recurrence (&lt;30 days); Retreat for early recurrences but for 10-15 days</td>
<td>Consider prophylaxis for 3 or more recurrences per year: Sulfamethoxazole/Trimethoprim one-half to one tab or nitrofurantoin 50 mg qhs daily</td>
</tr>
<tr>
<td>Candiduria in symptomatic patients with riskfactors such as ICU setting, immunosuppression</td>
<td><em>Candida</em></td>
<td>Oral therapy: Fluconazole 200 mg daily for 3 to 7 days</td>
<td>IV therapy: Fluconazole 200 mg daily for 3 to 7 days²</td>
</tr>
</tbody>
</table>

1. Treatment of UTIs due to resistant organisms in patients with renal impairment or allergies which preclude the use of other agents
2. Restricted to ID or ICU physicians
3. May be possible to initiate therapy with oral agents in the absence of nausea and vomiting
4. The addition of ampicillin/amoxicillin may be necessary in the presence of enterococci
Vancomycin Usage Guidelines

Recommendations for Appropriate Use of Vancomycin

Prudent antibiotic use is critical to stem the rise of vancomycin-resistant enterococci (VRE), and even hospitals where the pathogen has not been detected should develop plans to curtail inappropriate use of vancomycin. Situations in which the use of vancomycin is appropriate and inappropriate are summarized below.

Using vancomycin is appropriate:
- for treatment of serious infections due to beta-lactam-resistant, gram-positive microorganisms. (Clinicians should be aware that vancomycin may be less rapidly bactericidal than beta-lactam agents for beta-lactam susceptible staphylococci);
- for treatment of infections due to gram-positive microorganisms in patients with serious allergy to beta-lactam antimicrobials;
- when antibiotic-associated colitis (AAC) fails to respond to metronidazole therapy, or if AAC is severe and potentially life-threatening;
- for prophylaxis, as recommended by the American Heart Association, for endocarditis following certain procedures in high-risk patients;
- as prophylaxis for surgical procedures involving implantation of prosthetic materials at institutions with a high rate of infections due to methicillin-resistant Staphylococcus aureus (MRSA) or Staphylococcus epidermidis (MRSE). A single dose administered immediately before surgery is sufficient unless the procedure lasts more than six hours, in which case the dose should be repeated. Prophylaxis should be discontinued after a maximum of two doses.

Using vancomycin is inappropriate:
- routine surgical prophylaxis;
- empiric antimicrobial therapy for a febrile neutropenic patient, unless there is strong evidence at the onset that the patient has an infection due to gram-positive microorganisms and the prevalence of infections due to beta-lactam-resistant, gram-positive microorganisms (e.g. MRSA or MRSE) in the hospital is substantial;
- treatment in response to a single blood culture positive for coagulase-negative Staphylococcus, if other blood cultures drawn in the same time frame are negative. (Contamination of blood cultures with skin flora may cause vancomycin to be administered inappropriately to patients. Phlebotomists and other personnel who obtain blood cultures should be trained properly to minimize microbial contamination of specimens);
- continued empiric use for presumed infections in patients whose cultures are negative for beta-lactam-resistant, gram-positive microorganisms;
- systemic or local prophylaxis for infection or colonization of indwelling central or peripheral intravascular catheters and vascular grafts;
- selective decontamination of the digestive tract;
- eradication of MRSA colonization;
- primary treatment of AAC, except if moderate to severe or contains binary toxin;
- routine prophylaxis for patients on continuous ambulatory peritoneal dialysis.
Vancomycin Dosing Guidelines (cont’d)

1. INITIAL DOSAGE REGIMEN
The usual initial dose is 15 mg/kg of total body weight (round to the nearest 250 mg), unless seriously ill (20-25 mg/kg).
The interval should be based on the patient’s estimated creatinine clearance.
There is a degree of patient variability in volume of distribution and drug clearance which makes it difficult to determine the ideal dosing regimen for an individual. There are many nomograms available for dosing based on creatinine clearance and weight but individual patient response remains somewhat unpredictable.

<table>
<thead>
<tr>
<th>Clcr (mL/min)</th>
<th>&gt;75</th>
<th>40-75</th>
<th>25-39</th>
<th>15-24</th>
<th>&lt;15</th>
</tr>
</thead>
<tbody>
<tr>
<td>dosing interval</td>
<td>12 hours</td>
<td>24 hours</td>
<td>48 hours</td>
<td>72 hours</td>
<td>5-7 days</td>
</tr>
</tbody>
</table>

Hemodialysis 20 mg/kg IV then 500 mg post dialysis (as a supplemental dose), (aim for pre-dialysis 7.5 - 20 mg/L or 1 g post dialysis (if severe infection or MRSA) aim for level 15-25 mg/L.

