

UPMC Presbyterian

Antibiotic  
Management  
Program

# Guide to Antimicrobial Chemotherapy

July 2008, Fourth edition

UPMC Presbyterian

Antibiotic  
Management  
Program

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July 2008, Fourth edition

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## UPDATES AND CHANGES FOR 2008

Welcome to the fourth edition of the Guide to Antimicrobial Chemotherapy.  
Below are listed key updates from the third edition.

### Miscellaneous

- Pg. VI Updated contributors list
- Pg. 2-7 Latest Antibigram data, including data for hospitals other than UPMC Presbyterian
- Pg. 3 Revised *Streptococcus pneumoniae* breakpoints for penicillin in both non-meningeal and meningeal disease
- Pg. 10 Updated formulary status of doripenem (Doribax™)
- Pg. 13,14 Updated information regarding dosing and susceptibility of Community-associated *Staphylococcus aureus* (CA-MRSA)

### Common questions related to antimicrobial therapy (PLEASE READ)

- Pg. 15 New section added addressing common questions received by the AMP

### Antimicrobial recommendations in pulmonary disease

- Pg. 16,17 Community-acquired pneumonia (CAP) therapy recommendations updated to reflect the latest consensus guidelines
- Pg. 16 Empiric beta-lactam in CAP therapy when *Pseudomonas* is not a consideration changed to include ampicillin/sulbactam, penicillin, or ceftriaxone
- Pg. 18 Addition of antibiotic and adjunctive therapy recommendations in patients with PCP pneumonia

### Antimicrobial recommendations in gastrointestinal disease

- Pg. 19 Updated antimicrobial recommendations in acute cholangitis
- Pg. 20 Updated comment on PO vancomycin use in severe *C. difficile* disease
- Pg. 20 Updated comment on why rifampin and rifaximin should NOT be used in *C. difficile* disease at UPMC

### Antimicrobial recommendations in skin/soft tissue infections

- Pg. 22 Updated recommendations for bite wounds including human, dog, and cat

### Antimicrobial recommendations in endocarditis

- Pg. 24-27 Expanded recommendations for enterococcal endocarditis by various susceptibility phenotypes

### Antimicrobial recommendations for candidiasis

- Pg. 30-32 Changes reflect forthcoming consensus guidelines statement on invasive candidiasis

CONTINUED

## UPDATES AND CHANGES FOR 2008 (CONTINUED)

Pg. 30 Updated therapy recommendations in candidemia by fluconazole susceptibility testing results

### Antimicrobial recommendations in systemic fungal infections

Pg. 33-38 Changes reflect recently published consensus guidelines on invasive aspergillosis

Pg. 33 Therapeutic drug monitoring recommendations for voriconazole and the goal trough concentration

### Print-On-Demand Forms – Infectious Diseases

Pg. 39 HIV Order Set included in available preprinted order sets

### Infections in Solid-organ Transplant Recipients

Pg. 44 Updated statement that voriconazole prophylaxis is not warranted for all solid-organ transplant recipients

### Renal Dosing Recommendations

Pg. 46 Addition of doripenem and cefuroxime for UTI

Pg. 48 Updated dosing recommendations for the critically ill receiving continuous renal replacement therapy and cefepime

### Prevention of Infective (Bacterial) Endocarditis

Pg. 50,51 Newly added: Prevention of infective (bacterial) endocarditis (Procedure-related antibiotic prophylaxis, when necessary and when unnecessary)

### UPMC Recommendations for Surgical Antimicrobial Prophylaxis

Pg. 52 Added statement regarding compliance with Surgical Care Improvement Project (SCIP)

Pg. 53 Preferred prophylactic antibiotic in esophagectomy and lung transplantation updated

Pg. 56 Recommended agents and dosing regimens/alternatives in Gynecologic and Obstetric section updated

### *Clostridium difficile*-associated disease pathway

Pg. 60 Cholestyramine administration caveat added

### Required Isolation Barriers for Micro-organisms of Epidemiological Significance

Pg. 65 Updated to include extended-spectrum beta-lactamase producing (ESBL) and carbapenemase producing bacteria

### Aminoglycoside dosing

Pg. 70 Clarification that individualized regimens of aminoglycosides in the critically ill should be done using the MIC value of the infecting organism

## **UPMC PRESBYTERIAN GUIDE TO ANTIMICROBIAL CHEMOTHERAPY**

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### **Antibiotic Management Program**

AMP Telephone: 412-225-7866

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The Antibiotic Management Program is a patient safety initiative and was developed to address infections related to *C. difficile*, increasing antimicrobial resistance in nosocomial Gram-negative organisms, and increasing antimicrobial costs. This program is fully endorsed by the Medical Executive and Pharmacy and Therapeutics committees of UPMC for implementation at UPMC Presbyterian. To see the impact the Antibiotic Management Program in conjunction with Infection Control have had on *C. difficile* at UPMC Presbyterian, please see *Clin Infect Dis* 2007;45:1266-73.

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## UPMC FORMULARY MEDICATIONS

A Web-based formulary has been established for UPMC Presbyterian Shadyside. This formulary is searchable by name and class and contains all drugs on formulary.

Log on to <http://druginfo.infonet.upmc.com>. Select "Online Formulary" in the right-hand column.

This site also provides:

- a downloadable formulary for your PDA
- links to managed care formularies:
  - UPMC Health Plan formulary
  - Highmark Blue Cross Blue Shield
  - Gateway Health Plan
  - Three Rivers Health Plan
- drug package inserts
- drug information
- industry medication shortages

### Drug Use and Disease State Management Initiatives for UPMC Presbyterian

*Drug Use and Disease State Management Initiatives for UPMC Presbyterian are located at the following website —*

***<http://druginfo.infonet.upmc.com/managementpub.htm>*** *These initiatives have been written and edited by clinical pharmacists and physicians, and have been approved by the UPMC Presbyterian Pharmacy and Therapeutics Committee.*

**GRAM-POSITIVE ORGANISMS (PERCENT SUSCEPTIBLE) – TREATMENTS OF CHOICE ARE IN **BOLD****

Gram-Positive Cocci	# Tested	Penicillin	Oxacillin	Vancomycin	Clindamycin	Erythromycin	Tetracycline	Ampicillin	Ampicillin/Sulbactam	Cephalothin	Sulfamethoxazole/ Trimethoprim	Linezolid <sup>1</sup>	Nitrofurantoin <sup>2</sup>
<i>S. aureus</i>	2054	9	48 <sup>3</sup>	100	69	30			48	48	94	98	
Coag. neg. Staph.	2040	7	19	<b>100</b>		23			19	19	35		
Group A Streptococci	65	<b>100</b>		100	88	89							
<i>Enterococcus faecalis</i>	1285			91				<b>98<sup>5</sup></b>				81	95 <sup>2</sup>
<i>Enterococcus faecium</i>	1072			19 <sup>4</sup>				6				87	11 <sup>2</sup>

## Footnotes:

<sup>1</sup> The presence of linezolid resistance in UPMC isolates of MRSA and VRE is noteworthy.<sup>2</sup> Nitrofurantoin is only useful for urinary tract infection, and only in patients with a creatinine clearance of greater than 50 ml/minute.<sup>3</sup> 52% of all UPMC *S. aureus* isolates were MRSA.<sup>4</sup> 81% of all UPMC *E. faecium* isolates were VRE.<sup>5</sup> Synergy can be expected between ampicillin and gentamicin in 71% of *E. faecalis* isolates. Please note that gentamicin should never be used as monotherapy for enterococcal infections.

Antibiograms (data from January 2007-December 2007)

### **STREPTOCOCCUS PNEUMONIAE**

**Important note:** The minimum inhibitory concentration (MIC) breakpoints for *S. pneumoniae* to penicillin differ when causing meningitis vs. non-meningitis disease. The following tables represent the susceptibility of *S. pneumoniae* using the breakpoints for pneumonia or other non-CNS disease (Table 1) and the breakpoints for meningitis (Table 2). Patients who are empirically treated for community acquired pneumonia (CAP) with penicillin should receive 4 million units (MU) IV q4h until the MIC is known (see Table 1 below).

**TABLE 1. *S. PNEUMONIAE* PENICILLIN ANTI BIOGRAM IN PNEUMONIA OR OTHER NON-CNS DISEASE**

	<b>MIC(mg/ml)</b>	<b>N% Interpretation</b>	<b>Penicillin dose (once MIC known)</b>
<b><i>S. pneumoniae</i> (n=136)</b>	≤ 2	87% Susceptible	3MU IV q4h OR 18MU IV q24h as a continuous infusion
	4	11% Intermediate	4MU IV q4h OR 24MU IV q24h as a continuous infusion
	≥ 8	2% Resistant	If ceftriaxone is susceptible, use ceftriaxone otherwise use vancomycin

**TABLE 2. *S. PNEUMONIAE* PENICILLIN ANTI BIOGRAM IN MENINGITIS**

	<b>MIC(mg/ml)</b>	<b>N% Interpretation</b>	<b>Penicillin dose (once MIC known)</b>
<b><i>S. pneumoniae</i> (n=136)</b>	≤ 0.06	55% Susceptible	4MU IV q4h OR 24MU IV q24h as a continuous infusion
	0.12-1	20% Intermediate	If ceftriaxone is susceptible, use ceftriaxone otherwise use vancomycin
	≥ 2	25% Resistant	

<sup>1</sup>Performance Standards for Antimicrobial Susceptibility Testing. CLSI document M100-S18. Wayne, PA: Clinical and Laboratory Standards Institute; 2008

**STREPTOCOCCUS PNEUMONIAE**

Breakpoints between ceftriaxone meningitis disease and non-meningitis disease have been previously established.<sup>2</sup> The following tables represent the susceptibility of *S. pneumoniae* to ceftriaxone using the breakpoints for non-meningitis disease (Table 3) and meningitis disease (Table 4).

**TABLE 3. S. PNEUMONIAE CEFTRIAXONE ANTILOGRAM IN PNEUMONIA OR OTHER NON-CNS DISEASE**

<i>S. pneumoniae</i> (n=136)	<b>MIC(mg/ml)</b>	<b>N% Interpretation</b>	<b>Ceftriaxone dose</b>
	≤ 1	88% Susceptible	1g IV q24h
	2	9% Intermediate	Use Vancomycin
	≥ 4	3% Resistant	Use Vancomycin

**TABLE 4. S. PNEUMONIAE CEFTRIAXONE ANTILOGRAM IN MENINGITIS**

<i>S. pneumoniae</i> (n=136)	<b>MIC(mg/ml)</b>	<b>N% Interpretation</b>	<b>Ceftriaxone dose</b>
	≤ 0.5	73% Susceptible	2g IV q12h
	1	15% Intermediate	Use Vancomycin
	≥ 2	12% Resistant	Use Vancomycin

## Antibiograms

UPMC Presbyterian (data from January 2007-December 2007)

## GRAM-NEGATIVE ORGANISMS (PERCENT SUSCEPTIBLE)

Gram-Negative Bacilli	# Tested	Doxycycline	Ampicillin	Ampicillin/Sulbactam	Cephalothin	Cefuroxime	Ceftaxone	Cefepime	Piperacillin	Piperacillin/Tazobactam	Aztreonam	Gentamicin	Tobramycin	Sulfamethoxazole/ Trimethoprim	Ciprofloxacin	Nitrofurantoin	Meropenem	Amikacin
<i>E. coli</i> <sup>†</sup>	2270	76	43	71	35	89	95	98	50	92	92	87		71	73	91		
<i>P. aeruginosa</i>	1571							80	72	77	48	79	89		69		74	85
<i>K. pneumoniae</i> <sup>†</sup>	1174	62	0	70	65	77	88	92	51	72	87	88		73	81	31		
<i>K. oxytoca</i> <sup>†</sup>	249	85	0	58	44	74	80	94	54	71	78	93		85	89	80		
<i>E. cloacae</i>	575	45	4	27	1	47	65	93	59	61	67	92		76	79	22		
<i>E. aerogenes</i>	203	68	4	55	3	63	74	97	70	66	77	99		95	90	23		
<i>Acinetobacter</i>	262		0	37				26	11	32	0	35	54	24	23		74	56
<i>P. mirabilis</i>	439	4	74	92	74	94	95	97	86	97	98	90		76	75	1		
<i>Serratia spp.</i>	355	16	1	3	0	2	75	97	75	82	81	97		73	80			
<i>Citrobacter freundii</i>	150	53	3	68	1	66	69	97	51	74	58	88		75	88	88		

<sup>†</sup> Includes ESBL isolates.

## ICU SPECIFIC ANTIBIOGRAMS

The susceptibility of *Pseudomonas aeruginosa* to antimicrobial agents is particularly important in ICU situations because *P. aeruginosa* is the leading cause of ventilator-associated pneumonia. The susceptibilities of this organism in samples obtained from patients in each of UPMC's ICUs are documented here for the period January 2007 to April 2008.

Ward	# Isolated	Amikacin	Aztreonam	Cefepime	Ciprofloxacin	Gentamicin	Meropenem	Piperacillin	Tobramycin	Piperacillin/Tazobactam
5F	21	100	65	95	90	100	100	95	100	95
4G	36	92	73	100	89	92	92	96	97	94
6F/G	137	96	52	79	81	83	82	77	88	76
MICU <sup>1</sup>	349	78	33	67	55	67	61	56	80	61
CTICU	124	74	38	61	52	70	62	63	88	63
TICU <sup>2</sup>	132	91	37	69	63	81	68	71	87	72

*Comments: 2005 ATS/IDSA guidelines call for combination therapy including anti-pseudomonal and anti-MRSA agents empirically in treatment of suspected ventilator-associated pneumonia (VAP). The antibiograms above can be used to determine the optimal combination of anti-pseudomonal therapy for patients in each ICU, with the caveat that administration of anti-pseudomonal agents the patient has previously received should be avoided. For example, a patient who received cefepime in the last month should not receive cefepime empirically for a new episode of suspected VAP. The hospital's VAP order sets prioritize the 2005 ATS/IDSA guidelines.*

<sup>1</sup> Units include 10C, 9F, 10F, 11F

<sup>2</sup> Units include 5E, 5S, 5W

## Antibiogram data for UPMC hospitals other than UPMC Presbyterian

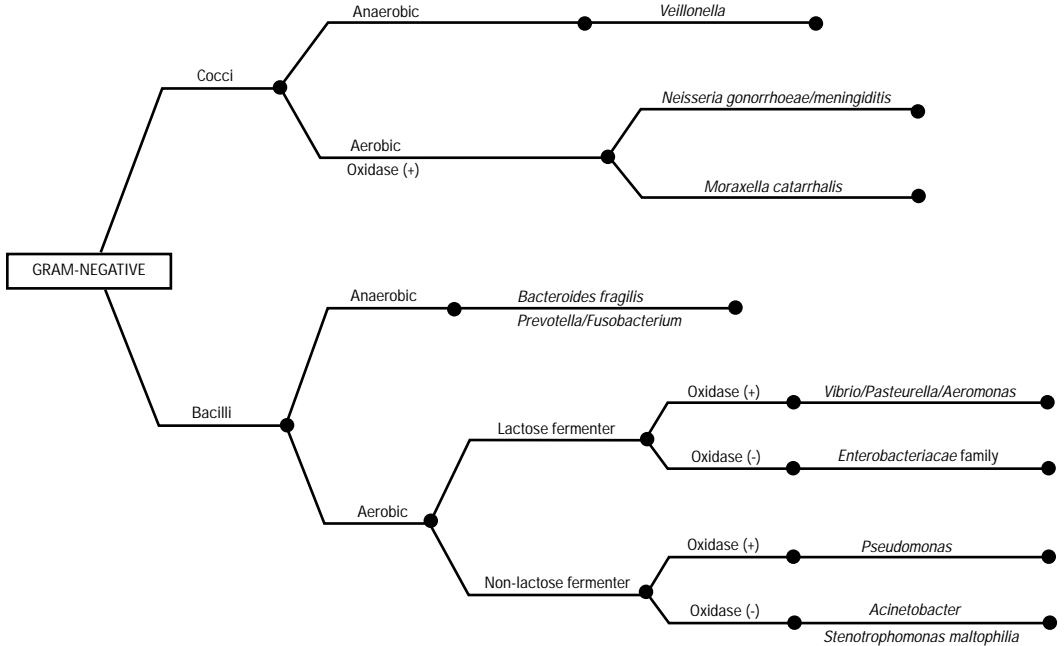
For those seeking antibiogram data for UPMC hospitals other than UPMC Presbyterian, please visit the new UPMC Antibiograms website. This website will provide a continuity of care for patients regularly transferred among UPMC institutions. Currently, the antibiogram website contains data for the following UPMC hospitals:

- UPMC Bedford Memorial
- UPMC Braddock
- Children's Hospital of Pittsburgh of UPMC
- Magee-Womens Hospital of UPMC
- UPMC Horizon
- UPMC McKeesport
- UPMC Mercy
- UPMC Passavant
- UPMC Presbyterian
- UPMC St. Margaret
- UPMC Shadyside
- UPMC South Side

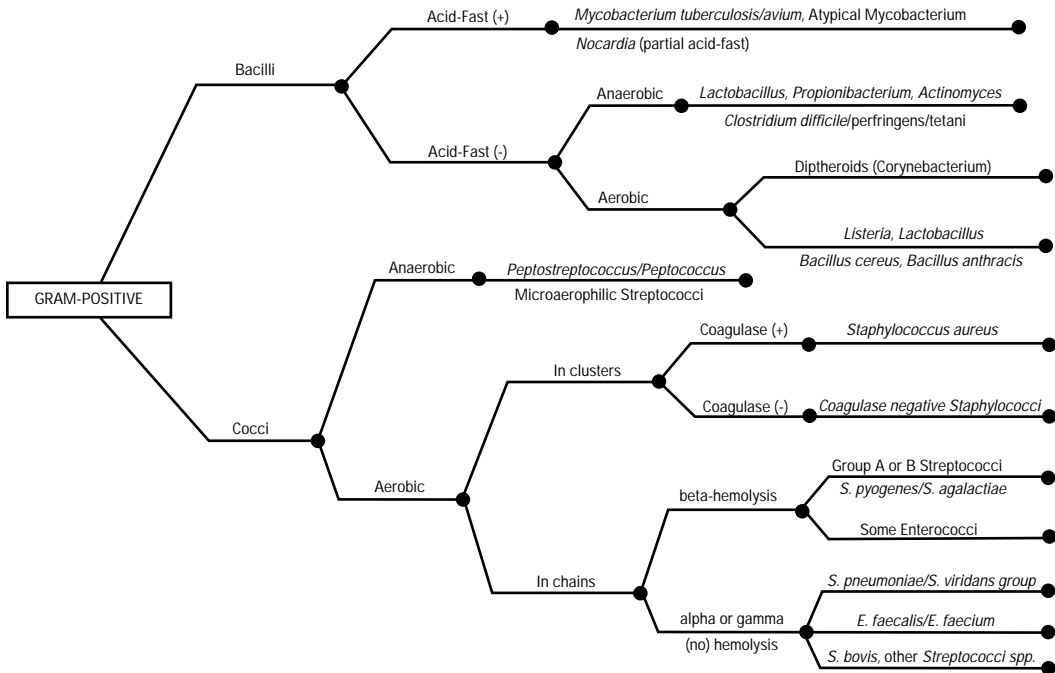
### There are two options to access this information:

1. This website is accessible at <http://spis.upmc.com/isd/cdsis/cp/Antibiograms/default.aspx>. You will need to enter your UPMC username and password. The website may be accessed from outside the hospitals via [connect@upmc](mailto:connect@upmc).
2. Another link to the website has been established through Results Review (PowerChart). From the upper left-hand corner of the screen, select "Task" from the drop-down menu and click on "Organizer Actions." When a second options window opens, find and click on "Launch Application." At this point, a third options window will open. Find and click on "antibiogram."

