James A. Haley Veterans' Hospital Antimicrobial Guide: 2020/2021

Inpatient Edition

Antimicrobial Stewardship Program

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Infectious Diseases Section, Medical Service
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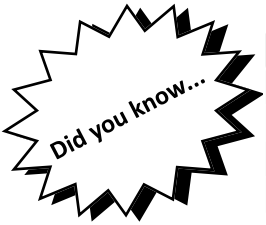
Antimicrobial Stewardship Subcommittee

Updated October 2020

NOTES PAGE



Updated CLSI Interpretive Categories and MIC Breakpoints - M100 S30

Agent	Organism	S	I	R
Ciprofloxacin	*Enterobacteriaceae*	≤0.25	0.5	≥1
Ciprofloxacin	*Pseudomonas aeruginosa*	≤0.5	1	≥2
Levofloxacin	*Enterobacteriaceae*	≤0.5	1	≥2
Levofloxacin	*Pseudomonas aeruginosa*	≤1	2	≥4

Ciprofloxacin and levofloxacin breakpoints have changed for *Pseudomonas aeruginosa* and *Enterobacteriaceae (*such as *Escherichia, Klebsiella, Enterobacter, Serratia, Citrobacter, Proteus* spp.) These new breakpoints are substantially lower than previous breakpoints and are NOT yet reflected in CPRS.

For example, an *E. coli* isolate with a ciprofloxacin MIC of 1 will be reported in CPRS as 'S' for susceptible (based on prior breakpoints). However, this is now considered 'R' or resistant and an alternative therapy should be utilized.

In addition, the *Pseudomonas aeruginosa* breakpoints are based on high-dose therapy (ciprofloxacin 400 mg IV Q8H, ciprofloxacin 750 mg PO Q12H, and levofloxacin 750 mg IV/PO Q24H) so be sure to use these higher anti-*Pseudomonal* doses when necessary.

You can read more about minimum inhibitory concentrations (MICs) and interpreting a culture and susceptibility report on page 17. You can also access the full CLSI document here: http://em100.edaptivedocs.net/Login.aspx

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Note, the information provided in this booklet is a summary of published guidelines, literature, and accepted practices as they relate to the JAHVH formulary. It is provided as a reference and should not be used in lieu of clinical decision making. Guidelines may have been updated since the time of printing. For the most complete and up-to-date information, please access the literature directly. All empiric doses recommended herein assume normal renal function.

URINARY TRACT INFECTIONS ALGORITHM

Pyuria, cloudy urine, foul smell, or positive urinalysis are NOT symptoms of a urinary tract infection (UTI) and are NOT indications for antibiotic therapy

Does the patient have any urinary signs or symptoms consistent with the following modified diagnostic criteria?

Cystitis	**Urinalysis available:** • **At least 1 of the following: frequency, urgency, dysuria, or suprapubic pain AND** • **At least 1 of the following findings on UA: positive leukocyte esterase or pyuria** **Urinalysis not available:** • **At least 2 of the following: frequency, urgency, dysuria, or suprapubic pain**
Pyelonephritis	• **Fever (>100.4 F) AND** • **At least 1 of the following: flank pain or costovertebral angle (CVA) tenderness AND** • **No indwelling urinary catheter**
Catheter-associated UTI	• **Indwelling urinary catheter AND** • **At least 1 of the following: fever (>100.4 F), rigors, flank pain, CVA tenderness, acute hematuria, or pelvic discomfort**

No → **Do NOT send urine culture unless patient is pregnant or scheduled to undergo invasive urologic intervention**

Yes → **Does a non-UTI diagnosis likely account for the symptoms?**

Yes → **Work up other cause**

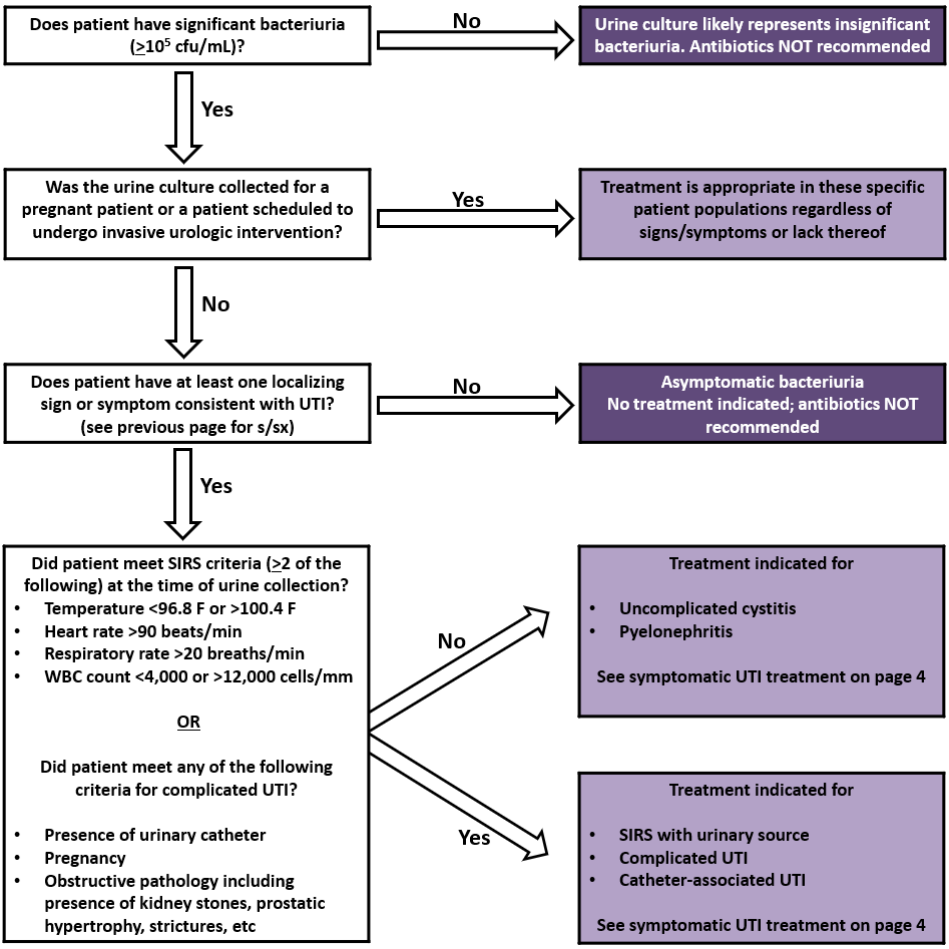
No → **Send urinalysis AND urine culture** → **Follow up results of urinalysis and urine culture. Continue to follow algorithm on next page**