2. RATIONALE FOR USE OF PRE (TROUGH) SAMPLES FOR THERAPEUTIC DRUG MONITORING
Efficacy – Vancomycin exhibits time-dependent killing at concentrations >0.5 mg/L with a minimum inhibitory concentration (MIC) for susceptible bacteria usually <2 mg/L. Vancomycin exhibits minimal post-antibiotic effect and does not display concentration dependent killing. There seems to be general consensus in the current literature that maintaining a trough concentration above 10 mg/L is desirable for optimal therapeutic response. There is no evidence to suggest that the peak serum concentration has any bearing on efficacy. In some cases pre/post pairs may be preferable to provide dosage recommendations based on calculated pharmacokinetic data. The post results in this case should be drawn post-distribution (i.e. 2 hours after the end of infusion).

Ototoxicity – This problem is less frequent than originally feared, especially when vancomycin is used alone.

Nephrotoxicity – There appears to be a very low incidence of nephrotoxicity when vancomycin is used alone. However, when used in combinations with aminoglycosides the incidence increases beyond that of either drug used alone. There is recent evidence to suggest that the number of nephrotoxic agents used may be one of the most important factors in predisposing a patient to nephrotoxicity.

3. THERAPEUTIC RANGE
Optimal predose vancomycin level depends on the organism and type of infection being treated:
• 5-10 mg/L - mild to moderate infections; infections involving coagulase negative staphylococci or enterococci
• 10-15 mg/L - Staphylococcus aureus NOT MRSA
• 15-20 mg/L - severe infections including osteomyelitis, meningitis and endocarditis or infection with MRSA
• For organisms with an MIC ≥2 consult ID as an alternate agent should be considered.
Vancomycin Dosing Guidelines (cont’d)

4. SERUM DRUG CONCENTRATION MONITORING:

All patients started on vancomycin should have a steady state (trough) level obtained. To assure steady state has been achieved, the level should be drawn just before the 4th or 5th dose, not sooner. Adjustments to the dosing regimen may be made as follows:

Continued monitoring could be achieved by following the Scr (M,W,F) and drawing a pre (trough level) if Scr increases 25% above baseline or every five days if therapy is continued.

Additional monitoring is required for the following patients:

1. Patients with severe renal impairment (CLcr <25 mL/min) - trough level every second dose.
2. Burn patients, intravenous drug abusers, or dehydrated patients - pre and post levels should be drawn to high variability of clearance and/or volume of distribution within a single patient.
3. Dialysis patients - trough levels drawn prior to dialysis.
Sequential Antibiotic Therapy and Pharmacist Initiated Route of Administration Therapeutic Interchange

SEQUENTIAL ANTIBIOTIC THERAPY (SAT) refers to the practice of limiting intravenous (IV) antimicrobials to the early stages of infection and then converting to oral agents for the duration of treatment. The concept of sequential antibiotic therapy or “stepping down” or “switching” is a natural sequence in patient care, with many potential benefits:

- Provides similar blood/tissue levels as IV (with some agents identical levels)
- Maintains the same spectrum of activity
- Is well tolerated by the patient
- Improves patient comfort
- Involves less nursing time
- Decreases the risk of line-related phlebitis and infections
- May facilitate an earlier discharge
- Is less expensive

The following Therapeutic Interchange policies enable the pharmacist to change the route of administration of a drug when, following an assessment of the patient, this is deemed clinically appropriate. Drug therapy initiated intravenously can often be switched to a suitable oral regimen, particularly those drugs that are well-known to exhibit a high degree of oral bioavailability. Selecting the oral administration route over the more expensive intravenous route can be appropriate in many situations.

For drugs affected by this policy, the pharmacist may change the route of administration for an ordered medication when he/she has personally assessed the patient, and the patient meets the following criteria:

- The patient is tolerating oral medications, receiving as a minimum a clear fluid diet or is enterally fed, and
- The patient does not have/is not experiencing any of the following:
  - severe nausea and/or vomiting
  - malabsorption syndrome
  - severe sepsis
  - GI obstruction.