# ORGANISM IDENTIFICATION THROUGH GRAM STAIN (NOT COMPREHENSIVE)



# MICRO-ORGANISM IDENTIFICATION THROUGH GRAM STAIN (NOT COMPREHENSIVE)



**SELECTED FORMULARY AND NONFORMULARY ANTIBIOTICS BY CLASS ([R] = RESTRICTED)**

<b>Penicillins</b> Penicillin Ampicillin Amoxicillin Nafcillin Oxacillin Dicloxacillin Cloxacillin Piperacillin Ampicillin/Sulbactam Piperacillin/Tazobactam [R] Ticarcillin/clavulanate [R]	<b>Cephalosporins</b> Cefazolin (1 <sup>st</sup> generation) Cephalexin (1 <sup>st</sup> generation) Cefoxitin (2 <sup>nd</sup> generation) Cefuroxime (2 <sup>nd</sup> generation) Cefpodoxime (3 <sup>rd</sup> generation) Cefotaxime (3 <sup>rd</sup> generation) [R] Ceftriaxone (3 <sup>rd</sup> generation) [R] Ceftazidime (3 <sup>rd</sup> generation) [R] Cefepime (4 <sup>th</sup> generation) [R]	<b>Macrolides</b> Erythromycin Azithromycin
	<b>Carbapenems</b> Ertapenem [R] Meropenem [R] Imipenem [R] Doripenem [R]	<b>Aminoglycosides</b> Amikacin Gentamicin Tobramycin Streptomycin
<b>Fluoroquinolones</b> Ciprofloxacin [R] Moxifloxacin [R]	<b>Streptogramin</b> Quinupristin/Dalfopristin [R]	<b>Tetracyclines</b> Tetracycline Minocycline Doxycycline
		<b>Monobactam</b> Aztreonam [R]
<b>Oxazolidinone</b> Linezolid [R]	<b>Sulfonamide combination</b> Trimethoprim/Sulfamethoxazole	<b>Cyclic Lipopeptide</b> Daptomycin [R]
<b>Rifamycins</b> Rifampin Rifabutin		<b>Lincosamide</b> Clindamycin [R]
<b>Glycopeptide</b> Vancomycin-IV Vancomycin-PO[R]	<b>Miscellaneous</b> Metronidazole Nitrofurantoin	
<b>Glycylcycline</b> Tigecycline [R]		

**SELECTED FORMULARY AND NONFORMULARY ANTIFUNGALS ([R] = RESTRICTED)**

<b>Polyenes</b> Amphotericin B deoxycholate Amphotericin B lipid complex (Abelcet™)[R] Nystatin (powder, oral suspension)	<b>Echinochandin</b> Caspofungin [R] Micafungin [R] Anidulafungin [R]	<b>Triazoles</b> Fluconazole Itraconazole (I.V. – [R]) Voriconazole (I.V. – [R]) Posaconazole [R]
	<b>Miscellaneous</b> Flucytosine (5FC) Griseofulvin Terbinafine	

**Restricted agents:**

In the following tables, antibiotics are recommended that may be restricted. Although a restricted antibiotic (designated by the “[R]”) may be recommended in this guide, a call to the Antibiotic Management Program is still required.

**Restricted agents that have exceptions:**

Piperacillin/tazobactam[R] (Zosyn™) and cefepime[R] (Maxipime™) do not require prior approval from the AMP in ICU units. These units include CTICU, SICU, 3F, 4F, 4G, 5F, 6F/G, MICU (9F, 10F, 10C, 11F), TICU (5W, 5E, 5S). Also, restricted antibiotics do not need prior approval if they are printed on “print on demand” or preprinted order forms available on Infonet (<http://infonet.upmc.com>) — See pages 39, 40.

**NOTE: Carbapenems (Ertapenem, Meropenem, Imipenem, and Doripenem) and Quinolones (Ciprofloxacin, Moxifloxacin) are not exempt from prior approval in ICUs.**

**Patients with renal insufficiency:**

Please note that the dose recommendations below are based on patients with estimated creatinine clearances of > 50ml/min. For patients with moderate to severe renal impairment, including hemodialysis, please see the Renal Dosing Recommendations section of this handbook.

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## WHY IS VANCOMYCIN NOT RESTRICTED?

The majority of Coagulase-negative Staphylococci (>80%) and *Staphylococcus aureus* (~50%) at this institution are resistant to methicillin. Thus, preapproval calls for vancomycin would be overwhelming. Those prescribing vancomycin should be aware that the CDC has published a document with recommendations for its prudent use. The following table illustrates instances when its use is appropriate and those when it should be discouraged<sup>1</sup>.

### When vancomycin is appropriate:

1. Treatment of serious infections due to beta-lactam resistant Gram-positive micro-organisms
2. Treatment of Gram-positive infections in patients with allergies to beta-lactam antimicrobials
3. When antibiotic-associated colitis fails to respond to metronidazole, or if it is severe and life-threatening (PO vancomycin only)
4. Prophylaxis, as recommended by the American Heart Association, for endocarditis after certain procedures in patients at high risk for endocarditis
5. Prophylaxis for surgical procedures involving implantation of prosthetic materials or devices at institutions with a high rate of infections due to MRSA or MRSE
6. Prophylaxis in patients with severe PCN allergy

### When vancomycin is inappropriate:

1. Routine surgical prophylaxis
2. Empiric antimicrobial therapy for a febrile neutropenic patient, unless there is strong evidence that the patient has an infection due to Gram-positive micro-organisms, and the prevalence of beta-lactam resistant organisms in the hospital is substantial
3. Treatment in response to a single blood culture positive for coagulase-negative staphylococci, if other blood cultures drawn in the same time frame are negative (contamination)
4. Continued empiric use for presumed infections in patients whose cultures are negative for beta-lactam resistant Gram-positive micro-organisms
5. Systemic or local prophylaxis for infection or colonization of indwelling central or peripheral intravascular catheters or vascular grafts
6. Selective decontamination of the digestive tract
7. Eradication of MRSA colonization
8. Primary treatment of antibiotic-associated colitis (AAC)
9. Routine prophylaxis for infants with very low birth weights
10. Routine prophylaxis for patients on continuous ambulatory peritoneal dialysis
11. Routine PO prophylaxis for *C. difficile* colitis\*

<sup>1</sup> Federal Register 1994; 59:25758-63

\*PO Vancomycin is restricted – For the appropriate use of PO Vancomycin in *C. difficile* colitis, please see the *C. difficile* print on demand order set available on Infonet.

## COMMUNITY-ASSOCIATED METHICILLIN-RESISTANT *STAPHYLOCOCCUS AUREUS* (CA-MRSA)

Infections due to CA-MRSA are increasing in frequency. Here are some relevant points worth noting:

- 1.) Risk factors associated with CA-MRSA include
  - a. Children
  - b. Incarcerated persons
  - c. Alaskan natives, Native Americans, Pacific Islanders
  - d. Sports participants, specifically with:
    - i. Abrasions and lacerations
    - ii. Physical contact
    - iii. Equipment sharing (e.g. towels, uniforms, razors, etc.)
  - e. Military personnel
- 2.) Patients may incorrectly attribute their skin infection to a "spider bite."
- 3.) Consensus guidelines for the appropriate course in diagnosis and management of patients with infections due to CA-MRSA do not yet exist. See table below for comparison of CA-MRSA and health care-associated MRSA (HA-MRSA)<sup>1</sup>.

Drug Susceptibility	CA-MRSA	HA-MRSA
Erythromycin	Usually resistant	Usually resistant
TMP/SMX <sup>a</sup>	Usually susceptible	Usually susceptible
Fluoroquinolone <sup>b</sup>	Geographic variability	Usually resistant
Clindamycin <sup>c</sup>	Usually susceptible <sup>c</sup>	Usually resistant

<sup>1</sup>Weber JT. *Clin Infect Dis* 2005;41:S269-72

<sup>a</sup>TMP/SMX (Trimethoprim/sulfamethoxazole). In 2007, approximately 2,000 *S. aureus* isolates at UPMC Presbyterian were tested to TMP/SMX and 94% were susceptible.

<sup>b</sup>In 2007, a total of 39 *S. aureus* isolates at UPMC Presbyterian were tested to moxifloxacin, and 85% were susceptible. Ciprofloxacin should not be thought of as an agent with reliable Gram-positive activity.

<sup>c</sup>Clindamycin may test susceptible *in vitro*, yet may be resistant *in vivo* due to inducible resistance. Confirmatory testing for clindamycin to *S. aureus* (known as the "D-test") can be performed. Please call the AMP team to discuss whether this is warranted. In 2007, approximately 2,000 *S. aureus* isolates at UPMC Presbyterian were tested to clindamycin and 69% were susceptible (Confirmatory testing as described above not routinely performed).

- 4.) The role of antimicrobial therapy for the treatment of uncomplicated CA-MRSA skin infections is unclear. However, in one of the largest studies to date, the use of an inactive antimicrobial agent was an independent predictor of treatment failure<sup>2</sup>. An incision and drainage (I+D) procedure was performed in the majority of patients. If antibiotic therapy is desired and the patient can tolerate, initiate Trimethoprim/sulfamethoxazole 1 to 2 double strength tablet(s) PO q12h.
- 5.) In those patients who have an I+D performed, culture and Gram stain of the drained material is of value in directing therapy.
- 6.) Invasive infections due to CA-MRSA such as septic arthritis, endocarditis, and pneumonia are well described. A variety of agents can be used to treat these infections. A partial list is included to help guide therapy selection. If further guidance is needed, an Infectious Diseases consult should be obtained.

Antimicrobial	Dose	Route	Notes
Vancomycin	15-20mg/kg q12h	IV	Dose adjust in renal insufficiency.
Daptomycin	6mg/kg q24h	IV	Do not use for the treatment of pneumonia. Dose adjust in renal insufficiency. Indicated for bacteremia and endocarditis. (dosing in these indications is 6mg/kg)
Linezolid	600mg q12h	IV/PO	

<sup>2</sup> Ruhe JJ, et al. *Clin Infect Dis* 2007;44:777-84

## COMMON QUESTIONS RELATED TO ANTIBIOTIC THERAPY

### 1.) What is the appropriate PO dose of ciprofloxacin for cystitis?

**Answer:** Ciprofloxacin 250mg PO q12h is the FDA-approved dose for cystitis in patients without renal insufficiency. Healthy volunteer data (conservative pharmacokinetic surrogates of sick patients) have shown that ciprofloxacin peak and trough urine concentrations are approximately 200 and 20 times the MIC, respectively, of Gram-negative organisms at their highest MIC of susceptibility (1mcg/ml).<sup>1,2</sup> At these exposure concentrations, even intermediate and low-level resistant organisms may potentially be treated. There is no added benefit of increasing the dose to 500mg, and this remains true in the presence of prosthetic material (urinary catheter).

### 2.) If I want to cover bowel anaerobes, do I need to add metronidazole to a patient's regimen if he or she is already receiving ampicillin/sulbactam or piperacillin/tazobactam?

**Answer:** No. The beta-lactamase component of each penicillin (sulbactam for ampicillin and tazobactam for piperacillin) broadens its coverage to include, among others, bowel anaerobes. This includes non-difficile *Clostridia spp.* and *Bacteroides spp.*

### 3.) Why should I not use metronidazole or vancomycin PO for *C. difficile* prophylaxis?

**Answer:** Prophylaxis of *C. difficile* disease remains untested. One retrospective study in abstract form concluded that metronidazole and lactobacillus prophylaxis significantly decreased *C. difficile* colitis in lung transplant recipients after transplantation.<sup>3</sup> This retrospective study, however, is highly confounded by the presence of two additional interventions aimed at decreasing *C. difficile* during the study period (increased infection control measures and reduction of antibiotic use with the greatest risk of *C. difficile* disease). Reliance on prophylactic metronidazole or vancomycin should not be seen as a substitute for adherence to proven strategies such as compliance with barrier precautions, appropriate hand hygiene practices, and evaluation of a risk/benefit relationship when initiating and selecting antibiotic therapy. Further, studies have reported an association between PO vancomycin and vancomycin-resistant Enterococcus (VRE).<sup>4,5</sup>

### 4.) If a patient is receiving piperacillin/tazobactam (Zosyn) for a monobacterial infection with *Pseudomonas aeruginosa* susceptible to both piperacillin/tazobactam and piperacillin, why should I streamline therapy to piperacillin alone?

**Answer:** The type of beta-lactamase commonly produced by *Pseudomonas spp.* is not overcome by the beta-lactamase component in Zosyn (tazobactam). For this reason, if you are treating only *Pseudomonas* which is susceptible to both piperacillin/tazobactam and piperacillin alone, you are afforded no greater chance of treatment success with one over the other. In that case, you should streamline to the more narrow agent — piperacillin.

### 5.) What is the appropriate dose of penicillin?

**Answer:** Please see the *S. pneumoniae* antibiogram section (pgs. 3,4) for dosing related to pneumonia or non-CNS disease and meningitis.

<sup>1</sup> *Int J Clin Pharmacol Res* 1987;7:181-6.

<sup>2</sup> *Antimicrob Agents Chemother* 1984;26:741-4.

<sup>3</sup> *J Heart Lung Transplant* 2005;24(S1):S169

<sup>4</sup> *J Infect Dis* 1996;173:1129-36

<sup>5</sup> *Emerg Infect Dis* 2001;7:183-7

## ANTIMICROBIAL RECOMMENDATIONS IN PULMONARY DISEASE

Diagnosis (Modifying Factors)	Likely Pathogens	Empiric Therapy	Alternative (Severe PCN allergy)	Comments
Aspiration pneumonitis "Mendelson's syndrome"	None (sterile gastric contents)	None	None	Aspirated gastric contents acutely causes lung injury with subsequent immune response.
COPD exacerbation	<i>S. pneumoniae</i> , <i>H. influenzae</i> , viral, other	<b>Doxycycline 100mg PO q12h</b> <b>OR Amoxicillin 500mg PO q8h</b>	Azithromycin 500mg PO q24 x 3 days OR Moxifloxacin[R] 400mg PO q24 x 5 days	
Aspiration pneumonia (Community acquired or hospitalized < 5 days)	Viridans Streptococci, Micrococci, oral anaerobes, Gram- negative rods	<b>Ampicillin/sulbactam</b> <b>3g IV q6h</b> (See comment)	TMP/SMX 3mg/kg PO/IV q12h plus Metronidazole 500mg PO/IV q8h OR Moxifloxacin[R] 400mg PO/IV q24h (see comment)	Patients who have aspirated with suspected upper airway colonization with noscomial bacteria should be treated using the pathway in the row below. (Aspiration pneumonia, hospitalized > 5 days)
Aspiration pneumonia (Hospitalized ≥ 5 days)	<i>E.coli</i> , <i>H. influenzae</i> , <i>Klebsiella spp.</i> , <i>Proteus</i> <i>spp.</i> , <i>Serratia</i> <i>marcescens</i> , <i>S.</i> <i>pneumoniae</i> , <i>S. aureus</i> <i>Pseudomonas</i> , <i>Acinetobacter spp.</i>	<b>Cefepime[R] 1g IV q8h OR</b> <b>Piperacillin/tazobactam[R]</b> <b>4.5g IV q8h +/- Vancomycin<sup>†</sup></b> <b>15mg/kg IV q12h</b>	Ciprofloxacin[R] 400mg IV q8h plus Vancomycin <sup>†</sup> 15mg/kg IV q12h	
Community Acquired Pneumonia (CAP)* (Not in an ICU)	<i>S. pneumoniae</i> , <i>H. influenzae</i> , <i>Legionella</i> , <i>Mycoplasma</i> , <i>Chlamydia pneumoniae</i>	<b>Ampicillin/sulbactam 3g IV q6h</b> <b>OR</b> <b>penicillin 4MU IV q4h OR</b> <b>penicillin 24MU continuous</b> <b>infusion over 24h OR</b> <b>Ceftriaxone[R] 1g IV q24h</b> <b>PLUS</b> <b>Azithromycin 500mg IV q24h x</b> <b>2 doses, then 500mg PO q24h</b>	Moxifloxacin[R] 400mg q24h	Switch to PO when tolerable.
CAP* (ICU without reason to suspect <i>Pseudomonas</i> – see below)	<i>S. pneumoniae</i> , <i>H. influenzae</i> , <i>Legionella</i> , <i>S. aureus</i> , <i>Mycoplasma</i> , <i>Chlamydia pneumoniae</i>	<b>Ampicillin/sulbactam 3g IV q6h</b> <b>OR penicillin 4MU IV q4h OR</b> <b>penicillin 24MU continuous</b> <b>infusion over 24h OR</b> <b>Ceftriaxone[R] 1g IV q24h</b> <b>PLUS</b> <b>Azithromycin 500mg IV q24h x</b> <b>2 doses, then 500mg PO q24h</b>	Aztreonam[R] 2g IV q8h PLUS Moxifloxacin[R] 400mg q24h	If <i>S. aureus</i> suspected (post-influenza pneumonia), add nafcillin OR vancomycin if severe PCN allergy. See footnote 5 end of next page.

CONTINUED ON PAGE 17

## ANTIMICROBIAL RECOMMENDATIONS IN PULMONARY DISEASE (CONTINUED)

Diagnosis (Modifying Factors)	Likely Pathogens	Empiric Therapy	Alternative (Severe PCN allergy)	Comments
CAP* (ICU with reason to suspect Pseudomonas†: structural lung disease‡, broad-spectrum antibiotics for > 7 days in the past month, recent hospital admission)	<i>S. pneumoniae</i> , <i>Legionella</i> , <i>S. aureus</i> , <i>Mycoplasma</i> , <i>Chlamydia pneumoniae</i> , <i>Pseudomonas</i>	<b>Cefepime[<sup>1</sup>] 1g IV q8h OR Piperacillin/tazobactam[<sup>1</sup>] 4.5g IV q8h PLUS Ciprofloxacin[<sup>1</sup>] 400mg IV q12h</b>	Aztreonam[ <sup>1</sup> ] 2g IVq8h plus Moxifloxacin 400mg IV q12h	If <i>S. aureus</i> suspected (post-influenza pneumonia), add nafcillin OR vancomycin if severe PCN allergy. See footnote 5 end of this page
Hospital Acquired Pneumonia (HAP) – early‡ (within 4 days of admission) Note: Excludes patients with immunosuppression.	<i>E.coli</i> , <i>H. influenzae</i> , <i>Klebsiella spp.</i> , <i>Proteus spp.</i> , <i>Serratia marcescens</i> , <i>S. pneumoniae</i> , <i>S. aureus</i> (Methicillin sensitive)	<b>Ampicillin/sulbactam 3g IV q6h OR Ceftriaxone[<sup>1</sup>] 1g IV q24h</b>	Moxifloxacin[ <sup>1</sup> ] 400mg q24h x 7	If <i>S. aureus</i> suspected (post-influenza pneumonia), add nafcillin OR vancomycin if severe PCN allergy. See footnote 5 end of this page
HAP – late (5 days or more since admission)	<i>E.coli</i> , <i>H. influenzae</i> , <i>Klebsiella spp.</i> , <i>Proteus spp.</i> , <i>Serratia marcescens</i> , <i>S. pneumoniae</i> , <i>S. aureus</i> <i>Pseudomonas</i> , <i>Acinetobacter spp</i>	<b>Cefepime[<sup>1</sup>] 1g IV q8h OR Piperacillin/tazobactam[<sup>1</sup>] 4.5g IV q8h +/- Aminoglycoside +/- Vancomycin<sup>†</sup> 15-20mg/kg IV q12h</b>	Ciprofloxacin[ <sup>1</sup> ] 400mg IV q8h +/- Aminoglycoside +/- Vancomycin <sup>†</sup> 15-20mg/kg IV q12h OR Aztreonam[ <sup>1</sup> ] 1g IV q8h +/- Aminoglycoside +/- Vancomycin <sup>†</sup> 15-20mg/kg q12h	Perform BAL – narrow spectrum based on results
Ventilator Associated Pneumonia (VAP) <sup>†</sup>	<i>Pseudomonas</i> , <i>Enterobacter</i> , <i>S. marcescens</i> , <i>Klebsiella</i> , <i>Acinetobacter</i> , <i>S. aureus</i> (MRSA)	<b>Cefepime[<sup>1</sup>] 1g IV q8h OR Piperacillin/tazobactam[<sup>1</sup>] 4.5g IV q6h OR Meropenem[<sup>1</sup>] 1g IV q8h OR Imipenem[<sup>1</sup>] 500mg IV q 6h + aminoglycoside + Vancomycin<sup>†</sup> 15-20mg/kg IV q12h</b>	Ciprofloxacin[ <sup>1</sup> ] 400mg IV q8h + Aminoglycoside + Vancomycin <sup>†</sup> 15-20mg/kg q12h OR Aztreonam[ <sup>1</sup> ] 1g IV q8h + Aminoglycoside + Vancomycin <sup>†</sup> 15mg/kg q12h (Linezolid[ <sup>1</sup> ] 600mg PO/IV in vancomycin failure)	Therapy duration in the majority of cases should be limited to 8 days. VAP <sup>2</sup> to <i>Pseudomonas</i> treated for 15 days versus 8 days had less recurrence of pneumonia, yet a greater incidence in resistant isolates in those who had recurrence. There was no difference in outcomes between groups. <sup>3</sup>

TMP/SMX = Trimethoprim/Sulfamethoxazole

<sup>†</sup> Use the VAP Order set for initial and follow-up therapy

<sup>‡</sup> Note: Vancomycin troughs in MRSA pneumonia should be targeted at 15–20mcg/ml (See *Am J Respir Crit Care Med* 2005;171:388-416, *Antimicrob Agents Chemother* 1993;37:281-6, and *J Antimicrob Chemother* 1996;38:865-869.) CAP: Community acquired pneumonia; HAP: Hospital acquired pneumonia; VAP Ventilator associated pneumonia

<sup>1</sup> ATS/IDSA Guidelines for CAP in Adult. *Clin Infect Dis* 2007; 44:S27-72

<sup>2</sup> *Am J Respir Crit Care Med* 2005;171:388-416.