Urinary Tract Infection (UTI) Diagnosis = Significant bacteriuria (>10^5) AND urinary signs/symptoms

- *Female*: Two consecutive voided urine specimens with identification of same bacterial strain in quantities ≥ 100,000 CFU/mL
- *Male*: Single, clean-catch voided urine specimen with one bacterial species identified in quantities ≥ 100,000 CFU/mL
- *Catheterized patient*: Single urine specimen with one bacterial species identified in quantities ≥ 100,000 CFU/mL

Did You Know?

- Our lab does not reflex urinalysis and urine culture; these tests need to be ordered separately
- Urinalysis results are available quickly while a urine culture may take several days
- UTI cannot be diagnosed based on urinalysis results alone



References for pages 1-4

Algorithm adapted from Antimicrobial Stewardship Task Force UTI Diagnosis and Treatment Algorithm available on VA Antimicrobial Stewardship National Sharepoint site

Nicolle LE et al. Clinical Practice Guideline for the Management of Asymptomatic Bacteriuria: 2019 Update by the Infectious Diseases Society of America. *Clinical Infectious Diseases* 2019; 68(10):83-110

Gupta K et al. International clinical practice guidelines for the treatment of acute uncomplicated cystitis and pyelonephritis in women: A 2010 update by the Infectious Diseases Society of America and the European Society for Microbiology and Infectious Diseases. *Clinical Infectious Diseases* 2010; 52:6e103-20

Hooton TM et al. Diagnosis, Prevention, and Treatment of Catheter-Associated Urinary Tract Infection in Adults:2009 International Clinical Practice Guidelines from the Infectious Diseases Society of America. *Clinical Infectious Diseases* 2010; 50:625–663

"FDA Updates Warnings for Fluoroquinolone Antibiotics" Available at: https://www.fda.gov/newsevents/newsroom/pressannouncements/ucm513183.htm Accessed May 2019

ASYMPTOMATIC BACTERIURIA (ASB)

Definition

The presence of one or more species of bacteria growing in the urine at a colony count of $\geq 10^5$ CFU/mL, irrespective of the presence of pyuria, in the absence of signs or symptoms attributable to urinary tract infection (UTI)

High Prevalence of Asymptomatic Bacteriuria

- The bladder is frequently colonized with bacteria
- A positive urinalysis or culture without symptoms should be considered **colonization, NOT infection**
- Treatment of ASB is **NOT recommended***

*See below for select indications requiring treatment for ASB

⇨

It's Difficult to Ignore a Positive Test

Frequent testing + Prevalent colonization = Unnecessary prescriptions & missing the true diagnosis

⇨

Cost of Unnecessary Rx & Missed Diagnosis

- Drug/drug interactions
- Renal and other complications
- Drug allergies
- *C. difficile* infection
- Missing the real diagnosis
- No improvement in "UTI"
- Increased risk of **developing resistant organisms**

Fiction	*Fact*
Bacteria on urinalysis always indicates UTI	• Urinalyses are often contaminated in the elderly
Urinalysis should be ordered as a screening test	• The high prevalence of asymptomatic bacteriuria means these tests SHOULD NOT be done routinely • Only screen for ASB in pregnant women and before invasive urologic procedures with risk of mucosal bleeding • Test only when UTI symptoms are present
An abnormal urinalysis is a good explanation for weakness, fatigue, or mental status changes	• Many elderly patients have asymptomatic bacteriuria • Seek other causes to ensure appropriate diagnosis; consider using the PINCH-ME approach: **P** – pain **I** – other infection **N** – poor nutrition **C** – constipation **H** – poor hydration **M** – other medication **E** – environment change • Hydrate if not contraindicated
Pyuria always indicates UTI	• Pyuria is common in patients with ASB – as high as 100% in patients with long-term catheters
Patients with pyuria and bacteruria need antibiotics	• Neither pyuria nor bacteriuria indicate a need for antibiotics. With rare exceptions treat ONLY symptomatic patients