<table>
<thead>
<tr>
<th>Preparation/regimen ordered</th>
<th>Dispensed as</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ciprofloxacin 200 mg IV</td>
<td>Ciprofloxacin 250 mg po (same frequency)</td>
</tr>
<tr>
<td>Ciprofloxacin 500 mg IV</td>
<td>Ciprofloxacin 750 mg po (same frequency) or in the case of UTI, ciprofloxacin 500 mg po (same frequency)</td>
</tr>
<tr>
<td>Fluconazole ____ mg IV</td>
<td>Fluconazole ____ mg po (same frequency)</td>
</tr>
<tr>
<td>Levofloxacin 500 mg IV daily</td>
<td>Levofloxacin 500 mg po daily</td>
</tr>
<tr>
<td>Levofloxacin 250 mg IV daily</td>
<td>Levofloxacin 250 mg po daily</td>
</tr>
<tr>
<td>Metronidazole 500 mg IV q12h or bid</td>
<td>Metronidazole 500 mg po q8h</td>
</tr>
</tbody>
</table>
# Potential Savings Intravenous-to-Oral (IV to PO) Stepdown Program

<table>
<thead>
<tr>
<th>IV Drug/Dosage/Cost per Day</th>
<th>PO Drug/Dosage/Cost per Day</th>
<th>Daily Cost Savings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acyclovir 5 mg/kg q8h $18.45</td>
<td>Acyclovir 400 mg q8h $3.90 OR Valacyclovir 500 mg q12h $3.18</td>
<td>$14.55 $6.36</td>
</tr>
<tr>
<td>Ampicillin 1 g q6h $7.04</td>
<td>Amoxicillin 500 mg q8h $0.03 OR Amoxicillin/Clavulanate 875/125 mg q12h $4.56</td>
<td>$7.69 $5.12</td>
</tr>
<tr>
<td>Azithromycin 500 mg q24h $20.36</td>
<td>Azithromycin 250 mg q24h $4.40</td>
<td>$15.96</td>
</tr>
<tr>
<td>Cefazolin 1 g q8h $7.68</td>
<td>Cephalexin 500 mg q6h $0.68</td>
<td>$7.00</td>
</tr>
<tr>
<td>Cefuroxime Sodium 750 mg q8h $13.05</td>
<td>Cefuroxime Axetil 500 mg q12h $5.16</td>
<td>$7.89</td>
</tr>
<tr>
<td>Ceftriaxone 1 g q24h $35.15</td>
<td>Cefuroxime Axetil 500 mg q12h $5.16</td>
<td>$30.60-$18.99</td>
</tr>
<tr>
<td>Cefuroxime 1 g q8h $22.02</td>
<td>Ciprofloxacin 500 mg q12h + Cephalexin 500 mg q6h $2.00</td>
<td>$20.02-$33.15</td>
</tr>
<tr>
<td>Ciprofloxacin 200-400 mg q12h $33.00-66.00</td>
<td>Ciprofloxacin 500-750 mg q12h + Cephalexin 500 mg q6h $2.00</td>
<td>$32.40-$65.73</td>
</tr>
<tr>
<td>Cefuroxime Axetil 500 mg q12h $5.16</td>
<td>Ciprofloxacin 500-750 mg q12h + Clindamycin 300 mg q6h $6.77</td>
<td>$18.00</td>
</tr>
<tr>
<td>Clindamycin 600 mg q8h $10.59</td>
<td>Clindamycin 300-450 mg q6h $0.32-0.64</td>
<td>$8.27-6.95</td>
</tr>
<tr>
<td>Clotrimazole 1 g q6h $8.00</td>
<td>Clotrimazole 250 mg q8h $2.00</td>
<td>$6.00</td>
</tr>
<tr>
<td>Doxycycline 100 mg once daily $2.75</td>
<td>Doxycycline 100 mg once daily $0.30</td>
<td>$2.45</td>
</tr>
<tr>
<td>Levofloxacin 500 mg q24h $35.15</td>
<td>Levofloxacin 500 mg q24h $4.00</td>
<td>$31.15</td>
</tr>
<tr>
<td>Linezolid 600 mg q12h $141.02</td>
<td>Linezolid 600 mg q12h $143.14</td>
<td>$2.12</td>
</tr>
<tr>
<td>Imipenem 500 mg q6h $245.00</td>
<td>Ciprofloxacin 500-750 mg q12h + Metronidazole 500 mg q8h $2.64</td>
<td>$21.00</td>
</tr>
<tr>
<td>Piperacillin/Tazobactam 3.375 g q6h $68.20</td>
<td>Piperacillin/Tazobactam 5.5 g q8h $67.05</td>
<td>$60.28-$61.43</td>
</tr>
<tr>
<td>Trimeprazine/Sulfamethoxazole 5/25 mg/kg q6h $64.00</td>
<td>Trimeprazine/Sulfamethoxazole 1 DS q12h $0.16</td>
<td>$64.00</td>
</tr>
<tr>
<td>Voriconazole 400 mg q12h</td>
<td>Voriconazole 200 mg q12h $100.00</td>
<td>$400.00</td>
</tr>
</tbody>
</table>

1. These are examples only, choice of stepdown therapy must be individualized.
2. Assumes fixed cost of $1.15 per IV dose for IV bag (exceptions: ciprofloxacin, fluconazole, linezolid and metronidazole available ready to administer).
3. Does not include saving in nursing/pharmacy time, IV tubing, etc.
4. IV cost based on a 80 kg patient.