<sup>3</sup> *JAMA* 2003; 290:2588-98.

<sup>4</sup> Structural lung disease: bronchiectasis, repeated exacerbations of severe COPD leading to frequent steroid and/or antibiotic use.

<sup>5</sup> Necrotizing or cavity pneumonia is a risk for community-acquired methicillin-resistant staphylococcus aureus (CA-MRSA). Add vancomycin to the antibiotic regimen in this setting. Sputum samples should be obtained, but preferably bronchoalveolar lavage.

\* Please use the CAP preprinted order form available on Infonet (<http://infonet.upmc.com>).

Diagnosis	Likely Pathogens	Empiric Therapy	Alternative	Comments
Pneumocystis Pneumonia (PCP) <sup>5</sup>	<i>Pneumocystis jiroveci</i> (Previously known as <i>Pneumocystis carinii</i> ) <sup>5</sup>	IV Therapy: TMP/SMX 5mg/kg IV q8h x 21 days PLUS Adjunctive steroid therapy <sup>4</sup> (see Notes in Comments section AND see dosing table below) OR PO Therapy: TMP/SMX 2 D.S. tablets q8h PLUS Adjunctive steroid therapy <sup>4</sup>	Pentamidine 4mg/kg IV q24h x 21 days	<b>Note:</b> Adjunctive steroid therapy typically reserved for sicker patients (PaO <sub>2</sub> < 70mmHg or Aa gradient >35mmHg). <sup>4</sup>  <b>Note:</b> Start adjunctive steroid therapy as early as possible for maximal benefit, but definitely within 24 to 72 hours of antipneumocystis therapy <sup>4</sup>

<sup>4</sup> *New Engl J Med* 1990;132:1500-4.

<sup>5</sup> Despite the nomenclature change from *Pneumocystis carinii* to *Pneumocystis jiroveci* to reflect its proper classification as a fungus and not a protozoa, the acronym "PCP" has been retained and should still be used when referring to the disease. The interested reader is directed to: *Emerg Infect Dis* 2002;8:891-6.

PCP Adjunctive Therapy (Route)	Days 1 through 5	Days 6 through 10	Days 11 through 21
Prednisone (PO)	40mg PO q12h	40mg PO q24h	20mg PO q24h
Methylprednisolone (IV)	30mg IV q12h	30mg IV q24h	15mg IV q24h

**Note:** If patient can tolerate PO administer prednisone, if not administer methylprednisolone

## ANTIMICROBIAL RECOMMENDATIONS IN GASTROINTESTINAL INFECTIONS

Diagnosis (Modifying Factors)	Likely Pathogens	Empiric Therapy	Alternative (Severe PCN allergy)	Comments
Prophylaxis of spontaneous bacterial peritonitis (SBP)		<sup>1</sup> TMP/SMX DS one tablet PO Monday through Friday	<sup>1</sup> TMP/SMX DS one tablet PO Monday through Friday	Also efficacious: <sup>2</sup> Ciprofloxacin[R] 750mg PO once weekly.
Peritonitis prophylaxis after large GI bleed	<i>E.coli</i> , <i>Streptococcus spp.</i> , <i>Klebsiella spp.</i>	<b>Ampicillin/sulbactam 1.5g IV q6h x 5 days</b>	TMP/SMX 3mg/kg IV q12h OR Ciprofloxacin[R] 500mg IV/PO q12h	
SBP	<i>E.coli</i> , <i>Streptococcus spp.</i> , <i>Klebsiella spp.</i>	<b>Cefotaxime[R] 1g IV q8h OR Ampicillin/sulbactam 1.5g IV q6h</b>	TMP/SMX 3mg/kg IV q12h OR Ciprofloxacin[R] 500mg IV/PO q12h	See Ref. 3 bottom of next page for indications for antifungal therapy.
Ruptured bowel	<i>E.coli</i> , <i>B. fragilis</i> and other colonic anaerobes and Gram-negative flora	<b>Ampicillin/sulbactam 3g IV q6h</b>	Ciprofloxacin[R] 400mg IV q12h plus Metronidazole 500mg IV q8h	Consider anti-pseudomonal coverage in patients with recent admission, immunocompromised, or prolonged hospital course. See Ref. 3 bottom of next page for Indications for antifungal therapy.
Acute Cholangitis	<i>E. coli</i> , <i>Klebsiella spp.</i> , <i>Enterobacter spp.</i> , <i>Enterococcus spp.</i>	<b>Ampicillin/sulbactam 3g IV q6h OR Piperacillin/tazobactam[R] 4.5g IV q8h OR Cefepime[R] 1g IV q8h PLUS Metronidazole 500mg IV/PO q8h</b>	Ciprofloxacin[R] 400mg IV q12h plus Metronidazole 500mg IV/PO q6h	See Ref. 3 bottom of next page for indications for antifungal therapy.

Diagnosis (Modifying Factors)	Likely Pathogens	Empiric Therapy	Alternative (Severe PCN allergy)	Comments
Acute Cholecystitis	<i>Enterobacteriaceae</i> (see "comment" column)	<b>If necessary:</b> <b>Ampicillin/sulbactam 3g IV q6h</b>	Ciprofloxacin[R] 400mg IV q12h plus Metronidazole 500mg IV q6h	Often an inflammatory but non-infectious disease. Initiate therapy on the basis of clinical and/or radiographic findings.
Perirectal abscess	<i>Enterobacteriaceae</i> , <i>Bacteroides</i> , <i>Enterococci</i>	<b>Ampicillin/sulbactam 3g IV q6h</b>	Ciprofloxacin[R] 400mg IV q12h plus Metronidazole 500mg IV q6h	
Crohn's disease flare (ileitis, colitis, perineal or perianal disease)		<b>Data showing efficacy severely limited. Reasonable when abscess accompanies flare.</b>	Metronidazole 500mg PO q6h OR Ciprofloxacin[R] 500mg PO q12h plus Metronidazole 500mg PO q8h (or IV if unable to tolerate PO)	
<i>C. difficile</i> colitis	<i>C. difficile</i>	<p><b>Note 1:</b> Severity score to identify when patients should be given PO vancomycin is located in the <i>C. difficile</i> colitis clinical pathway available as a print on demand document and on pgs. 59-60 of this book.</p> <p><b>Note 2:</b> Rifampin is not recommended for additive therapy in active <i>C. difficile</i> disease as 88.2% of the outbreak <i>C. difficile</i> strains from this institution were rifampin non-susceptible.<sup>4</sup> These isolates would also be rifaximin non-susceptible and patients being treated with rifaximin for hepatic encephalopathy gain no added benefit related to <i>C. difficile</i> disease.</p> <p><b>Note 3:</b> To see why prophylaxis against <i>C. difficile</i> is not recommended, see pg. 15</p>		

<sup>1</sup> *Ann Intern Med* 1995 Apr 15;122(8):595-8

<sup>2</sup> *Hepatology* 1995 Oct;22(4 Pt 1):1171-4

<sup>3</sup> Antifungal therapy unnecessary even if fungi are recovered by culture unless patient is immunosuppressed, or with post-op/recurrent intra-abdominal infections (*Lancet* 1989;2:1437-40. *Surgery* 1980;88:524-30. *Clin Infect Dis* 2003;37:997-1005)

<sup>4</sup> Curry SR, Marsh JW, Muto C, et al. Rifampin Non-Susceptibility Associated with Epidemic BI/NAP1 *C. difficile* Isolates in Pittsburgh, Pa. [abstract C2-2059a]. In: Program and abstracts of the 47th Interscience Conference on Antimicrobial Agents and Chemotherapy (Chicago, IL). Washington, DC: American Society of Microbiology, 2007:231.

## ANTIMICROBIAL RECOMMENDATIONS IN SKIN/SOFT TISSUE INFECTIONS

Diagnosis (Modifying Factors)	Likely Pathogens	Empiric Therapy	Alternative (Severe PCN allergy)	Comments
Cellulitis	<i>S. aureus</i> , Streptococci	<u>IV therapy:</u> Nafcillin 2g IV q4h OR Cefazolin 1g IV q8h <u>PO therapy:</u> Cephalexin 500mg PO q6h OR Dicloxacillin 250-500mg PO q6h	Vancomycin 1g IV q12h OR Clindamycin[R] 600mg IV q8h OR Doxycycline 100mg PO q12h	See section on Community-associated methicillin-resistant <i>S. aureus</i> (CA-MRSA) in this book.
Necrotizing fasciitis	Group A Strep; Polymicrobial (Patients with recent surgery, diabetes and peripheral vascular disease)	<u>Group A Strep:</u> Penicillin G 4 Million Units q4h plus Clindamycin[R] 900mg IV q8h;  <u>Polymicrobial:</u> Ampicillin/sulbactam 3g IV q6h OR Piperacillin/tazobactam 4.5g IV q8h +/- Clindamycin[R] 900mg IV q8h OR Metronidazole 500mg IV q6h	Group A Strep: Clindamycin[R] 900mg IV q8h  Polymicrobial: Ciprofloxacin[R] 400mg IV q8h +/- Clindamycin[R] 900mg IV q8h OR Metronidazole 500mg IV q6h	Surgical intervention essential in patient management.
Wound infection (nontraumatic)	<i>S. aureus</i>	Nafcillin 2g IV q4h OR Cefazolin 1g IV q8h OR Cephalexin 500mg PO q6h OR Dicloxacillin 250-500mg PO q6h OR TMP/SMX 1 DS q12h	Vancomycin 1g IV q12h OR Clindamycin[R] 600mg IV q8h	PO Bactrim 1-2 tablets DS q12h may be used as outpatient therapy if MRSA is suspected. (See section on Community Associated MRSA on page 13,14.)
Wound infection (traumatic and severe)	Polymicrobial	<b>Ampicillin/Sulbactam 3g IV q6h</b>	Ciprofloxacin 400mg IV q12h plus Metronidazole 500mg IV q 6h +/- Vancomycin 1g IV q12h	If multidrug-resistant organisms cultured or suspected, Ertapenem[R] 1g IV q24h OR Piperacillin/tazobactam[R] 4.5g IV q8h.
Mediastinitis	<i>S. aureus</i> , <i>S. epidermidis</i> , Enteric Gram-negatives	Vancomycin 1g IV q12h plus Cefepime[R] 1g IV q8h OR Piperacillin /tazobactam[R] 4.5g IV q8h	Vancomycin 1g IV q12h plus Ciprofloxacin[R] 400mg IV q8h	Candidal mediastinitis is rare <sup>1</sup> . Debridement and subsequent deep sternal wound cultures should guide future therapy.

Diagnosis (Modifying Factors)	Likely Pathogens	Empiric Therapy	Alternative (Severe PCN allergy)	Comments
Diabetic foot  Definitive antibiotic regimen should be based on culture results, images, other investigations, and the initial clinical response	Early: Gram-positives  Late: Gram-positives, Enteric Gram-negatives, <i>Enterobacteriaceae</i> , and anaerobes	<u>Moderate Infection</u> <b>Ampicillin/Sulbactam 3g IV q6h</b> <b>OR Ertapenem[<math>\text{R}</math>] 1g IV q24h<sup>2</sup></b>	<u>Moderate Infection</u> Ciprofloxacin 400mg IV q12h plus Metronidazole 500mg IV q 6h +/- Vancomycin 15mg/kg IV q12h <sup>a</sup>	Culturing clinically uninfected lesions is unnecessary. Superficial cultures are useless.  Infection should be diagnosed clinically based on the presence of purulent secretions, or at least 2 of the cardinal manifestations of inflammation (redness, warmth, swelling or induration, and pain or tenderness).
		<u>Severe Infection</u> <b>Piperacillin/Tazobactam[<math>\text{R}</math>] 4.5g IV q8h</b> <b>OR Ertapenem[<math>\text{R}</math>] 1g IV q24h<sup>2</sup></b> <b>+/- Vancomycin 15mg/kg IV q12h<sup>a</sup></b>	<u>Severe Infection</u> Ciprofloxacin IV q8h plus Metronidazole 500mg IV q 6h +/- Vancomycin 15mg/kg IV q12h <sup>a</sup>	
Bite wounds (cat)	<i>Pasteurella spp.</i> , <i>Streptococcus spp.</i> , <i>Staphylococcus spp.</i> , <i>Fusobacterium spp</i>	<u>Outpatient:</u> <b>Amoxicillin/clavulanate 500mg PO q8h</b> <b>OR Cefuroxime 500mg PO q12h</b>  <u>Inpatient:</u> <b>Ampicillin/sulbactam 1.5g IV q6h</b>	<u>Outpatient:</u> TMP/SMX DS 1 tablet PO q12h OR Doxycycline 100mg PO q12h  <u>Inpatient:</u> Clindamycin 600mg IV q8h PLUS Ciprofloxacin 400mg IV q12h	Length of treatment is shorter for prophylaxis (5 days) vs. active infection (14 days).  Dog bites are usually crush injuries and cat bites are typically puncture wounds.
Bite wounds (human or dog)	<i>S. viridans</i> , <i>S. epidermidis</i> , <i>Corynebacterium spp.</i> , <i>S. aureus</i> , <i>Eikenella corrodens</i> , <i>Capnocytophaga canimorsus</i> (mainly dog)	<u>Outpatient:</u> <b>Amoxicillin/clavulanate 500mg PO q8h</b> <b>OR Cefuroxime 500mg PO q12h</b>  <u>Inpatient:</u> <b>Ampicillin/sulbactam 1.5g IV q6h</b>	<u>Outpatient:</u> <b>Clindamycin 300mg PO q6h PLUS TMP/SMX 1 tablet PO q12h</b> <b>OR</b> <b>Clindamycin 300mg PO q6h PLUS Ciprofloxacin 500mg PO q12h</b>  <u>Inpatient:</u> <b>Clindamycin 600mg IV q8h PLUS Ciprofloxacin 400mg IV q12h</b>	

<sup>1</sup> Clin Infect Dis 1997;25:608-13

<sup>a</sup> For patients in whom methicillin resistant *S. aureus* infection is proven or likely.

<sup>2</sup> Lancet 2005;366:1695-1703.

## ANTIBIOTIC RECOMMENDATIONS IN MENINGITIS<sup>5</sup>

Diagnosis (Modifying Factors)	Likely Pathogens	Empiric Therapy	Alternative (Severe PCN allergy)	Comments
Meningitis (Adults >18 y/o and ≤ 50 y/o)	<i>S. pneumoniae</i> , Meningococcus	Ceftriaxone[R] 2g IV q12h plus Vancomycin <sup>†</sup> 20mg/kg IV x 1, then 15mg/kg IV q8-12h <b>AND see comment column</b>	TMP/SMX 15-20mg/kg/day IV divided q6-8h plus Vancomycin <sup>†</sup> 20mg/kg IV x 1, then 15mg/kg IV q8-12h <b>AND see comment column</b>	Add dexamethasone 0.15mg/kg IV q6h x 4days with the first dose administered 10–20 minutes before, or at least concomitant with, the first dose of antimicrobial therapy. <sup>2</sup> Do not add dexamethasone if the patient is in septic shock. If the CSF culture grows an organism other than <i>S. pneumoniae</i> , d/c the dexamethasone.
Meningitis (>50y/o)	<i>S. pneumoniae</i> , <i>Listeria</i> , Gram-negative bacilli	Ceftriaxone[R] 2g IV q12h plus Ampicillin 2g IV q4h plus Vancomycin <sup>†</sup> 20mg/kg IV x 1, then 15mg/kg IV q8-12h	TMP/SMX 15-20mg/kg/day IV divided q6-8h plus Vancomycin <sup>†</sup> 20mg/kg IV x 1, then 15mg/kg IV q8-12h	An aminoglycoside or TMP/SMX may be added for synergy with ampicillin in <i>Listeria</i> meningitis. However, due to the minimal penetration into the meninges, the utility of aminoglycosides in this situation is debatable. <sup>1</sup>
Head trauma				
• Basilar skull fracture	<i>S. pneumoniae</i> , <i>H. influenzae</i> , group A beta-hemolytic streptococci	Ceftriaxone[R] 2g IV q12h plus Vancomycin <sup>†</sup> 20mg/kg IV x 1, then 15mg/kg IV q8-12h	Ciprofloxacin[R] 400mg IV q8h OR Aztreonam[R] 2g IV q8h PLUS Vancomycin <sup>†</sup> 20mg/kg IV x 1, then 15mg/kg IV q8-12h	Consider Infectious Diseases Consult
• Penetrating Trauma	<i>S. aureus</i> , coagulase-negative staphylococci, aerobic gram-negative bacilli (including <i>P. aeruginosa</i> )	Cefepime[R] 2g IV q8h plus Vancomycin <sup>†</sup> 20mg/kg IV x 1, then 15mg/kg IV q8-12h	Ciprofloxacin[R] 400mg IV q8h OR Aztreonam[R] 2g IV q8h PLUS Vancomycin <sup>†</sup> 20mg/kg IV x 1, then 15mg/kg IV q8-12h	Consider Infectious Diseases Consult
Post neurosurgery or CSF shunt	Aerobic gram-negative bacilli (including <i>P. aeruginosa</i> ), <i>S. aureus</i> , coagulase-negative staphylococci	Cefepime[R] 2g IV q8h plus Vancomycin <sup>†</sup> 20mg/kg IV x 1, then 15mg/kg IV q8-12h	Ciprofloxacin[R] 400mg IV q8h OR Aztreonam[R] 2g IV q8h PLUS Vancomycin <sup>†</sup> 20mg/kg IV x 1, then 15mg/kg IV q8-12h	Consider Infectious Diseases Consult

<sup>5</sup> *New Engl J Med* 1997;336:708-16, *Clin Infect Dis* 2004;39:1267-84

<sup>†</sup> Vancomycin Troughs should be targeted at 15-20mg/L. Round Vancomycin doses to the nearest 500mg

<sup>1</sup> *Eur J Clin Microbial Infect Dis* 1990;9:206-9

<sup>2</sup> *New Engl J Med* 2002;347:1549-56

## ANTIBIOTIC RECOMMENDATIONS IN ENDOCARDITIS<sup>5</sup>

Pathogen specific	Diagnosis (Modifying Factors)	Targeted therapy	Alternative (Severe PCN allergy)	Comments
Penicillin susceptible viridans streptococci, <i>S. bovis</i> , other streptococci with an MIC to pcn $\leq$ 0.12mcg/ml	Endocarditis (native valve)	Penicillin G 12-18 Million Units IV either as a continuous infusion or in 4 or 6 equally divided doses OR Ceftriaxone[R] 2g IV q24h for 4 weeks OR Penicillin G 12-18 million units IV divided q6h PLUS Gentamicin 1mg/kg IV q8h x 2 weeks	Vancomycin <sup>†</sup> 15mg/kg IV q12h for 4 weeks (Consider Infectious Diseases consult for desensitization.)	Penicillin G can be compounded as a 24h infusion for efficacy/ convenience in outpatient scenarios. See footnote 3 at end of endocarditis section for additional information on Gentamicin dosing.
	Endocarditis (prosthetic valve)	Penicillin G 24 Million Units IV either as a continuous infusion over 24 hours, or in 4 or 6 equally divided doses OR Ceftriaxone[R] 2g IV q24h for 6 weeks, +/- Gentamicin 1mg/kg IV q8h x 2 weeks	Vancomycin <sup>†</sup> 15mg/kg IV q12h for 6 weeks plus Gentamicin 1mg/kg IV q8h x 2 weeks (Consider Infectious Diseases consult for desensitization.)	Adjust gentamicin for renal insufficiency. Targeted peaks 3-4mcg/ml; targeted troughs < 1mcg/ml. See footnote 3 at end of endocarditis section for additional information on gentamicin dosing.
Streptococci with penicillin MIC > 0.12mcg/ml and < 0.5 mcg/ml	Endocarditis (native valve)	Penicillin G 24 Million Units IV either as a continuous infusion over 24 hours, or in 4 or 6 equally divided doses OR Ceftriaxone[R] 2g IV q24h for 4 weeks, plus Gentamicin 1mg/kg IV q8h x 2 weeks	Vancomycin <sup>†</sup> 15mg/kg IV q12h for 4 weeks plus Gentamicin 1mg/kg IV q8h x 2 weeks (Consider Infectious Diseases consult for desensitization.)	Adjust gentamicin for renal insufficiency. Targeted peaks 3-4mcg/ml; targeted troughs < 1mcg/ml. See footnote 3 at end of endocarditis section for additional information on gentamicin dosing.
	Endocarditis (prosthetic valve)	Penicillin G 24 Million Units IV either as a continuous infusion over 24 hours, or in 4 or 6 equally divided doses OR Ceftriaxone[R] 2g IV q24h for 6 weeks, plus Gentamicin 1mg/kg IV q8h x 6 weeks	Vancomycin <sup>†</sup> 15mg/kg IV q12h for 6 weeks plus Gentamicin 1mg/kg IV q8h x 6 weeks (Consider Infectious Diseases consult for desensitization.)	Adjust gentamicin for renal insufficiency. Targeted peaks 3-4mcg/ml; targeted troughs < 1mcg/ml. See footnote 3 at end of endocarditis section for additional information on gentamicin dosing.