Select Populations Who Should NOT be Screened for ASB

- Functionally impaired older adults residing in the community or long-term care facility
- Diabetic patients
- Solid organ transplant patients or renal transplant patients who have had renal transplant surgery >1 month prior
- Patients with neutropenia
- Spinal cord injury patients
- Patients with indwelling catheters
- Patients undergoing surgery for artificial urine sphincter or penile prosthesis implantation

Select Patients for Which ASB Should be Screened & Treated

- Pregnant women; recommended duration 4-7 days depending on regimen chosen
- Patients undergoing endoscopic urologic procedures associated with mucosal trauma; recommended duration of 1-2 doses initiated 30-60 minutes prior to procedure

SYMPTOMATIC URINARY TRACT INFECTION

Definitions

- *Cystitis*: lower urinary tract (bladder) infection
- *Pyelonephritis*: upper urinary tract (kidney) infection
- *Catheter-associated UTI (CA-UTI)*: urinary tract infection associated with indwelling urethral, indwelling suprapubic, or intermittent catheterization

Diagnosis

See modified diagnostic criteria on page 1

Common Causative Organisms

E. coli, Proteus spp., Klebsiella spp., Pseudomonas aeruginosa

Empiric Treatment

- When available, empiric treatment should be based off results of prior urine cultures
- Use pathogen-specific antibiotic therapy once urine culture results are available

	Preferred	*Alternative*
Cystitis (lower UTI)	• TMP/SMZ 1 DS tablet PO q12h • nitrofurantoin* 100 mg PO q12h	• amoxicillin/clavulanate 875/125 mg PO q12h • cefdinir 300 mg PO q12h • fosfomycin[§] 3 g PO q72h
Pyelonephritis (upper UTI)	• ceftriaxone 1 g IV q24h • cefepime 1 g IV q12h (if mild-moderate) • cefepime 1 g IV q6h (if severe)	• ciprofloxacin 400 mg IV q8-12h
CA-UTI	Change catheter then choose one of the above treatment options based on site of infection (lower vs upper urinary tract)	

**Nitrofurantoin should not be used for treatment of upper urinary tract infections because it concentrates in the urine. Although the nitrofurantoin package insert does not recommend use in patients with CrCl <60 ml/min, there is literature supporting safe nitrofurantoin use for short durations (≤7 days) in patients with CrCl > 30 ml/min*

[§]See Clinical Pearls section below

NOTE: As of July 2016, the FDA recommends fluoroquinolones be reserved for use in patients who have no other treatment options for uncomplicated UTIs because the risk of serious side effects generally outweighs the benefits. Additionally, local resistance rates of levofloxacin and ciprofloxacin to common causative organisms are high.

****AVOID fluoroquinolones for the treatment of uncomplicated urinary tract infections****

Suggested Treatment Duration

Uncomplicated cystitis (males)	7 – 10 days, depending on antibiotic class
Uncomplicated cystitis (females)	3 – 7 days, depending on antibiotic class
Pyelonephritis	10 – 14 days
SIRS with urinary source	10 – 14 days
Complicated urinary tract infection	10 – 14 days
Catheter associated urinary tract infection	7 days if prompt symptom resolution 10 – 14 days if delayed response

Clinical Pearls

- Oral fosfomycin may be an option for some patients with uncomplicated cystitis caused by either ESBL+ *E. coli* or select Gram negatives with contraindications to other oral options. Fosfomycin should not be used for the treatment of upper urinary tract infections. This medication is nonformulary and requires a Prior Authorization Drug Request (PADR) consult. Please refer to local criteria-for-use (CFU).
- When using fluoroquinolones to treat *Pseudomonas aeruginosa,* anti-Pseudomonal doses should be used:
  - Ciprofloxacin 750 mg PO q12h or ciprofloxacin 400 mg IV q8h
  - Levofloxacin 750 mg PO/IV q24h

COMMUNITY ACQUIRED PNEUMONIA

Diagnosis

Requires both the presence of clinical features (cough, fever, sputum production, pleuritic chest pain) AND chest infiltrate demonstrated on imaging

Common Etiologic Agents

Streptococcus pneumoniae, Mycoplasma pneumonia, Haemophilus influenza, Staphylococcus aureus, Chlamydophila pneumonia, Moraxella catarrhalis, and respiratory viruses

Clinical Pearls

- Obtain sputum cultures before starting antimicrobial therapy
- Consider PSI scores to help identify appropriate treatment strategies; outpatient vs. inpatient
- Signs and symptoms of CAP may be lacking or altered in elderly patients
- Cough and chest X-ray abnormalities may take up to 6 weeks to improve and are NOT a valid reason for extended antibiotic courses

Classification

Non-severe CAP	Patient meets no major and 2 or fewer minor criteria below
Severe CAP	Patient meets at least 1 major or 3 minor criteria below

Major Criteria	Minor Criteria		
Septic shock with need for vasopressors	RR ≥30 breaths/min	PaO2/FIO2 ratio≤250	Multilobar infiltrates
Respiratory failure requiring mechanical ventilation	Confusion/disorientation	BUN ≥20 mg/dL	WBC ≤ 4,000 cells/mL
	Platelets < 100,000	Hypotension requiring fluids	Hypothermia

Empiric Treatment

Non-severe CAP

Recent hospitalization AND IV antibiotics within 90 days?
If yes; obtain sputum Gram stain/culture and blood cultures

Prior (+) sputum culture within 12 months for *MRSA* or *PSA*?