---

**Antimicrobial Handbook**

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## Bioavailability of Oral Antibiotics

<table>
<thead>
<tr>
<th>Name</th>
<th>Bioavailability</th>
<th>$t_{1/2}$ (h)</th>
<th>Administration</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Penicillins</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Amoxicillin</td>
<td>60-89</td>
<td>1</td>
<td>&lt; - &gt;</td>
</tr>
<tr>
<td>Amoxicillin/Clavulanate</td>
<td>60-89</td>
<td>1</td>
<td>&lt; - &gt;</td>
</tr>
<tr>
<td>Cloxacillin</td>
<td>35-70</td>
<td>1</td>
<td>ES</td>
</tr>
<tr>
<td>Penicillin VK</td>
<td>35-70</td>
<td>1</td>
<td>&lt; - &gt;^1</td>
</tr>
<tr>
<td><strong>Cephalosporins</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cephalexin</td>
<td>80-100</td>
<td>0.5-1.3</td>
<td>&lt; - &gt;</td>
</tr>
<tr>
<td>Cefuroxime axetil</td>
<td>30-50</td>
<td>1.2-1.3</td>
<td>Food^2</td>
</tr>
<tr>
<td><strong>Fluoroquinolones</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ciprofloxacin</td>
<td>69-85</td>
<td>3-5</td>
<td>&lt; - &gt;^4</td>
</tr>
<tr>
<td>Levofloxacin</td>
<td>99</td>
<td>6-8</td>
<td>&lt; - &gt;^3,4</td>
</tr>
<tr>
<td><strong>Macrolides</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Clarithromycin</td>
<td>50</td>
<td>3.4</td>
<td>&lt; - &gt;^1</td>
</tr>
<tr>
<td>Erythromycin</td>
<td>18-45</td>
<td>1.4</td>
<td>ES</td>
</tr>
<tr>
<td><strong>Tetracyclines</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Doxycycline</td>
<td>90-100</td>
<td>18</td>
<td>&lt; - &gt;^1</td>
</tr>
<tr>
<td>Tetracycline</td>
<td>75-80</td>
<td>8.5</td>
<td>ES^4</td>
</tr>
<tr>
<td><strong>Miscellaneous</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Clindamycin</td>
<td>90</td>
<td>2.4</td>
<td>&lt; - &gt;</td>
</tr>
<tr>
<td>Linezolid</td>
<td>100</td>
<td>4-5</td>
<td>&lt; - &gt;</td>
</tr>
<tr>
<td>Metronidazole</td>
<td>90-100</td>
<td>6-14</td>
<td>&lt; - &gt;^1</td>
</tr>
<tr>
<td>Trimethoprim/Sulfamethoxazole</td>
<td>85-90</td>
<td>11/9</td>
<td>&lt; - &gt;</td>
</tr>
<tr>
<td><strong>Antivirals</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Amantadine</td>
<td>86-90</td>
<td>12</td>
<td>&lt; - &gt;</td>
</tr>
<tr>
<td>Acyclovir</td>
<td>15-30</td>
<td>2.2-5.0</td>
<td>&lt; - &gt;</td>
</tr>
<tr>
<td>Valacyclovir</td>
<td>55</td>
<td>3</td>
<td>&lt; - &gt;</td>
</tr>
<tr>
<td>Valganciclovir</td>
<td>60</td>
<td>4</td>
<td>Food^2</td>
</tr>
<tr>
<td><strong>Antifungals</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fluconazole</td>
<td>90</td>
<td>24</td>
<td>&lt; - &gt;</td>
</tr>
<tr>
<td>Itraconazole</td>
<td>55</td>
<td>17-24</td>
<td>Food^2</td>
</tr>
<tr>
<td>Ketoconazole</td>
<td>Variable</td>
<td>6.5-9.6</td>
<td>Food^1</td>
</tr>
<tr>
<td>Voriconazole</td>
<td>96</td>
<td>6</td>
<td>ES</td>
</tr>
</tbody>
</table>

Food = take with food
ES = empty stomach
< - > = without regards to meals

1. The presence of food in the GI tract results in lower and delayed peak serum concentrations but the total amount of drug absorbed is unaffected.
2. Bioavailability increases with food or milk.
3. Calcium, aluminum, magnesium and iron salts decrease oral bioavailability; milk/ yogurt decrease bioavailability by 30-50%.
4. Calcium, aluminum, magnesium and iron salts should be spaced.
Capital Health promotes a smoke-free and scent-free environment. Please do not use perfumed products. Thank you!

Capital Health, Nova Scotia
www.cdha.nshealth.ca

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