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**ANTIBIOTIC RECOMMENDATIONS IN ENDOCARDITIS<sup>§</sup> (CONTINUED)**

Pathogen specific	Diagnosis (Modifying Factors)	Targeted therapy	Alternative (Severe PCN allergy)	Comments
Streptococci with MIC $\geq$ 0.5mcg/ml, and Enterococci susceptible to ampicillin/penicillin G, vancomycin, and gentamicin	Endocarditis (native valve)	Penicillin G 18-30 Million Units IV either as a continuous infusion over 24 hours, or in 6 equally divided doses OR Ampicillin 12g IV q24h in 6 equally divided doses for 4-6 weeks (see comment) <b>PLUS</b> Gentamicin 1mg/kg IV q8h x 4-6 weeks (see comment)	Vancomycin <sup>†</sup> 15-20mg/kg IV q12h PLUS Gentamicin 1mg/kg IV q8h x 4-6 weeks (Consider Infectious Diseases consult for desensitization.)	4 week therapy recommended for patients with symptoms of illness $\leq$ 3 months; 6 weeks therapy recommended for patients with symptoms > 3 months. Adjust gentamicin for renal insufficiency. Targeted peaks 3-4mcg/ml; targeted troughs < 1mcg/ml.
	Endocarditis (prosthetic valve)	Penicillin G 18-30 Million Units IV either as a continuous infusion over 24 hours, or in 6 equally divided doses OR Ampicillin 12g IV q24h in 6 equally divided doses for 6 weeks, <b>PLUS</b> Gentamicin 1mg/kg IV q8h x 6 weeks	Vancomycin <sup>†</sup> 15-20mg/kg IV q12h PLUS Gentamicin 1mg/kg IV q8h x 6 weeks (Consider Infectious Diseases consult for desensitization.)	Minimum of 6 weeks of therapy recommended. Adjust gentamicin for renal insufficiency. Targeted peaks 3-4mcg/ml; targeted troughs < 1mcg/ml.
<i>Enterococcus</i> spp. resistant to penicillin and ampicillin, yet susceptible to vancomycin and gentamicin	Endocarditis (native or prosthetic valve)	Vancomycin <sup>†</sup> 15-20mg/kg IV q12h PLUS gentamicin 1mg/kg IV q8h x 6 weeks (See comment)	If true vancomycin allergy, consult infectious diseases for appropriate alternatives.	Consider Infectious Diseases consultation. Adjust gentamicin for renal insufficiency. Target peaks 3-4mcg/ml; targets troughs < 1mcg/ml.
<i>Enterococcus</i> spp. resistant to penicillin, ampicillin, and gentamicin; susceptible only to vancomycin	Endocarditis (native or prosthetic valve)	Vancomycin <sup>†</sup> 15-20mg/kg IV q12h PLUS streptomycin 7.5mg/kg (Max streptomycin dose 1g) IV q12h x 6 weeks (See comment)	If true vancomycin allergy, consult infectious diseases for appropriate alternatives.	Consider Infectious Diseases consultation. Adjust streptomycin for renal insufficiency. Target troughs <5mcg/ml. Call AMP when considering streptomycin.
<i>Enterococcus</i> spp. resistant to penicillin, ampicillin and vancomycin	Infectious Diseases consultation recommended as therapy options and data are limited.			

MSSA	Endocarditis (native valve)	<b>Nafcillin OR Oxacillin 12g IV either as a continuous infusion over 24 hours, or in 4 equally divided doses for 6 weeks PLUS Gentamicin 1mg/kg IV q8h for the first 3-5 days of therapy</b>	Daptomycin[R] 6mg/kg IV q24h x 4-6 weeks OR Vancomycin <sup>1</sup> 15-20 mg/kg IV Q12h x 6 weeks PLUS Gentamicin 1mg/kg q8h IV for the first 3-5 days of therapy	Daptomycin therapy does not require concomitant aminoglycoside therapy. Adjust gentamicin for renal insufficiency. Targeted peaks 3-4mcg/ml; targeted troughs < 1mcg/ml.
	Endocarditis (prosthetic valve)	<b>Nafcillin OR Oxacillin 12g IV either as a continuous infusion over 24 hours, or in 4 equally divided doses for at least 6 weeks PLUS Rifampin 300 mg IV/PO q8h for at least 6 weeks plus Gentamicin 1mg/kg IV q8h for 2 weeks</b>	Vancomycin <sup>1</sup> 15-20mg/kg IV q12h plus Rifampin 200 mg PO q8h for 6 weeks PLUS Gentamicin 1mg/kg IV q8h x 2 weeks (Consider Infections Diseases consult for desensitization).	Adjust gentamicin for renal insufficiency. Targeted peaks 3-4mcg/ml; targeted troughs < 1mcg/ml.
	Endocarditis (Tricuspid valve and IV drug user) Native valve only	<b>Nafcillin 2g IV q4h PLUS Gentamicin for 2 weeks (See note below, page 27)</b>	Consider Infectious Diseases consult for desensitization.) OR Daptomycin 6mg/kg IV q24h x 14-28 days	Isolate must be gentamicin and methicillin susceptible. Several exceptions exist <sup>1</sup> .

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## ANTIBIOTIC RECOMMENDATIONS IN ENDOCARDITIS<sup>§</sup> (CONTINUED)

Pathogen specific	Diagnosis (Modifying Factors)	Targeted therapy	Alternative (Severe PCN allergy)	Comments
MRSA	Endocarditis (native valve)	Vancomycin <sup>†</sup> 15-20mg/kg q12h x 6 weeks +/- Gentamicin 1mg/kg IV q8h x 3-5 days	Daptomycin[ <b>R</b> ] 6mg/kg IV q24h x 4-6 weeks OR Vancomycin <sup>†</sup> 15mg/kg IV q12h x 6 weeks +/- Gentamicin 1mg/kg IV q8h x 3-5 days	Daptomycin therapy does not require concomitant aminoglycoside therapy Adjust gentamicin for renal insufficiency. Targeted gentamicin peaks 3-4mcg/ml; targeted troughs < 1mcg/ml.
	Endocarditis (prosthetic valve)	Vancomycin <sup>†</sup> 15-20mg/kg q12h PLUS Rifampin 300mg po q8h for at least 6 weeks PLUS Gentamicin 1mg/kg IV q8h x 2 weeks	Vancomycin <sup>†</sup> 15-20mg/kg IV q12h plus Rifampin 300mg PO q8h for 6 weeks plus Gentamicin 1mg/kg IV q8h x 2 weeks	Adjust gentamicin for renal insufficiency. Targeted gentamicin peaks 3-4mcg/ml; targeted troughs < 1mcg/ml.
HACEK Organisms <sup>2</sup>	Endocarditis (native valve)	Ceftriaxone[ <b>R</b> ] 2g IV q24h x 4 weeks	Consult Infectious Diseases	Desensitization may be necessary in patients with severe PCN allergy.
	Endocarditis (prosthetic valve)	Ceftriaxone[ <b>R</b> ] 2q IV q24h x 4 weeks	Consult Infectious Diseases	Desensitization may be necessary in patients with severe PCN allergy.
Gram-negative	Endocarditis (native or prosthetic valve)	Consult Infectious Diseases	Consult Infectious Diseases	

<sup>§</sup> *N Engl J Med* 2001;345:1318-30

<sup>†</sup> Vancomycin troughs should be targeted at 15-20mg/L.

<sup>1</sup> Exceptions include: Cardiac or extra-cardiac complications associated with infective endocarditis; fever persistence for > 7 days; concomitant HIV infection. Patients with vegetation > 1-2 cm by echocardiography are of probable exclusion.

<sup>2</sup> HACEK organisms include: *Haemophilus aphrophilus*; *Haemophilus parainfluenzae*; *Actinobacillus actinomycetemcomitans*; *Cardiobacterium hominis*; *Eikenella corrodens*; *Kingella kingae*.

Note: Penicillin, ampicillin, and nafcillin can be given as a continuous infusion (CI) to maximize efficacy. Please contact the antibiotic team for an appropriate CI dose for penicillin or ampicillin.

## ANTIBIOTIC RECOMMENDATIONS IN URINARY TRACT INFECTIONS

Diagnosis (Modifying Factors)	Likely Pathogens	Empiric therapy	Restricted Alternative (Severe PCN & SULFA allergy)	Comments
Acute Uncomplicated Bacterial Cystitis/Urethritis (young women with structurally & neurologically normal urinary tract)	<i>E. coli</i> (~85%), <i>S. saprophyticus</i> (10-15%), enterococci and other <i>Enterobacteriaceae</i>	<sup>1,2,3</sup> TMP/SMX DS (160-800 mg) PO q12h x 3d OR TMP 200 PO q12h x 3d OR Nitrofurantoin, macrocrystals 100 PO q12h x 7d (CrCl ≥ 60 ml/min) OR <sup>5</sup> Cefuroxime axetil 250 mg PO q12h x 7d OR Amoxicillin/clavulanic acid 500mg/125mg PO q12h x 7d	Ciprofloxacin[R] 250 mg PO q12h x 3d (Nitrofurantoin is a good option in patients allergic to beta-lactams and sulfa)	- Do not use 3 day treatment in pregnancy or sulfonamides in late pregnancy. - 3 day treatment is not recommended in men or if nitrofurantoin is used.
Acute Uncomplicated Bacterial Pyelonephritis (mild-moderate symptoms, outpatient)	<i>E. coli</i> (~85%), <i>S. saprophyticus</i> (10-15%), enterococci and other <i>Enterobacteriaceae</i>	<sup>1,2,3</sup> TMP/SMX DS (160-800 mg) PO q12h x 10-14d OR <sup>5</sup> Cefuroxime axetil 250 mg PO q12h x 10-14d OR Amoxicillin/clavulanic acid 500mg/125mg PO q12h x 10-14d	Ciprofloxacin[R] 500 mg PO q12h x 7d	- For suspected Gram- positive infections, use amoxicillin/clavulanic acid.
Acute Uncomplicated Bacterial Pyelonephritis (severe symptoms, hospitalized)	<i>E. coli</i> (~85%), enterococci and other <i>Enterobacteriaceae</i>	Ciprofloxacin[R] 400 mg IV q12h	1,2,4Gentamicin (see aminoglycoside dosing section) + Ampicillin 2 g IV q6h OR TMP/SMX 3 mg/kg (TMP component) IV q12h OR Ampicillin/subactam 1.5g IV q6h	- Total treatment is 14 days. - Change to PO therapy (based on culture and susceptibility) with signs of clinical improvement (usually 48 to 72 hours). - For suspected Gram-positive infections, use ampicillin or ampicillin/subactam ± aminoglycoside.

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**ANTIBIOTIC RECOMMENDATIONS IN URINARY TRACT INFECTIONS (CONTINUED)**

Diagnosis (Modifying Factors)	Likely Pathogens	Empiric therapy	Restricted Alternative (Severe PCN & SULFA allergy)	Comments
<p>Complicated Bacterial UTI (urinary tract abnormalities)</p> <p>Differentiate colonization versus infection based on the following criteria:</p> <p>1.) Lack of pyuria (&lt; 10 WBCs in the urinalysis)</p> <p>2.) Presence of epithelial cells</p> <p>3.) Multiple organisms</p>	<p><i>Enterobacteriaceae</i>, <i>P. aeruginosa</i>, enterococci, Group B streptococci</p>	<p><sup>4</sup>Gentamicin (see aminoglycoside dosing) + Ampicillin 2 g IV q6h OR TMP/SMX 3 mg/kg (TMP component) IV q8h OR Ampicillin/sulbactam 1.5g IV q6h OR cefuroxime sodium 750mg IV q8h</p> <p><u>Oral Options:</u> TMP/SMX DS (160-800 mg) PO q12h OR Amoxicillin/clavulanic acid 500mg/125mg PO q12h OR Cefuroxime axetil 250 mg PO q12h</p>	<p>Ciprofloxacin[R] 400 mg IV q12h</p> <p>Oral Options: Ciprofloxacin[R] 500 mg PO q12h</p>	<ul style="list-style-type: none"> <li>- Total treatment is 14 days.</li> <li>- Agents listed may not have activity against <i>Pseudomonas</i> spp.</li> <li>- Streamline therapy based on culture and susceptibility.</li> <li>- Change to PO therapy upon signs of clinical improvement (usually 48 to 72 hours).</li> <li>- For suspected Gram-positive infections, use ampicillin or ampicillin/sulbactam ± aminoglycoside.</li> <li>- For males, suspect prostatitis if recurrence.</li> </ul>

<sup>1</sup> *Clin Infect Dis* 1999; 29:745-758.;

<sup>2</sup> *N Engl J Med* 2003; 349:259-266.;

<sup>3</sup> *JAMA* 1995; 273:41-45.;

<sup>4</sup> *AJM* 113(Suppl. 1A): 1S-44S.;

<sup>5</sup> *Drugs Exp Clin Res* 1987;13:95-99.;

<sup>6</sup> *JAMA* 2000;28: 1583-1590;TMP/SMX

DS = trimethoprim/sulfamethoxazole double strength; TMP = trimethoprim; nitrofurantoin macrocrystals = Macrobid

## EMPIRIC TREATMENT GUIDELINES FOR CANDIDIASIS<sup>‡</sup>

Infection / Modifying Factors	Primary	Alternative(s)	Duration	Comments
<b>Candidemia</b> Non-neutropenic adults <ul style="list-style-type: none"> <li>• clinically stable</li> <li>• no recent receipt of azoles</li> <li>• no recent abdominal surgery</li> </ul>	Fluconazole 800mg loading dose IV x 1, then Fluconazole ≥ 6 mg/kg IV q24h (400 mg IV q24h for 70 kg patient) OR Caspofungin[R] 70mg IV x1, then 50 mg q24h	Amphotericin B deoxycholate 0.6mg/kg q24h OR (Abelcet™)[R] 3 mg/kg q24h	14 days after last positive blood culture and resolution of signs/symptoms	<ul style="list-style-type: none"> <li>• Remove IV catheters if possible.</li> <li>• All patients should undergo ophthalmological exam to exclude possible endophthalmitis.</li> <li>• Ampho B or Caspofungin may be switched to IV/PO Fluconazole to complete treatment course in patients with a Candida isolate routinely susceptible to Fluconazole.</li> </ul>
Non-neutropenic Adults <ul style="list-style-type: none"> <li>• clinically unstable</li> <li>• recent receipt of azoles</li> <li>• recent abdominal surgery</li> </ul>	Caspofungin[R] 70mg IV x1, then 50 mg q24h. De-escalate to fluconazole if: 1) clinically stable; 2) not <i>Candida krusei</i> ; 3) Candida is S or S-DD to fluconazole	Ampho B 0.6 mg/kg IV q24h or Abelcet[R] 3 mg/kg IV q24h. De-escalate to fluconazole if: 1) clinically stable; 2) not <i>Candida krusei</i> ; 3) Candida is S or S-DD to fluconazole	14 days after last positive blood culture and resolution of signs/symptoms	<ul style="list-style-type: none"> <li>• Persistence of candidemia despite antifungal treatment suggests infected intravascular device, significant immunosuppression or microbiological resistance.</li> <li>• Patients on Ampho B should receive hydration.</li> <li>• Anidulafungin and micafungin are currently nonformulary, but are considered therapeutically interchangeable with caspofungin.</li> </ul>
<b>Intra-abdominal Candidiasis</b>	Fluconazole 6 mg/kg IV q24h (400 mg IV/PO q24h for 70 kg patient) OR Caspofungin[R] 70mg IV x1, then 50 mg q24h.	Ampho B 0.6 mg/kg IV q24h or Abelcet[R] 3 mg/kg IV q24h.	2-3 weeks	<ul style="list-style-type: none"> <li>• Intraperitoneal AmphoB should be avoided due to painful peritonitis.</li> </ul>
<b>Endocarditis</b>	(Consult Infectious Diseases) AmphoB 0.6-1.0 mg/kg IV q24h plus Flucytosine 25 mg/kg PO q6h* OR (Abelcet™)[R] 5 mg/kg IV q24h plus Flucytosine 25 mg/kg PO q6h* See note in comment section	Caspofungin[R] 70mg IV x1, then 50 mg q24h± fluconazole 400 mg IV q24h	At least 6 weeks after valve replacement	Fluconazole 200-400 mg PO q24h might be used to prevent recurrence, especially when valve surgery is not recommended.

<sup>‡</sup>Valve surgery is strongly recommended.

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EMPIRIC TREATMENT GUIDELINES FOR CANDIDIASIS<sup>†</sup> (CONTINUED)

Infection / Modifying Factors	Primary	Alternative(s)	Duration	Comments
<b>Endophthalmitis</b> • Maximum tolerable drug dosages should be utilized.	<b>AmphoB 0.6-1.0 mg/kg IV q24h</b> OR <b>Fluconazole 6–12 mg/kg IV/PO q24h</b>	<b>(Abelcet™) [R] 5 mg/kg IV q24h</b> (consider increase to 10mg/kg if no response)	6-12 weeks until complete resolution of visible disease	Ophthalmology and Infectious Diseases Consult. Consider intravitreal therapy.
<b>Meningitis</b> • Maximum tolerable drug dosages should be utilized.	<b>(Consult Infectious Diseases)</b> <b>AmphoB 0.7 -1.0 mg/kg IV q24h plus Flucytosine 25mg/kg PO q6h;</b> Request consultation for flucytosine dosage adjustment in renal failure	Consult Infectious Diseases	minimum of 4 weeks after resolution of all signs and symptoms associated with infection	<ul style="list-style-type: none"> <li>• Check flucytosine level if &gt; 2 weeks of therapy or with renal insufficiency. Keep peak serum concentration between 40-60mcg/ml.</li> <li>• Candida meningitis associated with neurosurgical procedures should include removal of prosthetic devices.</li> </ul>
<b>Mucocutaneous candidiasis</b> Oropharyngeal ("Thrush")	<b>Clotrimazole troche (10mg) PO 5 times/day;</b> OR Nystatin 200,000-400,000 Units PO 5 times/day; OR Fluconazole 200 mg loading dose x 1, then 100mg PO q24h	<b>Itraconazole oral solution 200 mg PO q24h</b> <u>Refractory Disease:</u> AmphoB > 0.3 mg/kg IV q24h OR Caspofungin [R] 50 mg IV q24h (reduce maintenance dose to 35mg IV q24h for moderate hepatic	7-14 days after clinical improvement	<ul style="list-style-type: none"> <li>• Most patients respond initially to topical therapy, but relapses occur sooner with topical therapy.</li> <li>• Recurrent infections are common in patients with immunosuppression, especially AIDS.</li> <li>• Resistance may develop with either topical or systemic therapy.</li> </ul>

Infection / Modifying Factors	Primary	Alternative(s)	Duration	Comments
Esophageal	Fluconazole 100-200 mg IV/PO q24h	Itraconazole solution 200 mg PO/IV q24h or voriconazole <sup>(R)</sup> 200 mg PO/IV q24h Refractory Disease AmphoB 0.3-0.7 mg/kg IV q24h;OR Capofungin <sup>(R)</sup> 50 mg IV q24h reduce maintenance dose to 35mg IV for moderate hepatic insufficiency	14-21 days after clinical improvement	<ul style="list-style-type: none"> <li>• Recurrent infections are observed more commonly in patients treated with an echinocandin agent.</li> </ul>
Urinary Candidiasis	Treatment indicated only in symptomatic patients, renal transplant patients, neutropenic patients, and in those who will soon undergo surgical manipulation of the urinary tract, independent of the U/A results. For patients w/ urinary catheter in place, remove or replace the catheter. In patients meeting the above criteria, Fluconazole 200 mgPO or IV q24h.	AmphoB 0.3-1 mg/kg IV q24h	7-14 days	<ul style="list-style-type: none"> <li>• Neither capofungin nor voriconazole have good urinary tract penetration and should not be used for UTI.</li> <li>• Do not treat asymptomatic candiduria in non-neutropenic, catheterized patients.</li> <li>• Removal of urinary devices is often helpful.</li> <li>• If removal of a device is not possible, replacement is beneficial.</li> </ul>
Vaginal Candidiasis Uncomplicated (mild to moderate severity, sporadic frequency, normal host, presumed pathogen <i>C. albicans</i> )	Fluconazole 150 mg PO x 1 dose	Topical over-the-counter azoles; butoconazole, clotrimazole, miconazole, tioconazole, terconazole	1-7 days depending upon chosen regimen	<ul style="list-style-type: none"> <li>• ~ 90% of cases are uncomplicated.</li> </ul>

<sup>1</sup> adapted from IDSA Guideline for treatment of candidiasis. Clin Infect Dis 2004; 3:161-89.