Yes

Only *MRSA*:	Vancomycin (dosing per TDM consult) PLUS EITHER Ceftriaxone 2 g IV q24h + Azithromycin 500 mg PO/IV q24 OR Levofloxacin 750 mg PO/IV q24h
Only *Pseudomonas*:	Cefepime 2 g IV q8h PLUS Azithromycin 500 mg PO/IV q24h
Both *MRSA* & *Pseudomonas*:	Cefepime 2 g IV q8h PLUS Azithromycin 500 mg PO/IV q24h PLUS Vancomycin (dosing per TDM consult)

No

Ceftriaxone 2 g IV q24h PLUS Azithromycin 500 mg PO/IV q24h
OR
Levofloxacin 750 mg PO/IV q24h

Severe CAP

Obtain sputum Gram stain/culture, blood cultures, & urinary antigens

Recent hospitalization AND IV antibiotics within 90 days?
OR
Prior (+) sputum culture within 12 months for *MRSA* or *PSA*?

Yes

Cefepime 2 g IV q8h
PLUS
Azithromycin 500 mg PO/IV q24h
PLUS
Vancomycin (dosing per TDM consult)

No

Ceftriaxone 2 g IV q24h
PLUS EITHER
Azithromycin 500 mg PO/IV q24h (preferred)
OR
Levofloxacin 750 mg PO/IV q24h

Suggested Duration of Therapy

Most patients should be treated for a minimum of 5 days, should be afebrile for 48-72h, and should have no more than 1 of the following:

- Heart rate >100 beats/min
- Respiratory rate >24 breaths/min
- Systolic blood pressure <90 mmHg
- Altered mental status
- Arterial O2 saturation < 90%

Patients with confirmed *MRSA* or *PSA* infection should be treated for a minimum of 7 days. In general, patients are treated for 1-2 past clinical stability.

Metlay JP et al. Diagnosis and Treatment of Adults with Community-acquired Pneumonia. An Official Clinical Practice Guideline of the American Thoracic Society and Infectious Diseases Society of America. *Am J Respir Crit Care Med.* 2019;200(7):e45-e67

HOSPITAL & VENTILATOR ASSOCIATED PNEUMONIA

Definitions

- *HAP (hospital acquired pneumonia)*: Pneumonia that occurs >48 hours after admission that was not incubating at the time of admission and is not associated with mechanical ventilation
- *VAP (ventilator associated pneumonia)*: Pneumonia that occurs >48 hours after endotracheal intubation

Recommended Empiric Therapy (listed in order of preference)

(suggested dosing regimens assume normal renal function)

Hospital Acquired Pneumonia (HAP)

Does patient meet any of the following criteria?

- **Ventilator support due to pneumonia**
- **Septic shock**
- **IV antibiotics within past 90 days**
- **Bronchiectasis or cystic fibrosis**

Ventilator-Associated Pneumonia (VAP)

Does patient meet any of the following criteria?

- **IV antibiotics within past 90 days**
- **Septic shock at VAP onset**
- **ARDS preceding VAP onset**
- **≥5 days hospitalization**
- **Renal replacement therapy prior to VAP onset**
- **Bronchiectasis or cystic fibrosis**

No → **Is patient MRSA nares colonized or are additional MRSA risk factors present?**

No →

One anti-Pseudomonal agent with MSSA coverage

Pip/tazo 4.5 g IV q8h over 4 hours
or
Cefepime 2 g IV q8h
or
Levofloxacin 750 mg IV q24h (only if penicillin allergic)

Yes →

One anti-MRSA agent & one anti-Pseudomonal agent

***Vancomycin 15-20 mg/kg IV q12h** (see dosing on page 25)

PLUS EITHER

Pip/tazo 4.5 g IV q8h over 4 hours
or
Cefepime 2 g IV q8h
or
Tobramycin 7 mg/kg IV q24h (see dosing on page 27)

Yes →

One anti-MRSA agent and two anti-Pseudomonal agents

***Vancomycin 15-20 mg/kg IV q12h** (see dosing on page 25)

PLUS

Tobramycin 7 mg/kg IV q24h (see dosing on page 27)

PLUS ONE OF THE FOLLOWING

Piperacillin/tazobactam 4.5 g IV q8h over 4 hours
or
Cefepime 2 g IV q8h
or
Aztreonam 2 g IV q8h (if penicillin-allergic)
or
Levofloxacin 750 mg IV q24h (if penicillin-allergic)

*If vancomycin intolerant, use linezolid (requires approval by infectious diseases or antimicrobial stewardship services)

Suggested Duration of Therapy

- 7 day treatment course
- Shorter or longer treatment durations may be indicated depending on the causative organism and rate of overall improvement

Clinical Pearls

- Antimicrobial therapy should be de-escalated once culture results are available
- Consider a respiratory viral panel to help rule out viral respiratory infection

Kalil AC, Metersky ML, Klompas M et al. Management of Adults With Hospital-acquired and Ventilator-associated Pneumonia: 2016 Clinical Practice Guidelines by the Infectious Diseases Society of America and the American Thoracic Society. *Clin Infect Dis*. 2016;63(1):1-51

DIABETIC FOOT INFECTIONS

Diagnosis

Consider the possibility of infection occurring in any foot wound in a patient with diabetes

Infection present (2+ of the following criteria)

- Local swelling or induration
- Erythema (>0.5 cm)
- Local tenderness or pain
- Local warmth
- Purulent discharge

Plain radiographs of the affected foot to look for bony abnormalities (deformity, destruction) as well as soft tissue gas/foreign bodies is recommended for ALL patients

Classification

Clinical Manifestations of Infection	*PEDIS Grade*	*IDSA Infection Severity*
No signs or symptoms of infection	1	Uninfected
Local infection involving ONLY the skin and subcutaneous tissue If erythema present, must be >0.5 cm and <2cm around the ulcer Exclusion of other causes of inflammatory response of the skin (trauma, gout, fracture, etc)	2	Mild
Local infection with erythema >2cm OR involving structures deeper than skin and subcutaneous tissues No systemic inflammatory response signs (SIRS)	3	Moderate
Local infection with signs of SIRS as manifested by 2+ of the following criteria Temperature >38C or <36C HR >90 beats/minute RR >20 breaths/minute or $PaCO_2$ <32 mmHg WBC >12,000 or <4000 cells/mm^3 or ≥10% bands	4	Severe

Major Causative Organisms

Aerobes	*Anaerobes*
Staphylococcus aureus Coagulase-negative *staphylococci* Beta-hemolytic *streptococci* *Enterococcus spp* *Enterobacteriaceae* *Proteus, Klebsiella, & Enterobacter spp* *Pseudomonas aeruginosa*	*Bacteroides spp* *Peptostreptococcus spp* *Peptococcus spp* *Finegoldia magna*

Empiric Antimicrobial Treatment (in addition to wound care/debridement)

*** Definitive treatment should be based off culture and sensitivity testing of the wound specimen***

Uninfected wound	No antibiotic therapy necessary
Mild-moderate infection	
• No recent antimicrobial use	Cephalexin or amoxicillin/clavulanate
• Recent antimicrobial use (within 1 month)	PO: Levofloxacin IV: Ampicillin/sulbactam or levofloxacin
• Concern for MRSA	PO: Doxycycline or SMX/TMP or clindamycin IV: Vancomycin
Severe infection	Vancomycin PLUS Piperacillin/tazobactam or cefepime or ceftazidime (consider addition of metronidazole if using cephalosporin)

If evidence of subcutaneous gas/emphysema on imaging, add clindamycin for anti-toxin effects

When to empirically cover *Pseudomonas aeruginosa?*

- Presence of risk factors including high local prevalence of PSA infection and frequent exposure of the foot to water

When to empirically cover MRSA?

- Patient is colonized with MRSA or has a history of MRSA infection within the past year
- The infection is sufficiently severe that failing to empirically cover MRSA would pose an unacceptable risk of treatment failure

Lipsky BA, Berendt AR, Cornia PB, et al. 2012 Infectious Diseases Society of America Clinical Practice Guideline for the Diagnosis and Treatment of Diabetic Foot Infections. *Clin Infect Dis* 2012;54(12):132–173

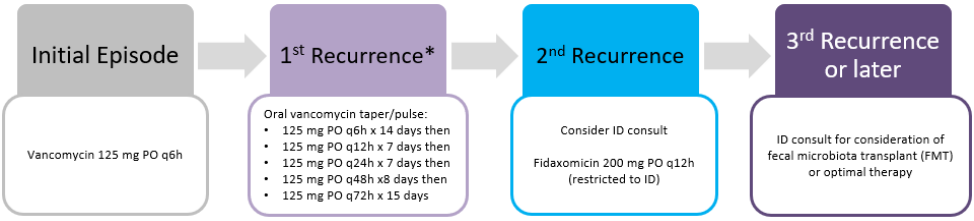
C. DIFFICILE INFECTION

Diagnosis

>3 unformed stools in 24 (or fewer) consecutive hours AND either a positive stool test for *C. difficile* or colonoscopic/histopathologic findings of pseudomembranous colitis

Recommended Management

Clinical Definition	*Supportive Clinical Data*	*Empiric Treatment*
Asymptomatic carriage	Positive *C. difficile* PCR **WITHOUT** diarrhea, ileus, or colitis	No treatment necessary
Non-severe	Leukocytosis ≤15,000 cells/µg **AND** SCr <1.5 mg/dL	Use algorithm below
Severe	Leukocytosis ≥15,000 cells/µg **OR** SCr >1.5 mg/dL	Use algorithm below
Fulminant	Hypotension or shock, ileus, megacolon, or perforation	Vancomycin 500 mg PO/NG q6h **PLUS** metronidazole 500 mg IV q8h • Consider adding vancomycin PR if ileus present • Recommend surgery consult



*Available via order set

Orders tab → Order sets → Medicine orders → 6. Disease specific → Clostridium Difficile Infection → First recurrence

Suggested Treatment Duration

- 10 day treatment course
- Consider extension to 14 days if patient has improved but not had symptom resolution at 10 days