AmphoB = amphotericin B deoxycholate; (Abelcet™) should be considered in patients based on the following: intolerant to conventional amphotericin B deoxycholate; infection refractory to conventional amphotericin B deoxycholate (≥ 500 mg); initial renal insufficiency (SCR ≥ 2.5 mg/dl or CrCl < 25 ml/min; a significant increase in SCR (up to 2.5 mg/dl); severe, acute administration related toxicity.

## ANTIFUNGAL RECOMMENDATIONS IN SYSTEMIC FUNGAL INFECTIONS

Infection / Modifying Factors	Primary	Alternative(s)	Duration	Comments
Allergic Bronchopulmonary Aspergillosis	<sup>1,2</sup> Corticosteroids	<sup>2</sup> Itraconazole oral solution 200 PO q12h (steroid-sparing regimen)		
Aspergilloma	No therapy or surgical resection			<ul style="list-style-type: none"> <li><sup>1</sup>Voriconazole was shown to be superior to Ampho B as initial therapy for invasive aspergillosis in terms of response rate, survival rate, and safety.</li> <li>Voriconazole dosing for mild to moderate hepatic cirrhosis (Child-Pugh Class A and B): 6 mg/kg IV q12h x 2 doses, then 2 mg/kg IV q12h ; Oral dosing: 100 mg PO q12h (&gt; 40 kg) and 50 mg PO q12h (&lt; 40 kg).</li> <li>Do not use voriconazole in severe cirrhosis unless the benefit outweighs the risk.</li> <li>Caspofungin is not FDA-approved for initial treatment of invasive aspergillosis, but only in refractory patients or those intolerant to other therapies.</li> <li>Check voriconazole level after 2 weeks, and keep level - 1 mcg/mL</li> </ul>
Invasive aspergillosis (pulmonary, extra-pulmonary)	<p>(Please see note at end of table on pg. 38)</p> <p>Voriconazole 6 mg/kg IV q12h x 2 doses, then 4 mg/kg IV q12 h x at least 7 days; convert to PO as soon as possible<sup>1</sup>; 200 mg PO q12h (&gt; 40kg) and 100 mg PO q12h (&lt; 40 kg); The dose must be adjusted for mild to moderate hepatic cirrhosis (see comments)</p>	<p>Abelcet[<b>R</b>] 5 mg/kg IV q24 or caspofungin[<b>R</b>] 70 mg IV then 50 mg IV q24h</p>		
<sup>5</sup> Blastomycosis Pulmonary infection and extra-CNS disease	(Please see note at end of table on page 38)	<p><u>Severe:</u> Abelcet[<b>R</b>] 5 mg/kg IV q24h</p>	<p><u>Severe:</u> ≥ 6 months</p>	

<sup>1</sup>Therapy can be switched to PO before 7 days is completed at 4mg/kg. Complete the 7 day duration at 4mg/kg PO then switch dose to 200mg PO BID.

Infection / Modifying Factors	Primary	Alternative(s)	Duration	Comments
Blastomycosis, Pulmonary Infection and extra-CNS disease	<p><u>Severe:</u> Ampho B 0.7-1.0 mg/kg IV q24h, until stable/improved then itraconazole<sup>1</sup> 200 mg PO/IV q8h x3 days, then 200-400 mg PO q24h</p> <p><u>Mild-Moderate:</u> Itraconazole<sup>1</sup> 200 mg PO/IV q 8h x 3 days, then 200-400 mg PO q24h</p>	<p><u>Mild-Moderate:</u> Fluconazole 400-800 mg PO q24h or ketoconazole 400-800 mg PO q24h</p>	<p><u>Mild-Moderate:</u> ≥ 6 months</p>	<p>(Please see note at end of table on page 38)</p> <ul style="list-style-type: none"> <li>The primary treatment course of Ampho B should be followed with suppressive therapy in immunosuppressed patients.</li> </ul>
Blastomycosis, CNS disease	<p>(Please see note at end of table on page 38) AmphoB 0.7-1.0 mg/kg IV q24h</p>	<p>Abelcet[<b>R</b>] 5 mg/kg IV q24h</p>	<p>≥ 4 weeks (or total dose &gt; 2g)</p>	
Candidiasis	<i>See Empiric Treatment Guidelines for Candidiasis section</i>			
Coccidioidomycosis Pulmonary and extra-CNS disease	<p>(Please see note at end of table on page 38)</p> <p><u>Severe:</u> Ampho B 0.7-1 mg/kg IV q24h until stable/improved, then itraconazole<sup>1</sup> 200 mg PO/IV q 8h x 3 days, then 200 mg PO q12h or fluconazole 400 mg PO q24h</p>	<p><u>Severe:</u> Abelcet[<b>R</b>] 5 mg/kg IV q24h</p> <p><u>Moderate to Severe:</u> Ampho B 0.5-0.7 mg/kg IV q24h</p>	<p><u>Severe:</u> ≥ 1 year</p> <p><u>Moderate to Severe:</u> 3-6 months</p>	<p>For acute pulmonary infection, treatment is indicated only for patients with immunosuppression, 3rd trimester pregnancy, or severe disease (weight loss 10%, intense night sweats &gt; 3 weeks), infiltrates &gt; ½ lung, CF titer &gt; 1:16, prominent or</p>

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## ANTIFUNGAL RECOMMENDATIONS IN SYSTEMIC FUNGAL INFECTIONS (CONTINUED)

Infection / Modifying Factors	Primary	Alternative(s)	Duration	Comments
	<p><b>Moderate to Severe:</b> Itraconazole<sup>1</sup> 200 mg PO/IV q8h x 3 days, then 200 mg PO q12h or fluconazole 400 mg PO q24h</p>	<p><b>Moderate to Severe:</b> Ampho B 0.5-0.7 mg/kg IV q24h</p>	<p><b>Moderate to Severe:</b> 3-6 months</p>	<p>persistent hilar adenopathy.</p> <p>ARDS presentation: give concomitant prednisone 60-80 mg/d PO until improved then taper.</p> <p>In pregnancy use ampho B 0.5-0.7 mg/kg IV q24</p>
Coccidioidomycosis CNS disease	<p>(Please see note at end of table on page 38)</p> <p>Fluconazole 400-800 mg IV/PO q24h until improved then fluconazole 400 mg q24h PO lifelong</p>	<p>Intrathecal ampho B 0.01-1.5 mg</p> <p>Itraconazole<sup>1</sup> 200 mg IV/PO q8h x 3 days, then 400-600 mg q24h</p>		<p>(Please see note at end of table on page 38)</p>
Cryptococcosis Pulmonary disease	<p>(Please see note at end of table on page 38)</p> <p><b>Severe:</b> Ampho B 0.7-1.0 mg/kg IV q24h until improved, then fluconazole 400 mg PO q24h</p> <p><b>Mild to Moderate<sup>2</sup>:</b> Fluconazole 400 mg PO q24h</p>	<p><b>Severe:</b> Ablecet[®] 5 mg/kg IV q24h then fluconazole 400 mg PO q24h or itraconazole<sup>1</sup> 200 mg IV/PO q24h</p> <p><b>Mild to Moderate:</b> Itraconazole<sup>1</sup> 200-400 mg q24h</p>	<p><b>Severe:</b> 6-12 months</p> <p><b>Mild to Moderate:</b> 6-12 months</p>	<ul style="list-style-type: none"> <li>• Lumbar puncture should be performed to rule out CNS involvement (exception: normal host with asymptomatic nodule(s), no CNS symptoms, and low or absent serum cryptococcal antigen).</li> <li>• All immunosuppressed patients with pulmonary cryptococcosis should be treated.</li> </ul>

Infection / Modifying Factors	Primary	Alternative(s)	Duration	Comments
Cryptococcosis (meningoencephalitis)	<p>(Please see note at end of table on page 38)</p> <ul style="list-style-type: none"> <li>• <b>HIV-infected patients:</b> <b>Induction:</b> Ampho B 0.7 mg/kg IV q24h + flucytosine 25 mg/kg PO q6h x weeks, then fluconazole 400 mg PO q24h x 8 weeks <b>Maintenance:</b> Fluconazole 200 mg PO q24h</li> <li>• <b>Transplant patients:</b> <b>Induction:</b> Ampho B 0.7 mg/kg IV q24h (or Abelcet[®] 5 mg/kg IV q24h) + flucytosine 25 mg/kg PO qid x 2 weeks, then fluconazole 400-800 mg/d x 8 weeks. <b>Maintenance:</b> Fluconazole 200 mg PO q24h</li> <li>• <b>Non-HIV and non-transplant patients:</b> <b>Induction:</b> Ampho B ≥0.7 mg/kg IV q24h + flucytosine 25 mg/kg PO q6h x 4-6 weeks, then fluconazole 400 mg PO q24 h x 8 weeks. <b>Maintenance:</b> Fluconazole 200 mg POq 24 h</li> </ul>	<ul style="list-style-type: none"> <li>• <b>HIV-infected patients:</b> <b>Induction:</b> Abelcet[®] 5 mg/kg IV q24h then fluconazole 400 mg PO q24h <b>Maintenance:</b> Itraconazole<sup>1</sup> 200-400 MG PO q24h or ampho B 1 mg/kg IV 3x/week</li> <li><b>Transplant patients:</b> <b>Induction:</b> Ampho B 0.7 mg/kg IV q24h (or Abelcet[®] 5 mg/kg IV q24h x 4 weeks, then fluconazole 400-800 mg/d x weeks. <b>Maintenance:</b> Itraconazole<sup>1</sup> 200-400 mg PO q24h</li> <li>• <b>Non-HIV and non-transplant patients:</b> <b>Induction:</b> Abelcet[®] 5 mg/kg q24h + flucytosine 25 mg/kg PO q6h x ≥ 4 weeks, then fluconazole 400 mg PO q24h x 8 weeks, then fluconazole 200 mg PO q24h x 6 months to 1 year. <b>Maintenance:</b> Itraconazole<sup>1</sup> 200-400 mg PO q24h</li> </ul>	<ul style="list-style-type: none"> <li>• <b>HIV-infected patients:</b> <b>Maintenance:</b> 1 year minimum. Antifungal therapy can be discontinued after introduction of HAART and achievement of CD<sub>4</sub> count ≥ 100 cells/mcg/ml for ≥ 3 months <b>Maintenance:</b> 6 month to 1 year</li> <li>• <b>Non-HIV and non-transplant patients:</b> <b>Maintenance:</b> 6 month to 1 year</li> </ul>	Begin HAART 4-10 weeks after start of initial antifungal treatment.

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## ANTIFUNGAL RECOMMENDATIONS IN SYSTEMIC FUNGAL INFECTIONS (CONTINUED)

Infection / Modifying Factors	Primary	Alternative(s)	Duration	Comments
Histoplasmosis (Pulmonary and disseminated)	<p>(Please see note at end of table on page 38)</p> <p><b>Severe:</b> Ampho B 0.7-1.0 mg/kg IV q24h until stable/improved, then itraconazole<sup>1</sup> 200 mg PO q8h x 3 days, then 200 mg PO q12h</p> <p><b>Mild to Moderate Disease:</b> Itraconazole<sup>1</sup> 200 mg PO q8h x 3 days, then 200 mg PO q12h</p>	<p><b>Severe:</b> Abelcet[<b>R</b>] 5 mg/kg IV q24h</p>	<ul style="list-style-type: none"> <li>• 12 weeks for acute pulmonary disease</li> <li>• 12-24 months for chronic pulmonary or disseminated disease.</li> </ul>	Treatment not necessary for mild-to-moderate acute pulmonary histoplasmosis of symptoms of < 1 month duration
Mucormycosis	<p>(Please see note at end of table on page 38)</p> <p>Abelcet[<b>R</b>] 5 mg/kg IV q24h</p>	<p>Abelcet[<b>R</b>] 10 mg/kg q 24h for severe or worsening infection</p> <p>Switch to posaconazole 200 mg PO q6h or 400 mg PO q12h once improved.</p>	≥ 6 months	Surgical debridements, normalization of glucose and blood pH, and minimization of immunosuppressed agents are strongly recommended.

Infection / Modifying Factors	Primary	Alternative(s)	Duration	Comments
Sporotrichosis • Cutaneous	Itraconazole <sup>1</sup> 200 mg PO q24h (or q12h for severe cases)	Terbinafine 500 mg PO bid or SSKI 40-50 gtts q8h	3-6 months	
Sporotrichosis • Deep-seated infection (mild to moderate)	Itraconazole <sup>1</sup> 200 mg PO or IV q8h, then 200 mg q12h	Ampho B 0.7-1.0 mg/kg q24h or Abelcet[®] 5 mg/kg q24h until stable then itraconazole <sup>1</sup> 200 mg PO or IV q8h, then 200 mg q12h	12 months	
Sporotrichosis • Disseminated/ meningeal/severe deep-seated infection	Ampho B 0.7-1.0 mg/kg IV or Abelcet[®] 5 mg/kg q24h IV.	When clinically stable and improved, de-escalate to itraconazole <sup>1</sup> 200 mg PO or IV q8h then 200 mg q12h	12 months	

<sup>1</sup>Check Itraconazole level after 2 weeks and keep levels - 1 ug/ml

<sup>2</sup>Absence of diffuse infiltrates, no severe immunosuppression, and negative work-up for dissemination.

**Note: Due to the rarity and/or complexity of certain fungal infections listed in this table coupled with the often unique patient-specific scenario, please consult Infectious Diseases for expertise in antifungal agent selection, management, and treatment duration.**

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## PRINT-ON-DEMAND FORMS – INFECTIOUS DISEASES

Infectious Diseases order sets for common infections exist as noted below:

- Community Acquired Pneumonia (CAP)
- *C. difficile* order set
- Endocarditis Prophylaxis
- Immunosuppressed patient with pulmonary nodule/unexplained infiltrate
- Ventilator-Associated Pneumonia (VAP)
  - Note: Two order sets are available: VAP Initial, and VAP 3 day follow-up. These are separated to encourage clinicians to re-evaluate the latest patient data for antibiotic streamlining. Also, the four options for antimicrobial therapy in the VAP Initial form should be followed in stepwise fashion and not simply selected based on desired regimen. This stepwise approach was developed to aid the clinician in selecting therapy with the highest likelihood of activity against the offending organism(s) *a priori*. See the VAP Initial form for more information.
- HIV Order Set
  - Note: For all HIV patients admitted receiving highly active antiretroviral (HAART) and/or other prophylactic regimens, **the HIV order set must be used**. This order set ensures continuity of care and appropriate therapy dosing. It can be found along with other Print-on-Demand Forms in the folder named “HIV Order Sets.”

## PRINT-ON-DEMAND FORMS — INFECTIOUS DISEASES (CONTINUED)

### Accessing the Print-On-Demand Forms

Starting at the Infonet homepage — (<http://infonet.upmc.com>)

- 1.) Find the “Quick Links” drop down menu and click on “Forms.”
- 2.) Click on the hyperlink “print-on-demand forms.”
- 3.) A new window opens with several folders. Expand (click on) the folder titled “Physician Order Sets.”
- 4.) Click on the “Infectious Disease Order Sets” for all order sets except for the VAP order forms. These are located in the “Critical Care Unit Order Sets.”



## GUIDELINES FOR TREATMENT OF COMMON VIRAL INFECTIONS

Infection	First-line	Alternative	Duration	Comments
Herpes zoster (VZV)	Acyclovir* 800mg PO 5x/day (If immunocompromised, use acyclovir 10mg/kg q8h IV)	Valacyclovir* 1 Gram PO q8h	5-7 days if immunocompetent; 10-14 days if immunocompromised	MUST BE IN CONTACT/DROPLET PRECAUTIONS: Health care workers who have not had chickenpox or vaccine should not enter the patient's room.
Cytomegalovirus (CMV)	Ganciclovir* 5 mg/kg q12h IV	Foscarnet* – suggest ID consult for dosing	2-3 weeks; may need maintenance therapy	Usually treatment is only given to immunocompromised patients.
Hepatitis A virus	None	None	-	Ensure hands are washed when leaving the patient's room.
Hepatitis B virus	Lamivudine* – should be initiated only with Hepatology consult	Adefovir* – should be initiated with Hepatology consult	Variable	All health care workers should be vaccinated against hepatitis B virus.
Hepatitis C virus	Interferon/Ribavirin – should be initiated with Hepatology consult	-	Variable	
Herpes simplex virus (genital - initial episode)	Acyclovir* 400mg PO q8h OR Valacyclovir 1g PO q12h	-	7-10 days	No vaccine is available.
Herpes simplex virus (genital - recurrent episode)	Acyclovir* 800mg PO q8h x 2 days OR Valacyclovir 500mg PO q12h x 3 days	-	See first-line recommendation for duration	Initiate at earliest sign of symptom or recurrence.
Herpes simplex virus (oral - recurrent)	Valacyclovir* 2g PO q12h x 1 day	Acyclovir cream - apply to affected area 5 times per day x 4 day	See first-line and alternative recommendation for duration.	
Herpes simplex virus (encephalitis)	Acyclovir* 10 mg/kg q 8h IV	-	14-21 days	
Influenza	Oseltamivir* 75 mg q12h PO	Amantadine* 100mg PO q12h	5 days	Amantadine is only active against Influenza A, whereas oseltamivir is active against influenza A and B.

\* Dose adjustment is necessary for patients with renal dysfunction.

## ANTIBIOTICS OF CHOICE BY ORGANISM

Organism	Antibiotic of Choice (If Susceptible)	Notes
<i>Staphylococcus aureus</i> (Methicillin Sensitive)	Nafcillin OR Oxacillin	Data have shown that the anti-staphylococcal penicillins have a greater anti-staphylococcal activity than vancomycin.
<i>Staphylococcus aureus</i> (Methicillin resistant)	Vancomycin (See Note)	Consider daptomycin in patients persistently bacteremic with MRSA in the absence of infectious focus despite therapeutic levels of vancomycin (15-20mg/ml); consult Infectious Diseases in this setting. Superiority of linezolid over vancomycin for patients with MRSA pneumonia is debatable and a prospective trial is ongoing.
Group A Streptococci ( <i>Streptococcus pyogenes</i> )	Penicillin	Clindamycin may be added in necrotizing fasciitis.
<i>Listeria monocytogenes</i>	Ampicillin	
<i>Enterococcus spp.</i> (ampicillin susceptible)	Ampicillin	Gentamicin or streptomycin may be added, if susceptible, for synergy for endocarditis or meningitis.
<i>Enterococcus spp.</i> (vancomycin susceptible, ampicillin resistant)	Vancomycin	Gentamicin or streptomycin may be added, if susceptible, for synergy for endocarditis or meningitis.
<i>Enterococcus spp.</i> (vancomycin resistant AND ampicillin resistant)	Linezolid[R] OR Tigecycline[R] (Tigecycline only in the setting of intra-abdominal infections)	Vancomycin resistance in the enterococcus does not predict ampicillin resistance.
<i>Stenotrophomonas maltophilia</i>	<sup>1</sup> TMP/SMX	Ticarcillin/clavulanate may be added in patients who are critically ill and responding poorly to TMP/SMX.
Extended Spectrum beta-lactamase (ESBL) producing bacteria	Carbapenems (Doripenem[R], Meropenem[R], or Ertapenem[R])	An alternative are the fluoroquinolones, (OR TMP/SMX if treating UTI) if susceptible.
<i>P. aeruginosa</i>	Piperacillin	Unless polymicrobial in nature, infections caused by Pseudomonas that are susceptible to piperacillin are offered no additional benefit by treatment with piperacillin/tazobactam.

<sup>1</sup>TMP/SMX doses for pneumonia caused by *Stenotrophomonas* are not as high as those seen for PCP pneumonia. In patients without renal insufficiency, dose TMP/SMX at 5mg/kg IV q12h for *Stenotrophomonas* pneumonia (Clin Infect Dis 1996;22:508-12).

## DURATION OF ANTIBIOTIC TREATMENT FOR COMMON INFECTIONS

Infection	Recommended Duration	Comment
Bacteremia; <i>Staphylococcus aureus</i>	14 days minimum; often 4-6 weeks	Suggest ID consult for all <i>S. aureus</i> bacteremia to determine duration (see <i>Clinical Infectious Diseases</i> 1998;27:478-486).
Bacteremia; Coagulase negative Staphylococcus	5-7 days if lines have been changed and bacteremia has cleared	This is frequently a contaminant.
Bacteremia; Gram-negative bacilli	Usually 7-14 days; depends on focus of infection	
Candidemia	14 days minimum from date of documented clearance of blood cultures	Presence of endophthalmitis, endocarditis, or other organ involvement will alter duration.
Community-acquired pneumonia	5-7 days	
Urinary tract infection, uncomplicated	3 days	
Urinary tract infection, complicated	7-14 days	
Ventilator-associated pneumonia	8 days	Patients with <i>Pseudomonas aeruginosa</i> , <i>Acinetobacter</i> , or <i>Stenotrophomonas</i> may require 14 days, depending on the clinical scenario.

## INFECTIONS IN SOLID-ORGAN TRANSPLANT RECIPIENTS

Infection	Prophylaxis	Treatment	Comments
Cytomegalovirus	Valganciclovir* 900 mg PO q24h (Liver and heart transplant recipients should have pre-emptive therapy if CMV antigenemia is positive).	Ganciclovir* 5 mg/kg IV q12h	Risk of infection is greatest for transplant recipients who are seronegative for CMV IgG pre-transplant but who receive an organ from a donor who was CMV IgG+.
Fungal Infections	Voriconazole[R] 200 mg q12h PO may be appropriate in select solid-organ transplant recipients	See "fungal guidelines" and seek ID advice.	There is a significant interaction between azole antifungal agents and tacrolimus or cyclosporine.
Herpes simplex virus	Acyclovir* 200mg PO q12h in patients not receiving (val)ganciclovir	Acyclovir – dose depends on site of infection.	Ganciclovir and valganciclovir also give protection against HSV.
PCP pneumonia ( <i>Pneumocystis jiroveci</i> formerly known as <i>Pneumocystis carinii</i> )	Bactrim SS one tab on Mondays, Wednesdays, and Fridays	See PCP pneumonia in Pulmonary Disease Section of this book for treatment recommendations.	TMP/SMX also gives protection against listeriosis, salmonellosis, nocardiosis, and legionellosis. Alternative PCP prophylaxis should only be used if there is a true allergy to TMP/SMX. Consider folate supplementation in chronic use.
Toxoplasmosis	Heart transplant recipients who are toxoplasma IgG negative pre-transplant and receive an organ from an IgG+ recipient should receive TMP/SMX DS 1 tablet PO q12h PO, pyrimethamine 50mg daily, and leucovorin 10mg PO daily, all for 21 days; then same regimen three times per week until the end of the 3rd post-transplant month.	Sulfadiazine plus pyrimethamine – seek ID advice for dosage.	Risk is greatest in heart transplant recipients.
Tuberculosis	Isoniazid 300mg PO q24h for 9 months in candidates who are PPD+ pre-transplant or who have a known exposure	Isoniazid, rifampin, pyrazinamide and ethambutol – seek ID advice for dosage.	Consider starting Pyridoxine 25-50mg PO q24h when TB regimen contains isoniazid to prevent peripheral neuropathy. Rifampin will interact significantly with tacrolimus or cyclosporine.

\*Dose adjustment is necessary for patients with renal dysfunction

## RENAL DOSING RECOMMENDATIONS <sup>1-9</sup>

Drug	Usual Dosing <sup>o</sup>	Adjusted Dose and/or Frequency of Dosing for Renal Function				
		CrCl ≥ 50ml/min	CrCl 29-50ml/min	CrCl 10-29ml/min	CrCl <10ml/min	HD*
Acyclovir	Herpes Simplex Prophylaxis	200mg PO q8h	200mg q8h	200mg q12h	200mg q12h	200mg q12h
	Shingles/Chicken Pox	800mg PO 5x/day	800mg q6h	800mg q8h	800mg q12h	800mg q12h
	Herpes Simplex Infection	200mg PO 5x/day	200mg q6h	200mg q8h	200mg q12h	200mg q12h
	Herpes encephalitis	10mg/kg IV q8h	10mg/kg IV q12h	10mg/kg IV q24h	5mg/kg IV q24	10mg/kg after HD only on HD days
Amoxicillin	500mg PO	q8h	q8h	q12h	250mg q12h	500mg q24h
Amoxicillin/Clavulanate (Augmentin)	500mg/125mg PO	q8h	q12h	q12h	500mg/125mg OR 250mg/125mg q24h	500mg/125mg q24h
Ampicillin	500mg-2gm IV	q6h	q8h	q12h	1gm q12h	1gm q12h
Ampicillin/Sulbactam (Unasyn)	1.5gm-3gm	q6h	q8h	q12h	q24h	q12h
Aztreonam[R]	1-2gm IV	q6-8h	q6-8h	0.5-1.0gm q8h	0.5-1.0gm q12h	500mg q12h
Cefazolin	1gm IV	q8h	q12h	500mg q12h	500mg q24h	HD1 (15mg/kg) 1g q48-72h HD2 20mg/kg q48-72h
Cefepime[R]	1-2 gm IV	q12	q24h	0.5-1.0gm q24h	250-500mg q24h	1g IV x 1, then 500mg q24h (1g q24h in febrile neutropenia)
Cefotaxime[R]	1gm IV	q8h	q8h	q12h	q24h	q24h
Cefotetan	1gm IV	q12	q12-24h	q24h	q48h	q48-72h
Ceftazidime[R]	2gm IV Meningitis or brain abscess	q8h	q12h	q24h	q48h	HD1 1gm q48h HD2 1gm q24h
Ceftriaxone	1g IV pneumonia	q24h	q24h	q24h	q24h	q24h

Drug	Usual Dosing <sup>o</sup>	Adjusted Dose and/or Frequency of Dosing for Renal Function				
		CrCl ≥ 50ml/min	CrCl 29-50ml/min	CrCl 10-29ml/min	CrCl <10ml/min	HD*
Cefuroxime	750mg IV	q8h	q8-12h	q12h	q24h	q12h
	500mg PO	q12h	q12h	q12h	q24h	q12h
	250mg PO (UTI)	q12h	q12h	q12h	q24h	q12h
Cephalexin	500mg	q8h	q12h	q24h	250-500mg q24h	500mg q24h
Ciprofloxacin	PO (UTI dosing)	250mg PO q12h	250mg q24h	250mg q24h	250mg q24h	250mg q24h
	PO (not UTI dosing)	500mg PO q12h	500mg q24h	500mg q24h	500mg q24h	500mg q24h
	IV	400mg IV q12h	400mg q24h	400mg q24h	400mg q24h	400mg q24h
Daptomycin[R]	6mg/kg	q24h	q24h	q48h	q48h	q48h
Doripenem[R]	500mg IV	q8h	250mg IV q8h	250mg IV q12h	Limited to no data	
Ertapenem[R]	1g IV	q24h	q24h	500mg q24h	500mg q24h	500mg q24h <sup>1</sup>
Fluconazole	200-400mg IV or PO	q24h	100-200mg q24h	50-100mg q24h	50-100mg q24h	Normal dose after hemodialysis
	<i>C. glabrata</i> 800mg (10mg/kg)	q24h	400mg q24h	200mg q24h	200mg q24h	800mg OR 10mg/kg after HD
Ganciclovir	IV Induction	2.5-5.0mg/kg q12h	2.5mg/kg q24h	1.25mg/kg q24h	1.25mg/kg q48h	1.25mg/kg q48-72h
	IV Maintenance	2.5mg/kg q24	1.25mg/kg q24h	0.625mg/kg q24h	0.625mg/kg q48h	0.625mg/kg q48-72h
	Oral	500mg q8h	1000mg q24h OR 500mg q12h	500mg q24h	500mg q48h	500mg q48-72h
Imipenem[R]	500mg IV	q6h	500mg q8h	500mg q8-12h	250 mg q12h	250mg q12h <sup>10</sup>
Meropenem[R]	1g IV	q8h	q12h	500mg-1g q12h	500mg q24h	500mg q24h (after dialysis on dialysis days)
Moxifloxacin[R]	400mg IV/PO	q24h	q24h	q24h	q24h	q24h
Nitrofurantoin	50-100mg PO	q6h	Not Recommended			
Penicillin	2-4 Million Units IV (MU)	q4-6h	1.5-3MU q6h	1-2MU q6h	0.5-2MU q6h	0.5-2MU q6h

<sup>1</sup>Am J Kidney Dis 1999;33:87-96 <sup>2</sup>Clin Nephrol 1998;50:51-55 <sup>3</sup>Pharm World Sci 1997;19:191-96 <sup>4</sup>Am J Kidney Dis 2001;37:766-76 <sup>5</sup>Am J Kidney Dis 1999;34:222-27 <sup>6</sup>Clin Pharmacokinet 1992;22:169-210

<sup>1</sup>No supplemental dose needed if dose given at least 6 hours prior to dialysis.

Drug	Usual Dosing <sup>o</sup>	Adjusted Dose and/or Frequency of Dosing for Renal Function				
		CrCl ≥ 50ml/min	CrCl 29-50ml/min	CrCl 10-29ml/min	CrCl <10ml/min	HD*
Piperacillin	4g IV	4gm q8h	4gm q8h-q12h	4gm q12h	4gm q24h	4gm q24h
Piperacillin/ Tazobactam <sup>[R]</sup> (Zosyn <sup>TM</sup> )	4.5g	4.5gm q8h q6h in nosocomial pneumonia	q8h-q12h	q12h	q24h	q24h
Ticarcillin/Clavulanate <sup>[R]</sup> (Timentin <sup>TM</sup> - nonformulary)	3.1gm IV	q4-6h	q8h	q12h	q24h	q24h
Trimethoprim-UTI	300mg PO	q24h	200mg q24h	100mg q24h	Not Recommended	Not Recommended
TMP/SMX -UTI	800mg/160mg PO (Double-Strength)	q12h	q12-24	q24h	400mg/80mg q24h	800mg/160mg q24h
TMP/SMX – Pneumocystis pneumonia	5mg/kg	q8h	q8h	q12h	q12h	10mg/kg after hemodialysis only
TMP/SMX – <i>S. maltophilia</i> pneumonia	5mg/kg	q12	q12	q24	q24	5mg/kg after hemodialysis only
Valganciclovir	Treatment	900mg q12h	450mg q12h	450mg q24h	450mg q48h	900mg q48-72h
	Maintenance/ Prophylaxis	900mg q24h	450mg q24h	450mg q48h	450mg q72h	450mg q48-72h
Vancomycin IV (For PO dosing see the <i>C. difficile</i> section of this book)	15-20mg/kg (see comment in row below)	q12h (CrCl >75ml/min)	q24h (CrCl 35- 50ml/min) q48h (CrCl 25-34ml/min)	q72h <sup>**</sup>	q7days <sup>**</sup>	HD2 * 15mg/kg q48-72h
		q12h-24h (CrCl 50-75ml/min)				HD1 * 15mg/kg q5-7days
Please see suggested vancomycin dosing strategies in relevant tables by disease state.						

<sup>o</sup>=all patients should receive the same initial/loading dose followed by the adjusted maintenance dose as indicated in the columns to the right;

\*=all doses should be given after dialysis; If daily HD required contact AMP team; LD=loading dose; MD=maintenance dose; HD1=Cobe 500 HG or Fresenius F7; HD2=Gambro Polyflux 17 or 21 or Baxter CT110; \*\*= Check serum levels q24-48h and redose when level is below 15mg/L.

<sup>9</sup>In: Replacement of Renal Function by Dialysis. Dordrecht, The Netherlands. Kluwer Academic Publishers; 1996, pp 750-820.

<sup>10</sup>250mg q12h of imipenem in patients receiving hemodialysis provides effective concentrations covering organisms in the susceptible range. An aggressive 500mg q12h regimen may cover intermediate Gram-negative pathogens with an MIC of 8mcg/ml. AM J Med 1985; 78 (6A): 113-6

**ANTIBIOTIC DOSING IN CRITICALLY ILL ADULT PATIENTS RECEIVING CONTINUOUS RENAL REPLACEMENT THERAPY<sup>1</sup>**

Dosage by type of renal replacement therapy		
Drug		CWHD or CWHDF
Amphotericin B formulation	Deoxycholate	0.4-1mg/kg q24h
	Lipid complex	3-5mg/kg q24h
Acyclovir		5-7.5mg/kg q24h
Ampicillin-sulbactam		3g q8h
Aztreonam		2g q12h
Cefazolin		2g q12h
Cefepime		1g q12h <sup>3,4</sup>
Cefotaxime		2g q12h
Ceftazidime		2g q12h
Ceftriaxone		2g q12h-24h
Clindamycin		600-900mg q8h
Ciprofloxacin		200-400mg q12h

Dosage by type of renal replacement therapy	
Drug	CWHD or CWHDF
Colistin	2.5mg/kg q12h <sup>2</sup>
Daptomycin	6mg/kg q48h
Fluconazole	400-800mg q24h
Imipenem-cilastatin	500mg q8h
Linezolid	600mg q12h
Meropenem	1g q12h
Moxifloxacin	400mg q24h
Nafcillin or oxacillin	2g q4-6h
Piperacillin-tazobactam	4.5g q8h
Ticarcillin-clavulanate	3.1g q6h
Vancomycin	1g q24h
Voriconazole	4mg/kg po q12h

<sup>1</sup> *Clin Infect Dis* 2005; 41:1159-66.

<sup>2</sup> *Antimicrob Agents Chemother* 2005; 49:4814-5

<sup>3</sup> *Antimicrob Agents Chemother* 2001;45:3148-55.

<sup>4</sup> Cefepime in the critically ill population dosed at 1g IV q12h provides Time>MIC 100% to MICs up to and including 8mcg/ml (upper limit of susceptible for Gram-negatives). See reference 3 above. Bactericidal activity for cephalosporins is reached at a Time>MIC of 60-70%. Pharmacodynamic animal models have shown that a Time>MIC past the threshold of cidal activity becomes asymptotic for bacterial killing and clinical outcome.

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## PREVENTION OF INFECTIVE (BACTERIAL) ENDOCARDITIS

The American Heart Association's Endocarditis Committee, along with a national/international expert panel of infective endocarditis (IE) experts have recently performed an extensive review of the data surrounding whether dental, gastrointestinal (GI), or genitourinary (GU) tract procedures are possible causes of IE. Their findings are available in published form and on Pubmed ([www.pubmed.gov](http://www.pubmed.gov)).<sup>1,2</sup> The following is a summary of their updated recommendations.

### When is prophylaxis reasonable?

- 1.) Only for patients with cardiac conditions associated with a the highest risk of adverse outcomes from endocarditis, including:
  - Prosthetic cardiac valve or prosthetic material used in valve repair
  - Previous endocarditis
  - Congenital heart disease only in the following categories
    - Unrepaired cyanotic congenital heart disease, including those with palliative shunts and conduits
    - Completely repaired congenital heart disease with prosthetic material or device, whether placed by surgery or catheter intervention, during the first six months after the procedure
    - Repaired congenital heart disease with residual defects at the site or adjacent to the site of a prosthetic patch or prosthetic device (which inhibit endothelialization).
- 2.) Dental procedures for which prophylaxis is reasonable in patients with the cardiac conditions listed above include:
  - Manipulation of gingival tissue or periapical region of the teeth
  - Perforation of the oral mucosa

### Antibiotic prophylaxis is NOT recommended for the following dental procedures or events:

- Routine anesthetic injections through noninfected tissue
- Taking dental radiographs
- Placement of removable prosthodontic or orthodontic appliances
- Adjustment of orthodontic appliances
- Placement of orthodontic brackets
- Shedding of deciduous teeth and bleeding from trauma to the lips or oral mucosa

### What about Gastrointestinal (GI) or Genitourinary (GU) procedures?

- Antibiotic prophylaxis solely to prevent IE is no longer recommended for patients who undergo a GI or GU tract procedure, including patients with the highest risk of adverse outcomes due to IE.

### What about other procedures?

- Procedures involving the respiratory tract or infected skin, superficial layers below the skin, or musculoskeletal tissue for which prophylaxis is reasonable are discussed in the published document found in references 1, 2. The interested reader should consult the referenced material.

## When prophylaxis is reasonable, what regimen should I use?

Situation	Agent	Regimen – Single Dose 30-60 minutes before procedure	
		Adults	Children
Oral	Amoxicillin	2g PO	50mg/kg PO
Unable to take oral medication	Ampicillin OR Cefazolin	2g IV or IM 1g IV or IM	50mg/kg IV or IM 50mg/kg IV or IM
Allergic to penicillins or ampicillin – oral regimen	Cephalexin OR Clindamycin OR Azithromycin	2g PO 600mg PO 500mg PO	50mg/kg PO 20mg/kg PO 15mg/kg PO
Allergic to penicillins or ampicillin and unable to take oral medication	Cefazolin OR Clindamycin	1g IV or IM 600mg IV or IM	50mg/kg IV or IM 20mg/kg IV or IM

<sup>1</sup> *Circulation* 2007;116:1736-54.

<sup>2</sup> <http://circ.ahajournals.org/cgi/reprint/CIRCULATIONAHA.106.183095>

## UPMC RECOMMENDATIONS FOR SURGICAL ANTIMICROBIAL PROPHYLAXIS

The Surgical Care Improvement Project (SCIP) is a national quality partnership of organizations interested in improving surgical care by reducing the incidence or surgical complications nationally by 25% by the year 2010.

### Tips for compliance with the SCIP antibiotic-related core measures are:

- Administer preoperative antibiotics within 60 minutes before incision (120 minutes for vancomycin).
- Select narrow-spectrum antibiotics for prophylaxis.
- Discontinue prophylactic antibiotic within 24 hours after surgery end-time (48 hours for CABG and other cardiac surgeries). If the antibiotic must be restarted for active or suspected infection, document the name of the antibiotic and specific the words “active” or “suspected” in the progress notes.