Clinical Pearls

- Stop offending agents when possible (systemic antibiotics, PPIs, H2 antagonists, etc.)
- In general, avoid the use of anti-motility agents, especially before treatment has started
- Use soap and water instead of EtOH based hand sanitizers
- Do NOT repeat stool test for a test of cure. This test may remain positive for weeks after treatment
- Certain antibiotics can predispose to a patient to *C. diff* infection. Help prevent infection by avoiding these antibiotics (fluoroquinolones, clindamycin, and broad-spectrum penicillins and cephalosporins) when appropriate and using antibiotics for the shortest effective duration
- Stress environmental cleaning and disinfection to prevent re-infection
    - Patients should wash hands with soap and water after using the bathroom, before eating or food preparation, and when hands are visibly soiled.
    - Patients with diarrhea should avoid using the same toilet as other family members.
    - Bathroom and kitchen areas (including toilet seats, toilet bowl, flush handle, sink faucet handles, and countertops) should be cleaned with a mixture of bleach and water (1-part bleach to every 10 parts water) to help prevent spread of infection.

McDonald CL, Gerding DN, Johnson S et al. Clinical Practice Guidelines for *Clostridium difficile* Infection in Adults: 2017 Update by the Society for Healthcare Epidemiology of America (SHEA) and the Infectious Diseases Society of America (IDSA). *Clin Infect Dis.* 2018 Feb 15. doi: 10.1093/cid/cix1085. [Epub ahead of print]

INFECTIVE ENDOCARDITIS

Diagnosis

Based on modified Duke's criteria

Definite endocarditis: Presence of 2 major OR
1 major and 3 minor OR
5 minor criteria

Possible endocarditis Presence of 1 major and 1 minor OR
3 minor criteria

Major Criteria	*Minor Criteria*
1) Two separate blood cultures positive for a typical microorganism causing IE 2) Evidence of endocardial involvement	1) Predisposing conditions 2) Fever >38°C 3) Embolic event 4) Immunologic phenomenon 5) Positive blood cultures that do not meet major criteria guidelines

Major Criteria

1. Blood culture positive for IE
   - Typical microorganisms consistent with IE from 2 separate blood cultures (Viridans *Streptococci*, *Strep. gallolyticus/bovis*, HACEK group, *Staph. aureus* or CA-*enterococci*) in the absence of a primary focus
   - Microorganisms consistent with IE from persistently positive blood cultures defined as follows: At least 2 positive cultures of blood samples drawn >12h apart or all of 3 or a majority of >4 separate cultures of blood (first and last sample drawn at least 1 hour apart)
   - Single positive blood culture for *Coxiella burnetii* or anti-phase 1 IgG antibody titer >1:800
2. Evidence of endocardial involvement
   - Echocardiogram positive for IE; oscillating intracardiac mass on valve or supporting structures, in the path of regurgitant jets, or on implanted material in the absence of an alternative anatomic explanation; new abscess; new partial dehiscence of prosthetic valve; new valvular regurgitation

Minor Criteria

1. Predisposing conditions
2. Fever >38 °C
3. Embolic event or vascular phenomena
   - Major arterial emboli, septic pulmonary infarcts, mycotic aneurysm, intracranial hemorrhage, conjunctival hemorrhage, Janeway lesions
4. Immunologic phenomena
   - Glomerulonephritis, Osler's nodes, Roth's spots, rheumatoid factor
5. Positive blood cultures that do not meet major criteria guidelines

Suggested Treatment Regimens/Duration by Causative Organism

See tables to the right

Baddour LM, Wilson WR, Bayer AS, et al. Infective Endocarditis in Adults: Diagnosis, Antimicrobial Therapy, and Management of Complications. A Scientific Statement for Healthcare Professionals From the American Heart Association. *Circulation*. 2016 ; 134 : 1435 -1486

***Streptococcal* species**

Native valve		
MIC (mcg/mL)	First-line therapy	Duration of treatment
≤0.12 (age >65 or poor renal function)	Penicillin G 12-18 million units/24h OR ceftriaxone 2 g q24h	4 weeks
≤0.12 (good renal function)	Penicillin G or ceftriaxone (above doses) AND gentamicin 1.5 mg/kg q12h	2 weeks 2 weeks
>0.12 and ≤0.5	Penicillin G 24 million units/24h OR ceftriaxone 2 g q24h AND gentamicin 1.5 mg/kg q12h	4 weeks 2 weeks
Prosthetic valve		
MIC (mcg/mL)	First-line therapy	Duration of treatment
≤0.12	Penicillin G 24 million units/24h OR ceftriaxone 2 g q24h AND gentamicin 1.5 mg/kg q12h	6 weeks 2 weeks
>0.12	Penicillin G 24 million units/24h OR ceftriaxone 2 g q24h AND gentamicin 1.5 mg/kg q12h	6 weeks 6 weeks

***Staphylococcal* species**

Native valve		
Etiologic organism	First-line therapy	Duration of treatment
MSSA or MSSE	Nafcillin 2 g q4h OR cefazolin 2 g IV q8h	6 weeks
MRSA or MRSE	Vancomycin 15 mg/kg q12h (goal trough 15-20 mcg/mL)	6 weeks
Prosthetic valve		
Etiologic organism	First-line therapy	Duration of treatment
MSSA or MSSE	Nafcillin 2 g q4h AND rifampin 300 mg PO q8h AND gentamicin 1.5 mg/kg IV q12h	≥6 weeks ≥6 weeks 2 weeks
MRSA or MRSE	Vancomycin 15 mg/kg q12h (goal trough 15-20 mcg/mL) AND rifampin 300 mg PO q8h AND gentamicin 1.5 mg/kg q12h	≥6 weeks ≥6 weeks 2 weeks