Surgical Procedure	Recommended Agent	Dosing Regimen <sup>a,b</sup>	Likely Pathogens	Allergic Alternatives <sup>a</sup>	Strength of Evidence for Prophylaxis <sup>c,e</sup>
CLEAN					
<b>Cardiac</b> Valve surgery, coronary artery bypass, and other open heart surgery	cefazolin <sup>d</sup> (or cefuroxime 1.5g IV q12h)	2g IV at induction of anesthesia and 1g q8h x48h post-op (5 post-op doses)	<i>S. aureus</i> , <i>S. epidermidis</i> , <i>Corynebacterium</i> , enteric gram-negative bacilli	vancomycin 1g IV q12h <sup>d</sup> (3 post-op doses)	A (selection)  48-hour duration is based on expert panel and Society of Thoracic Surgeons consensus statement.
Heart transplantation	cefazolin <sup>d</sup> (or cefuroxime 1.5g IV q12h)	2g IV at induction of anesthesia and 1g q8h x48h post-op (5 post-op doses)		clindamycin 600mg IV q8h (5 post-op doses)	
From or involving ventricular assist device	vancomycin <sup>d</sup>	1g IV at induction of anesthesia and q12h x48h post-op (5 post-op doses)		Aztreonam 1g IV q8h (5 post-op doses)	

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## UPMC RECOMMENDATIONS FOR SURGICAL ANTIMICROBIAL PROPHYLAXIS (CONTINUED)

Surgical Procedure	Recommended Agent	Dosing Regimen <sup>a,b</sup>	Likely Pathogens	Allergic Alternatives <sup>n</sup>	Strength of Evidence for Prophylaxis <sup>c,8</sup>
CLEAN					
<b>Thoracic</b> Pulmonary or mediastinal surgery	cefazolin <sup>d</sup> (or cefuroxime 1.5g IV q12h)	1-2g IV at induction of anesthesia	<i>S. aureus</i> , <i>S. epidermidis</i> , streptococci, enteric gram-negative bacilli, <i>P. aeruginosa</i> (transplant recipients)	vancomycin 1g IV q12h <sup>d</sup> (1 post-op dose)	A
Esophagectomy	Cefazolin <sup>d</sup>	1g IV at induction of anesthesia and q8h x 24h post-op (2 postop doses)			
Lung transplantation	Cefazolin <sup>d</sup> + aztreonam 1g IV q8h	1g IV of each at induction of anesthesia and 1g q8h x 48h post-op (non-septic), or individualize antimicrobials to infective flora and/or pretransplant culture and sensitivity results (septic)			
<b>Neurosurgery</b>	cefazolin <sup>d,e</sup>	1-2g IV at induction of anesthesia	<i>S. aureus</i> , <i>S. epidermidis</i>	vancomycin 1g IV <sup>d</sup>	A
<b>Orthopaedic</b> (orthopaedic trauma below) Internal fixation of fractures Hip fracture repair Total joint replacement	cefazolin <sup>d</sup> (or cefuroxime 1.5g IV q12h)	2g IV at induction of anesthesia and 1g q8h x 24h post-op <sup>i</sup> (2 post-op doses)  If proximal tourniquet, infuse antibiotic completely before inflation	<i>S. aureus</i> , <i>S. epidermidis</i>	vancomycin 1g IV q12h <sup>d</sup> (1 post-op dose)  clindamycin 600mg IV q8h (2 post-op doses)	A (TJR and fracture) C (fixation)

Surgical Procedure	Recommended Agent	Dosing Regimen <sup>a,b</sup>	Likely Pathogens	Allergic Alternatives <sup>n</sup>	Strength of Evidence for Prophylaxis <sup>c,8</sup>
<b>Peripheral Vascular</b>					
Arterial surgery involving the abdominal aorta, prosthesis, or groin incision	cefazolin <sup>d</sup>	1-2g IV at induction of anesthesia and 1g q8h x 24h post-op (2 post-op doses)	<i>S. aureus</i> , <i>S. epidermidis</i> , enteric Gram-negative bacilli	Vancomycin 1g IV q12h <sup>d</sup> (1 post-op dose) clindamycin 600mg IV q8h (2 post-op doses)	A
Lower extremity amputation for ischemia	cefazolin <sup>d,g</sup> (or cefuroxime 1.5g IV q12h)	1-2g IV at induction of anesthesia and 1g q8h x 24h post-op (2 post-op doses)	Above, plus <i>Clostridia spp.</i>		
<b>Ophthalmic</b>	Polytrim, gentamicin, or fluoroquinolone drops	Instill eyedrops 1h preop and q15minutes x3; post-op qid x 1 week [irrigate eye with 5% Betadine ophthalmic solution in OR prior to surgery]	<i>S. aureus</i> , <i>S. epidermidis</i> , enteric Gram-negative bacilli, <i>Pseudomonas spp.</i>	Cefazolin 100mg conjunctivally at end of procedure	C
CLEAN-CONTAMINATED					
<b>Head and Neck</b>	Cefazolin <sup>e</sup>	1-2g IV at induction of anesthesia and 1g q8h x 24h post-op (2 post-op doses)	<i>S. aureus</i> , anaerobes, enteric Gram-negative bacilli	Clindamycin[R] 600mg IV q8h <sup>9</sup>	A
<b>Abdominal</b> <u>Gastroduodenal</u> For high-risk patients when lumen is entered: esophageal obstruction, decreased gastric acidity, decreased GI motility, morbid obesity <sup>h</sup>	Cefotetan (or cefoxitin 2g)	2g IV at induction of anesthesia <sup>h</sup>	Group B streptococcus, enterococci, enteric gram-negative bacilli, staphylococci, anaerobes	Metronidazole 500mg IV plus gentamicin 1.5mg/kg or fluoroquinolone [ciprofloxacin 400mg IV] or aztreonam 1g IV	A C (duration of gastric bypass surgery prophylaxis at 24 hours)
Appendectomy	Cefotetan (or cefoxitin 2g, or cefazolin 2g plus metronidazole 500mg)	2g IV at induction of anesthesia (if complicated, continue antibiotic as treatment with 1g IV q12h [cefotetan] or 1g IV q6h [cefoxitin] for 3-5 days).	Above except Group B streptococcus		A

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## UPMC RECOMMENDATIONS FOR SURGICAL ANTIMICROBIAL PROPHYLAXIS (CONTINUED)

Surgical Procedure	Recommended Agent	Dosing Regimen <sup>a,b</sup>	Likely Pathogens	Allergic Alternatives <sup>n</sup>	Strength of Evidence for Prophylaxis <sup>c,8</sup>
<b>Abdominal (cont.)</b>					
<u>Biliary Tract</u> For high-risk patients: age >70 years, obstructive jaundice, nonfunctioning gallbladder, acute cholecystitis, biliary obstruction, or common bile duct stones	Cefotetan (or cefoxitin 2g)	2g IV at induction of anesthesia	Enterococci, enteric Gram-negative bacilli, <i>Clostridia spp.</i>	Metronidazole 500 mg IV plus: gentamicin 1.5 mg/kg or fluoroquinolone [ciprofloxacin 400 mg IV] or aztreonam 1g IV	A
<u>ERCP</u> For high-risk patients: patients with artificial heart valves, known valvular heart disease or prostheses, history of bacterial endocarditis, or biliary obstruction	piperacillin/ tazobactam[R]	4.5g 15-30 minutes prior to procedure	See above	Clindamycin 600mg IV plus gentamicin IV 1.5mg/kg	B
<u>Colorectal</u>	Oral: neomycin base plus: erythromycin base or metronidazole Cefotetan or cefoxitin or [cefazolin plus metronidazole] if IV route is necessary <sup>o</sup>	1g of each neomycin and erythromycin(after mechanical bowel preparation is completed) base at 1pm, 2pm, and 11pm on the day before surgery [no more than 18-24h before operation]. If neomycin and metronidazole, dose is 2g of each at 7p.m. and 11p.m. the day before the operation. 2g IV at induction of anesthesia or [1g of cefazolin and 500mg metronidazole]	Enterococci, enteric Gram-negative bacilli, anaerobes	Clindamycin 600mg IV plus: gentamicin IV 1.5mg/kg or fluoroquinolone [ciprofloxacin 400mg IV] or aztreonam 1g IV  Metronidazole 500mg IV plus gentamicin 1.5mg/kg IV or fluoroquinolone	A
<u>Genitourinary</u> For high-risk patients: Preoperative or prolonged postoperative catheterization, positive or unavailable urine culture, transrectal prostatic biopsy or placement of prosthetic material	Oral: Ciprofloxacin 500mg  IV: Cefazolin <sup>e</sup>	1 tablet orally 2h prior to surgery  1g IV at induction of anesthesia	Enterococci, enteric Gram-negative bacilli (especially <i>E. coli</i> )	Ciprofloxacin[R] 400mg IV	A

Surgical Procedure	Recommended Agent	Dosing Regimen <sup>a,b</sup>	Likely Pathogens	Allergic Alternatives <sup>n</sup>	Strength of Evidence for Prophylaxis <sup>c,8</sup>
<b>Abdominal Transplant</b> Liver (recipient) Multivisceral	Unasyn <sup>d,e</sup>	3g IV at induction of anesthesia and q6h x 48h post-op(7 post-op doses)	Gram-negative aerobic bacilli, staphylococci, enterococci	Vancomycin 1g IV <sup>d</sup> plus aztreonam 1g IV q12h x 48h (3 post-op doses)	
Kidney	Cefazolin <sup>d,e</sup>	1g IV at induction of anesthesia and 1g q8h x 24h post-op (2 post-op doses)	Staphylococci, enteric Gram-negative aerobic bacilli (especially <i>E. coli</i> and <i>Klebsiella spp.</i> )	Vancomycin 1g IV q12h <sup>d</sup> plus aztreonam 1g IV q12h x 24h (1 post-op dose)	
Kidney-pancreas	Cefotetan <sup>d,e</sup>	1g IV at induction of anesthesia and q12h x 24h post-op (1 post-op dose)			
<b>Gynecologic and Obstetric</b> Cesarean delivery	Cefazolin <sup>d</sup>	2g IV at induction of anesthesia (within 60 minutes prior to skin incision)		Clindamycin 600mg IV plus: gentamicin 1.5mg/kg IV	A
Hysterectomy	Cefotetan or cefoxitin <sup>o</sup> (or cefazolin or cefuroxime)	2g IV within 60 minutes prior to skin incision (or 1g cefazolin or 1.5g cefuroxime)	Enteric Gram-negatives, anaerobes, enterococci, streptococci, staphylococci	Metronidazole 500mg IV plus gentamicin or fluoroquinolone	A
Abortion <sup>1st</sup> trimester high-risk <sup>l</sup>	Doxycycline (see footnote j)	200 mg PO		Ciprofloxacin 500 mg (see footnote j)	C
CONTAMINATED <sup>k</sup>					
<b>Penetrating Abdominal Trauma</b>	Cefotetan or cefoxitin	2g IV at induction of anesthesia and 1g q12h x 24 hours (1 post-op dose)		Clindamycin[R] 600mg IV q6h	B
Laparotomy	Cefotetan or cefoxitin	2g IV at induction of anesthesia and 1g q12h x 24 hours <sup>l</sup> (1 post-op dose)	Enteric Gram-negative bacilli, anaerobes, enterococci	Clindamycin[R] 600mg IV q6h	
Ruptured Viscus	Cefotetan or cefoxitin ± gentamicin	2g IV at induction of anesthesia and 1g q12h (1 post-op dose) + gentamicin 1.5mg/kg IV q8h (2 post-op doses) after loading dose with normal renal function <sup>m</sup>		Clindamycin[R] 600mg IV q6h + gentamicin 1.5mg/kg IV q8h	

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## UPMC RECOMMENDATIONS FOR SURGICAL ANTIMICROBIAL PROPHYLAXIS (CONTINUED)

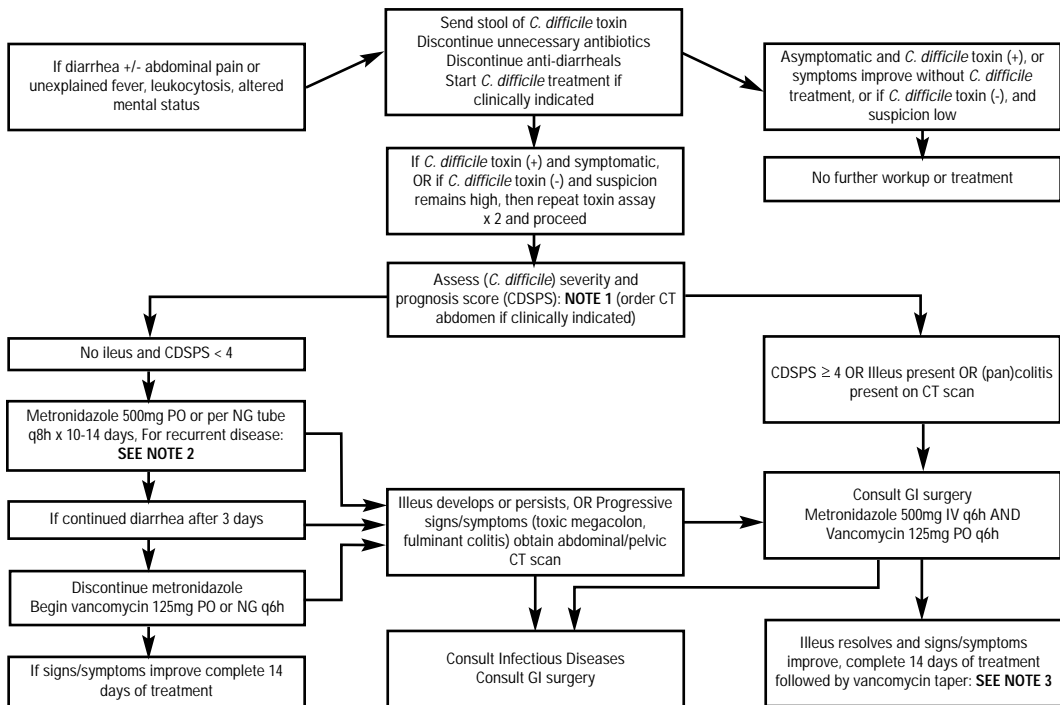
Surgical Procedure	Recommended Agent	Dosing Regimen <sup>a,b</sup>	Likely Pathogens	Allergic Alternatives <sup>n</sup>	Strength of Evidence for Prophylaxis <sup>c,s</sup>
Traumatic Wound	IV: Cefazolin <sup>d</sup>  Oral: Amoxicillin/ clavulanate (Augmentin)	2g IV at induction of anesthesia and 1g IV q8h x24h (2 post-op doses)  250-500mg PO q6h x 7-10 days	Staphylococci, streptococci, <i>Clostridia spp</i>	Vancomycin 1g IV q12h x 24h (1 post-op dose)	B
Orthopaedic Trauma	Cefazolin <sup>d,e</sup>	Closed fractures	Staphylococci, streptococci, <i>Clostridia spp</i>	Vancomycin 1g IV at induction and q12h x 24h (1 post-op dose)  Clindamycin <sup>(R)</sup> 600mg IV at induction and q8h x24h (2 post-op doses)	A
Open fractures		Grade I: see closed fracture  Grade II: add gentamicin 1.5mg/kg load, then 1mg/kg IV to closed fracture regimen, then both agents q8h x 24h (2 post-op doses)  Grade III: same as Grade II. In cases with soil contamination or very large amounts of soft tissue damage, add penicillin 1 million units at induction of anesthesia and continue q8h x48h until wound is closed/flapped.			B  E (expert consensus UPMC)

- a. Single antimicrobial doses, usually cephalosporins given immediately before the operation, are effective in preventing wounds in biliary, gastric, and transurethral operations, hysterectomies, colonic surgeries, and Cesarean sections. Repeated dosing may be needed intraoperatively if major blood loss occurs or if the procedure is prolonged. Where 24 hours or 48 hours of prophylaxis is used, the postoperative doses given should not continue beyond 24 hours (or 48 hours, respectively) from the end of the surgical procedure.
- b. Prophylactic IV antimicrobials should be present at the operative site as early as possible. IV administration of the appropriate dose in the operating room just before the induction of anesthesia is recommended. For dosing range, 1-2 grams is recommended. Consider using the high end of the dosing range due to high safety profile of agents in cases of obesity or hemodilution.

- c. *Strength of evidence supports using or not using prophylaxis as A (levels I-III), B (levels IV-VI), or C (level VII). Level I evidence is from large, well-conducted randomized, controlled trials. Level II evidence is from small, well-conducted randomized, controlled trials. Level III evidence is from well-conducted cohort studies. Level IV evidence is from well-conducted case-control studies. Level V, VI, and VII evidence is from poorly constructed uncontrolled studies, conflicted evidence that tends to support the opinion, and expert opinion, respectively.*
- d. *Vancomycin may be used for patients with documented penicillin or cephalosporin allergy. Routine use of vancomycin for surgical prophylaxis should be discouraged because it promotes the emergence of resistant enterococci. When used, vancomycin must be infused over 60 minutes. If patient is at high-risk for methicillin resistant *S. aureus*, vancomycin can be considered.*
- e. *If surgery is >3h, an additional dose is necessary q4-6 hours during the length of the surgery.*
- f. *Postoperative surgical drainage tubes carry the risk of infection. A lack of published data exists to evaluate infection risk in patients with and without drainage tubes. Studies comparing short and long duration of prophylaxis have shown no advantage to prolonged prophylaxis. Current practice guidelines advocate 24-hour duration of prophylaxis. (16b, 16d, 70a)*
- g. *If colonization or infection with Gram-negative organisms is expected, consider adding an aminoglycoside to the clindamycin regimen: gentamicin 80mg IV (1.7mg/kg) at induction of anesthesia. Addition of metronidazole 500mg IV to cefazolin regimen will increase coverage against anaerobic organisms.*
- h. *For gastric bypass surgery, duration up to 24 hours may be utilized.*
- i. *Previous pelvic inflammatory disease, previous gonorrhea, or multiple sex partners*
- j. *100mg one hour prior to procedure and 200mg after procedure. IV penicillin, 2 million units, also has been suggested as an intravenous regimen.*
- k. *Therapy may be continued for approximately five days to cover nosocomial pathogens.*
- l. *If small bowel entry, continue cefotetan x 48 hours postoperatively. If no small bowel entry, therapy may be changed postoperatively to cefazolin 1g IV q8h x48 hours.*
- m. *If there is no intestinal perforation or spillage, a single pre-op dose is sufficient. If perforation/spillage occurs, therapy is considered TREATMENT and should last up to 7-10 days.*
- n. *Antibiotic duration recommended at same length as noted in dosing regimen column . Frequency of administration designated as appropriate.*
- o. *Consider ampicillin/sulbactam (Unasyn®) if providing endocarditis prophylaxis.*

**CLOSTRIDIUM DIFFICILE-ASSOCIATED DISEASE CLINICAL PATHWAY**

at UPMC Presbyterian Shadyside



## NOTE 1

### C. difficile severity and prognosis score

Positive toxin for *C. difficile* or presence of pseudomembranes by endoscopy:

Mild to moderate disease: 3 or less points out of 7

Severe/fulminant disease: 4 or more points out of 7

1. underlying immunosuppression/chronic medical condition (1 point)
2. altered or depressed mental status (1 point)
3. abdominal pain and/or distention (1 point)
4. WBC > 20,000 or < 1,500 and/or bandemia > 10% (1 point)
5. hypoalbuminemia (< 3mg/dL) (1 point)
6. ascites (clinically or per CT scan findings) (1 point)
7. abnormal CT scan findings (1 point)
  - a. (pan)colitis
  - b. pneumatosis coli
  - c. bowel wall edema and/or thickening

## NOTE 2

### Recurrent disease management

First recurrence: Treat with anti-*C. difficile* antibiotic which resolved initial episode for 14 days

Second recurrence: Treat with vancomycin 125 mg PO q6h q24 for 14 days

Third recurrence: Treat with vancomycin 125 mg PO q6h q24 for 14 days followed by vancomycin taper (NOTE 3)

*Cholestyramine 4 gm PO TID can be given to help absorb toxin during primary treatment or during recurrent episodes.*

**Important note to those considering cholestyramine administration:** Cholestyramine, a bile acid sequestrant, may adsorb concomitantly administered drugs leading to the possibility of subtherapeutic levels. These include (but are not limited to) warfarin, glipizide, digoxin, metronidazole, valproic acid, amiodarone, acetaminophen, and cephalexin. Although this interaction may be avoided by administering concomitant agents hours before and after cholestyramine, other interaction mechanisms may not be avoided by this approach (for example, decreased enterohepatic recycling of warfarin). For these reasons, cholestyramine is not routinely recommended.

## NOTE 3

### Vancomycin taper

After 14 days of vancomycin 125 mg PO q6h:

Vancomycin 125 mg PO q8h x 7 days, then

Vancomycin 125 mg PO q12h x 7 days, then

Vancomycin 125 mg PO q24h x 7 days, then

Vancomycin 125 mg PO q48h x 4 doses, then

Vancomycin 125 mg PO q72h x 3 doses, then STOP

**Bloodborne Pathogen Standard**

OSHA 29 CFR 1910.1030

**If you have a significant needlestick, sharps, or mucous membrane exposure:**

- Wash the area well with soap and water.
- If the eyes are splashed, irrigate for 15 minutes at the eyewash station.
- Flush mucous membranes with water.
- Get evaluated at Employee Health/Work Partners at (412-647-3695) or ED after hours.

**Act fast! There is a two-hour window of opportunity for maximum preventive effect!****Hand Hygiene Prevents Infection**

Follow these basic rules for hand hygiene:

- If hands are not visibly soiled, use an alcohol-based hand product.
  - Apply product to palm of one hand and rub hands together, covering all surfaces of hands and fingers until hands are dry.
  - Follow the manufacturer's recommendations regarding the volume of the product to use.
- If hands are visibly soiled or contaminated with proteinaceous material, blood, or other bodily fluids, or if your patient has *Clostridium difficile* infection, wash hands with either a nonmicrobial soap and water or an antimicrobial soap and water.

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## DISEASES/CONDITIONS REPORTABLE BY LAW TO THE ALLEGHENY COUNTY HEALTH DEPARTMENT AND/OR THE PENNSYLVANIA DEPARTMENT OF HEALTH

- Acquired Immunodeficiency Syndrome (AIDS)
- Amebiasis
- Animal bites\*\*
- Anthrax\*\*
- An unusual cluster of isolates
- Arboviruses
- Botulism\*\*
- Brucellosis
- Campylobacter
- Cancer
- CD4 T-lymphocyte <200 cells/microliter or % of <14% of total lymphocytes
- Carbon Monoxide Poisoning\*\*
- Chancroid
- *Chlamydia trachomatis*
- Chickenpox (Varicella)
- Cholera\*\*
- Congenital adrenal hyperplasia (children < 5 years of age)
- Creutzfeldt-Jakob Disease
- Cryptosporidiosis
- Diphtheria\*\*
- *E. coli* 0157:H7 infections (or those caused by subtypes producing shiga-like toxin)\*\*
- Encephalitis
- Food poisoning\*\*
- Galactosemia
- Giardiasis
- Gonococcal infections
- Granuloma Inguinale
- Guillain-Barre Syndrome
- *Haemophilus influenzae*, invasive\*\*
- Hantavirus\*\*
- Hemorrhagic Fever\*\*
- Hepatitis, viral acute and chronic
- Histoplasmosis
- Human Immunodeficiency Virus (HIV)
- Influenza
- Lead Poisoning\*\*
- Legionellosis\*
- Leprosy
- Leptospirosis
- Listeriosis
- Lyme disease
- Lymphogranuloma venereum
- Malaria
- Maple Syrup Urine Disease (children < 5 years of age)
- Measles\*\*
- Meningitis, all types
- Meningococcal Disease\*\*
- Mumps
- Perinatal exposure of a newborn to HIV\*\*
- Phenylketonuria (children < 5 years of age)
- Pertussis
- Plague\*\*
- Polio\*\*
- Primary Congenital hypothyroidism (children < 5 years of age)
- Psittacosis (Ornithosis)
- Rabies (Human)\*\*
- Respiratory Syncytial Virus (RSV)
- Rickettsial Disease
- Rubella and Congenital Rubella Syndrome
- Salmonellosis
- SARS\*\*
- Sickle cell hemoglobinopathies (children < 5 years of age)
- Shigellosis
- Smallpox\*\*
- *Staphylococcus aureus*, methicillin-resistant (county health department alone)
- *Staphylococcus aureus*, (Vancomycin-resistant or intermediate), invasive disease
- Streptococcal invasive disease (group A)
- *Streptococcus pneumoniae*, drug resistant, invasive disease
- Syphilis, all stages
- Tetanus
- Toxic Shock Syndrome
- Toxoplasmosis
- Trichinosis
- Tuberculosis
- Tularemia
- Typhoid\*\*
- Varicella (Chickenpox)

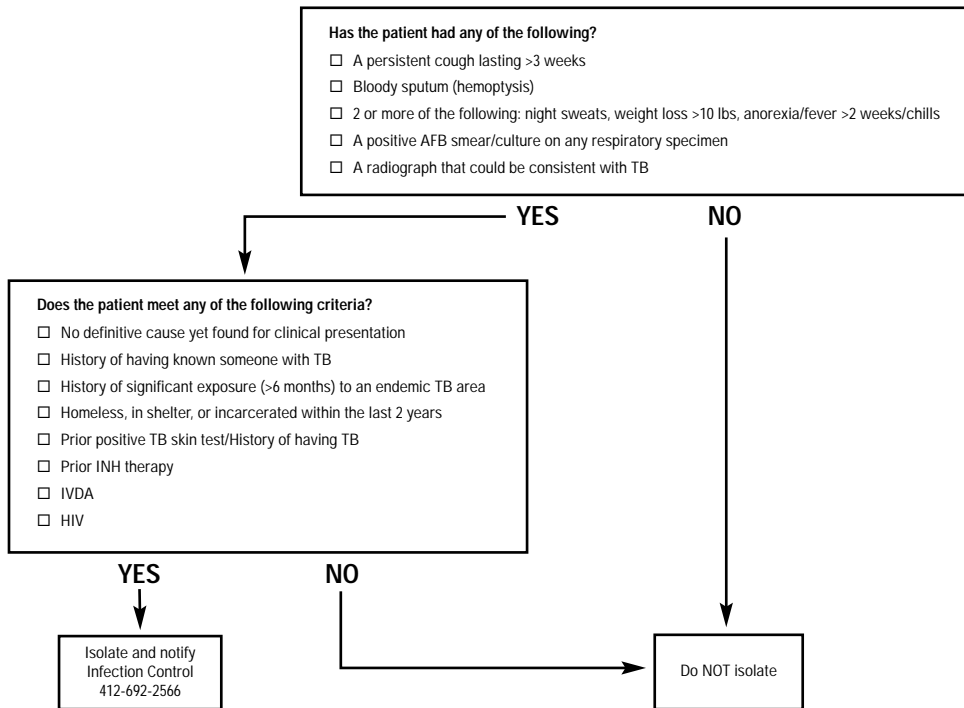
\*\*Report these and any other unusual disease occurrence within 24 hours.

Call 412-578-8060 to report to ACHD or contact Infection Control at 412-692-2566 to report conditions.

Infection Control must be made aware of all reporting by physicians to facilitate any necessary follow-up.

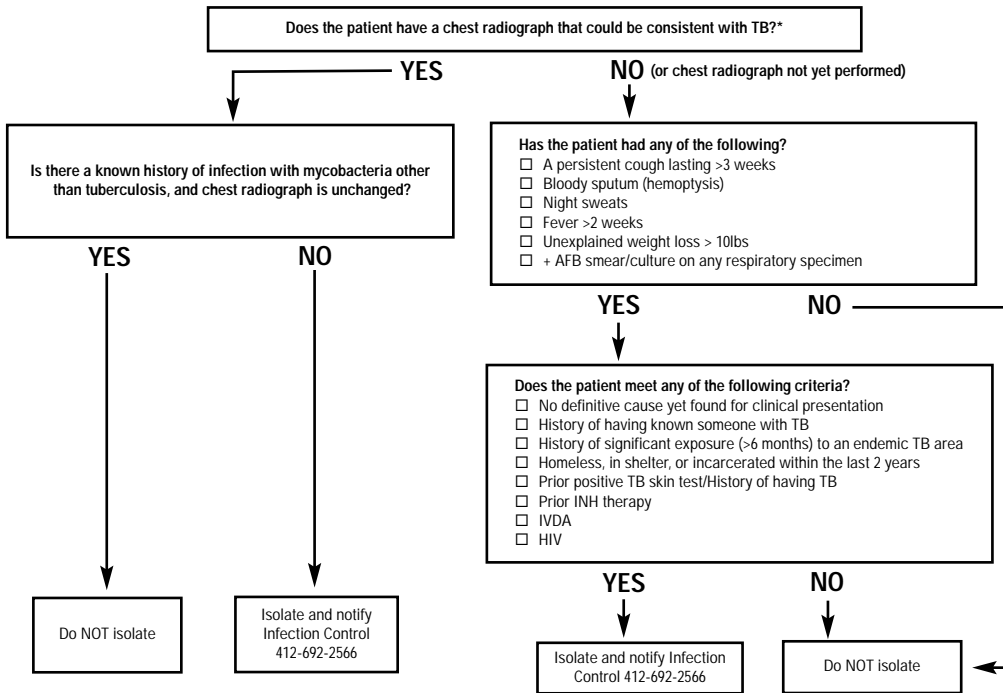
## WHO REQUIRES AIRBORNE ISOLATION?

A guide to airborne isolation (non-immunocompromised patient)



## WHO REQUIRES AIRBORNE ISOLATION?

A guide to airborne isolation (immunocompromised patient)



\*Patients who are transferred from other facilities should have a CXR report faxed to their coordinator prior to transfer.

## Required Isolation Barriers for Micro-organisms of Epidemiological Significance

Call Infection Control (412-692-2566) with questions.

Micro-organisms	Precautions Required	Barriers Used for All Patient Contact
Vancomycin-Resistant Enterococci (VRE)	Contact	Gloves and Gown
Methicillin-Resistant <i>Staphylococcus aureus</i> (MRSA)	Droplet/Contact	Gloves, Gown, and Mask
<i>Clostridium difficile</i>	Contact	Gloves and Gown
Extended-spectrum beta-lactamase (ESBL) and Carbapenemase producing Gram-negative organisms	Contact	Gloves and Gown

### Transmission-based Precautions Categories\*

\*Used in combination as well (Airborne Contact, Droplet Contact)

#### Airborne Precautions

- Used for TB and Measles. (Varicella may require Airborne/Contact)
- Patient must be placed in a negative pressure room.
  - For TB + can DC only with Infection Control consultation, patient on effective therapy, improving, and patient has 3 consecutive negative respiratory cultures collected at least 8 hours apart, one of those specimens an early morning specimen. For rule out TB, TB must be eliminated from the differential (3 consecutive negative respiratory cultures collected at least 8 hours apart, one of those specimens an early morning specimen or another diagnosis can explain the pulmonary findings).
  - If TB is suspected, an N95 respirator is required for room entry.
  - Fit-testing program is coordinated through UPMC Environmental Health and Safety Department.

#### Droplet Precautions

- Primarily used for influenza and meningitis.
- A private room is indicated. However, patients with the same organism may share a room. Door(s) should remain closed. For influenza, door does not need to be closed.
- A mask is required when entering room.
  - Can DC isolation with meningitis after 24 hours of effective therapy.
  - Influenza needs to stay in until symptoms resolve; Don't forget to order the NP swab on those you believe have "flu."

#### Contact Precautions

- Used for VRE, *C. difficile*, scabies, lice, infectious diarrhea.
- Requires:
  - a private room or cohorting.
  - must gown and glove before entering the room.
- The isolation sign will be on the patient's door.
- Isolation garb will be available at the door entrance.
- After removing isolation garb, good hand disinfection is essential.
- Hand washing with soap and water is required for *C. difficile* positive patients.
- Alcohol-based hand sanitizers are mounted in patient rooms and throughout the hospital.
- Dedicated equipment SHOULD BE AVAILABLE. If not, disinfection of personal equipment is required.

**ISOLATION REQUIREMENT FOR VARICELLA OR HERPES ZOSTER  
(REACTIVATION OF VARICELLA) AND HERPES SIMPLEX VIRUS**

Type of Infection	Isolation	Special Instruction	Duration of Transmission Based Precautions
Localized shingles (Zoster) Immunocompetent Host excluding face. <sup>1</sup>	Standard	Infected area should be covered. For direct contact with infected area, wear gown and gloves.	Until all lesions are dried and crusted.
Localized shingles (Zoster) Immunocompromised Host <sup>2</sup>	Airborne/Contact	Use full barriers at all times while in patient room  Full barriers = N95 Duck Bill Mask, Gown, Gloves, Negative Pressure Room	Until all visible lesions are dried and crusted.  Consult Infection Control for patient specific information.
Localized shingles (Zoster) Facial <sup>3</sup>			
Chickenpox (Varicella) <sup>4</sup>			
Disseminated Herpes Zoster <sup>5</sup>			
Varicella Pneumonia <sup>6</sup>			
Varicella Encephalitis <sup>7</sup>			
Herpes Simplex (HSV) Encephalitis	Standard	None	NA
HSV Mucocutaneous, Disseminated or Primary, severe <sup>8</sup>	Contact	None	Until all lesions are dried and crusted.
HSV Recurrent Mucocutaneous (skin, oral, genital)	Standard	None	NA

*During chickenpox infection, the varicella virus establishes latency in the dorsal root ganglia. Reactivation can occur later in life, and the rash can be localized (contained in 1 dermatome) or disseminated (outside of a single dermatome).*

<sup>1</sup> Localized shingles (Zoster) Infective Material: Lesion secretions

<sup>2</sup> Localized lesions in immunocompromised patients frequently become disseminated. Because such dissemination is unpredictable, use the same isolation precautions as for disseminated disease. Infective Material: Lesion secretions and possibly respiratory secretions

<sup>3</sup> Because these lesions are not readily coverable, the patient should be placed in Airborne/Contact precautions. Infective Material: Lesion secretions. But as lesions not coverable, infectious particles potentially could be aerosolized.

<sup>4</sup> Chickenpox represent primary infection with varicella. Infective Material: Respiratory secretions and lesion secretions.

CONTINUED ON PAGE 67

## ISOLATION REQUIREMENT FOR VARICELLA OR HERPES ZOSTER (REACTIVATION OF VARICELLA) AND HERPES SIMPLEX VIRUS (CONTINUED)

- <sup>5</sup> *Disseminated Herpes Zoster – Infective Material: Lesion secretions and possibly respiratory secretions.*
- <sup>6</sup> *Varicella Pneumonia – This is a complication of primary varicella. Infective Material: Lesion secretions and respiratory secretions.*
- <sup>7</sup> *Varicella encephalitis – This is a complication of primary varicella. Varicella encephalitis can also occur with reactivation (Zoster), especially when there is eye involvement (Herpes zoster ophthalmicus, in this syndrome the trigeminal nerve is involved and there will be lesions in the oral cavity as well). Infective Material: Lesion secretions, respiratory secretions, and CSF.*
- <sup>8</sup> *HSV Mucocutaneous, Disseminated or Primary, severe - Infective Material: Lesion secretions*

*Exposed susceptible patients should be placed in Airborne/Contact Isolation beginning 8 days after the first day of exposure and continuing until 21 days after the last day of exposure.*

*Employees who are unsure whether they have had chickenpox in the past should call Employee Health and verify varicella status if available. If not available, a titer can be done. The varicella vaccine is available free of charge to any employee without immunity.*

***For more information, refer to your Infection Control manual at <http://policymanuals.infonet.upmc.com/System/PDF/hsIC0609.pdf>, call IC at 412-692-2566, or page the on-call ICP at 412-255-9636.***

**SODIUM CONTENT OF SELECT ANTIMICROBIALS\***

Antibiotic and vial size/dose	Sodium (mg)	Sodium (mEq)
Acyclovir 1g vial	102	4.4
Amikacin 500mg	29.9	1.3
Ampicillin 1g	66.7	3
Ampicillin/Sulbactam 1.5g (add-vantage vial)	115	5
Cefazolin 1g	48	2
Cefotaxime 1g	51.7	2.2
Cefotetan 1g	80	3.5
Cefoxitin 1g	54	2.3
Ceftazidime 1g	54	2.3
Ceftriaxone 1g (Add-vantage vial)	83	3.6
Cefuroxime 750mg	111	4.8
Colistin 150mg	15	0.6
Ganciclovir 500mg	46	2
Imipenem 500mg	37.5	1.6
Meropenem 1g	90.2	3.9
Nafcillin 1g	68.2	2.9
Oxacillin 1g	54	2.3
Penicillin G Potassium, 5MU	35	1.5
Penicillin G Sodium, 5MU	186.6	8
Piperacillin 4g	42.6	1.85
Piperacillin/Tazobactam 4.5g (Add-vantage vial)	216	9.39

\*All data taken from package insert information unless otherwise noted.

## AMINOGLYCOSIDE DOSING<sup>1</sup>

### I. Determine the dosing weight (NOTE: Do not proceed to Sections II or III until a dosing weight is determined)

Aminoglycoside distribution decreases relative to total body weight in patients who are obese. For this reason, determining the appropriate dosing weight requires a comparison of the patient's actual body weight (ABW) versus his or her ideal body weight (IBW).

- 1.) Determine the patient's Ideal Body weight (IBW):
  - a. IBW for men (kg) =  $50 + [2.3 \times (\text{every inch} > 5 \text{ feet tall})]$
  - b. IBW for women (kg) =  $45.5 + [2.3 \times (\text{every inch} > 5 \text{ feet tall})]$

Scenario <sup>1</sup>	Dosing weight to use
ABW = IBW	Use ABW
ABW < 120% of the IBW	Use IBW
ABW > 120% IBW	Use Adjusted Body Weight (see below)

<sup>1</sup>Murphy JE, editor. *Clinical Pharmacokinetics*, Bethesda, MD: American Society of Health System Pharmacists; 1993

- 2.) If calculating the Adjusted Body weight is necessary (see above) use the following step:  
Adjusted body weight (kg) =  $IBW + [0.4 \times (ABW - IBW)]$

### II. Synergy for Gram-positive organisms

Aminoglycosides are often added to a beta-lactam or vancomycin regimen in patients being treated for Gram-positive infections. This is common in patients treated for such indications as bacteremia and endocarditis. The dosing strategy for Gram-positive synergy is different from that of Gram-negative infections.

Gentamicin dosing for Gram-positive synergy:

Renal function	Gentamicin dose and frequency
Creatinine clearance > 60mL/min	1mg/kg dosing weight q8h
Creatinine clearance 40 – 60mL/min	1mg/kg dosing weight q12h
Creatinine clearance < 40mL/min	1mg/kg dosing weight individualized

Note: for synergy in *Enterococcal spp.* use ONLY gentamicin

- 1.) Peaks/Troughs for Gram-positive synergy
  - a. Peak: 3-4mg/L
  - b. Trough: <2mg/L (<1mg/L preferred)

## AMINOGLYCOSIDE DOSING<sup>1,2</sup>

### III. Dosing for Gram-negative infections

a. Dosing in these situations is based on extended interval dosing, which is developed to maximize bacterial killing by known pharmacodynamic principles of aminoglycosides (concentration dependent bacterial killing).

Renal function	Dose and frequency per aminoglycoside		
	Gentamicin	Tobramycin	Amikacin
Creatinine clearance > 60mL/min	7mg/kg of dosing weight q24h	7mg/kg of dosing weight q24h	15mg/kg of dosing weight q24h
Creatinine clearance < 60mL/min	7mg/kg of dosing weight as a single dose	7mg/kg of dosing weight as a single dose	15mg/kg of dosing weight as a single dose

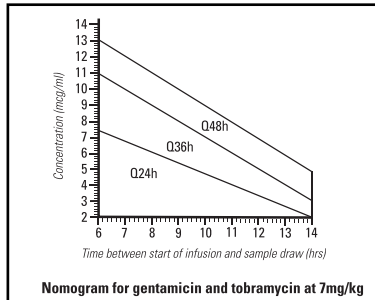
<sup>2</sup> *Antimicrob Agents Chemother.* 1995;39:650-5

b. To assess adequacy of the frequency, a random level may be obtained 6 to 12 hours after administering the dose, and this level can be plotted on the nomogram below.

c. Divide the amikacin serum level by 2 before applying to the nomogram.

#### Please note:

- Critically ill patients may often have their regimens individualized according to the MIC of the infecting organism.
- Extended interval dosing should not be used in patients who are pregnant or postpartum, have altered volume status, burns or ascites, or in patients being treated for Gram-positive synergy.



d. Peaks/Troughs for Gram-negative infections

1.) Peak: Ideally 10 to 12 times the MIC of the infecting organism.

2.) Trough: When using the previous nomogram, troughs should be undetectable. In situations where patients are treated via individualized therapy, troughs should be < 2mg/L. (For amikacin, troughs < 7mg/L.)

e. Individualization of regimens in the critically ill should not be done without an MIC value of the infecting organism to the aminoglycoside you are dosing.

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