***Enterococcal* species**

Native or prosthetic valve		
Etiologic organism	First-line therapy	Duration of treatment
Enterococci susceptible to penicillin, gentamicin	Ampicillin 2 g q4h OR penicillin G 18-30 million units/24h AND gentamicin 1.5 mg/kg q12h OR Ampicillin 2 g q4h AND ceftriaxone 2 g q12h	4-6 weeks 4-6 weeks 6 weeks
Enterococci resistant to penicillin	Vancomycin 15 mg/kg q12h (goal trough 15-20 mcg/mL) AND gentamicin 1.5 mg/kg q12h	6 weeks 6 weeks
Enterococci resistant to gentamicin	Ampicillin 2 g q4h AND ceftriaxone 2 g q12h	6 weeks
Enterococci resistant to vancomycin	Daptomycin 10-12 mg/kg q24h OR linezolid 600 mg IV/PO q12h	>6 weeks
HACEK organisms	Ceftriaxone 2 g q24h OR ampicillin 2 g q4h OR ciprofloxacin 400 mg IV q12h	4 weeks

HACEK organisms:
Haemophilus spp, Actinobacillus actinomycetemcomitans, Cardiobacterium hominis, Eikenella corrodens, Kingella kingae

NEUTROPENIC PROPHYLAXIS

Suggested Antimicrobial Prophylaxis	Bacterial	Fungal	Viral	PCP
Low Risk ▪ Anticipated duration of neutropenia <7 days ▪ Standard chemotherapy regimens for most solid tumors			✓*	
Intermediate Risk ▪ Anticipated duration of neutropenia 7-10 days ▪ CLL, multiple myeloma, lymphoma, autologous HCT ▪ Purine analog therapy (fludarabine, cladribine, etc.)	✓	✓	✓	✓
High Risk ▪ Anticipated duration of neutropenia >10 days ▪ Leukemia, allogeneic HCT ▪ Alemtuzumab therapy ▪ GVHD treated with high dose steroids (>20 mg prednisone or equivalent per day)	✓	✓	✓	✓

*Antiviral prophylaxis indicated only if patient had prior HSV episode

Antimicrobial Prophylaxis	
▪ levofloxacin 750 mg PO q24h or ▪ ciprofloxacin 500-750 mg PO q12h and amoxicillin/clavulanate 875/125 mg PO q12h	
Antifungal Prophylaxis	
Disease (intermediate to high risk)	*Suggested First-Line Prophylaxis*
ALL	fluconazole 400 mg PO q24h
MDS, AML (neutropenic)	▪ posaconazole 300 mg PO q12h x2 doses then 300 mg PO q24h (restricted to ID) or ▪ voriconazole 400 mg PO q12h x2 doses then 200 mg PO q12h (restricted to ID)
Autologous HCT with mucositis	fluconazole 400 mg PO q24h
Autologous HCT without mucositis	consider no prophylaxis
Allogeneic HCT (neutropenic)	fluconazole 400 mg PO q24h
Significant GVHD	▪ posaconazole 300 mg PO q12h x2 doses then 300 mg PO q24h (restricted to ID) or ▪ voriconazole 400 mg PO q12h x2 doses then 200 mg PO q12h (restricted to ID)
Other	fluconazole 400 mg PO QD
Antiviral Prophylaxis	**Antipneumocystis Prophylaxis**
Preferred: ▪ valacyclovir 500 mg PO q12h or q8h ▪ acyclovir 400 – 800 mg PO BID Alternative (restricted to ID): ▪ famciclovir 250 mg PO BID or	Preferred: ▪ TMP/SMZ 1 DS tablet PO q24h or ▪ TMP/SMZ 1 DS tablet PO 3x/week Alternative (restricted to ID): ▪ atovaquone 1500 mg PO q24h with food

National Comprehensive Cancer Network. Prevention and treatment of cancer related infections (Version 1.2016). http://www.nccn.org/professionals/physician_gls/pdf/infections.pdf Accessed April 2016

FEBRILE NEUTROPENIA

Definitions

- *Fever:* A single oral temperature >38.3°C (101°F) or a temperature of >38.0°C (100.4°F) sustained over a one-hour period
- *Neutropenia:* ANC <500 cells/mm^3 or an ANC that is expected to decrease to <500 cells/mm^3 during the next 48 hours

Common Etiologic Agents

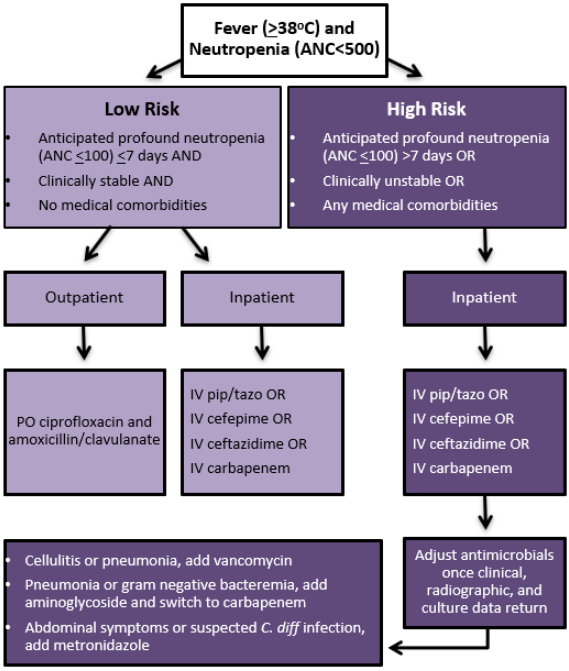
Gram-positive organisms	*Gram-negative organisms*
Coagulase-negative *staphylococci*	*Escherichia coli*
Staphylococcus aureus (including MRSA)	*Klebsiella* species
Enterococcus species (including VRE)	*Enterobacter* species
Viridans group *streptococci*	*Pseudomonas aeruginosa*
Streptococcus pneumoniae	*Citrobacter* species
Streptococcus pyogenes	*Acinetobacter* species
	Stenotrophomonas maltophilia

Anticipated Duration of Neutropenia
Refer to NCCN guidelines on the Prevention and Treatment of Cancer Related Infections

Empiric Treatment
Use algorithm to the right

Clinical Pearls

- Vancomycin is NOT recommended as a standard part of the initial empiric antibiotic regimen. Use vancomycin if:
  - Hemodynamic instability/evidence of severe sepsis
  - Pneumonia documented by imaging
  - Positive blood cultures for gram+ bacteria before final ID/susceptibilities
  - Suspected catheter-related infection
  - SSTI at any site
  - Colonization with MRSA
- Antibiotic prophylaxis with levofloxacin is recommended for high-risk patients expected to have prolonged and profound neutropenia
- Empiric antifungal therapy should be considered if persistent/recurrent fever after 4-7 days of antibiotics
- Antiviral therapy indicated for patients with documented HSV or VZV infection



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National Comprehensive Cancer Network. Prevention and treatment of cancer related infections (Version 1.2016). http://www.nccn.org/professionals/physician_gls/pdf/infections.pdf Accessed April 2016

BACTERIAL MENINGITIS

Diagnosis

- Clinical findings on lumbar puncture and CSF analysis
- Classic triad of fever, nuchal rigidity, and altered mental status
- Additional symptoms may include chills, vomiting, photophobia, severe headache, etc.

Recommended Empiric Management

Patient Characteristics	*Common Etiologic Agents*	*Empiric Treatment*
Immunocompetent AND age < 50	*Streptococcus pneumoniae* *Neisseria meningitides* *Haemophilus influenzae*	Ceftriaxone 2g IV q12h AND Vancomycin 30-45 mg/kg/day divided *Add dexamethasone 0.15 mg/kg IV q6h x2-4 days if pneumococcal meningitis suspected
Immunocompetent AND age ≥ 50 Immunocompromised	*Streptococcus pneumoniae* *Listeria monocytogenes* *Neisseria meningitides* *Haemophilus influenzae* Group B *Streptococci*	Ceftriaxone 2g IV q12h AND Vancomycin 30-45 mg/kg/day divided AND Ampicillin 2g IV q4h
Post neurosurgery, CSF shunt infection, or head trauma	*Staphylococcus aureus* Coagulase negative *Staphylococci* Aerobic gram-negative rods *Pseudomonas aeruginosa*	Vancomycin 30-45 mg/kg/day divided AND Cefepime 2g IV q8h
Severe penicillin allergy		Consult allergy service for desensitization If Listeria suspected, add TMP/SMZ 5mg/kg IV q6h

Suggested Duration of Therapy

Etiologic Agent	*Recommended Treatment Duration*
Neisseria meningitides	7 days
Haemophilus influenzae	7 days
Staphylococcus aureus	10 -14 days
Streptococcus pneumoniae	10-14 days
Coagulase negative *Staphylococci* or *P. acnes*	10 – 14 days
Streptococcus agalactiae	14-21 days
Aerobic gram-negative rods	21 days
Listeria monocytogenes	>21 days

Clinical Pearls

- Start antibiotics as soon as meningitis is suspected and optimize doses for CNS penetration
- Patient with any of the following criteria should receive a CT scan before lumbar puncture:
  - Immunocompromised
  - History of CNS disease
  - New onset seizure
  - Papilledema
  - Abnormal level of consciousness
  - Focal neurologic deficit
- If using dexamethasone, give 10-20 minutes before or concomitant with the first dose of antibiotics
- If a lumbar puncture must be delayed/deferred, obtain blood cultures and start empiric treatment

Tunkel AR, Hartman BJ, Kaplan SL et al. Practice Guidelines for the Management of Bacterial Meningitis. *Clin Infect Dis*. 2004; 39:1267–84

Tunkel AR, Hasbun R, Bhimraj AB et al. 2017 Infectious Diseases Society of America's Clinical Practice Guidelines for Healthcare-Associated Ventriculitis and Meningitis. *Clin Infect Dis*. 2017; 64(6):e34-65

SKIN AND SOFT TISSUE INFECTIONS

Definitions:

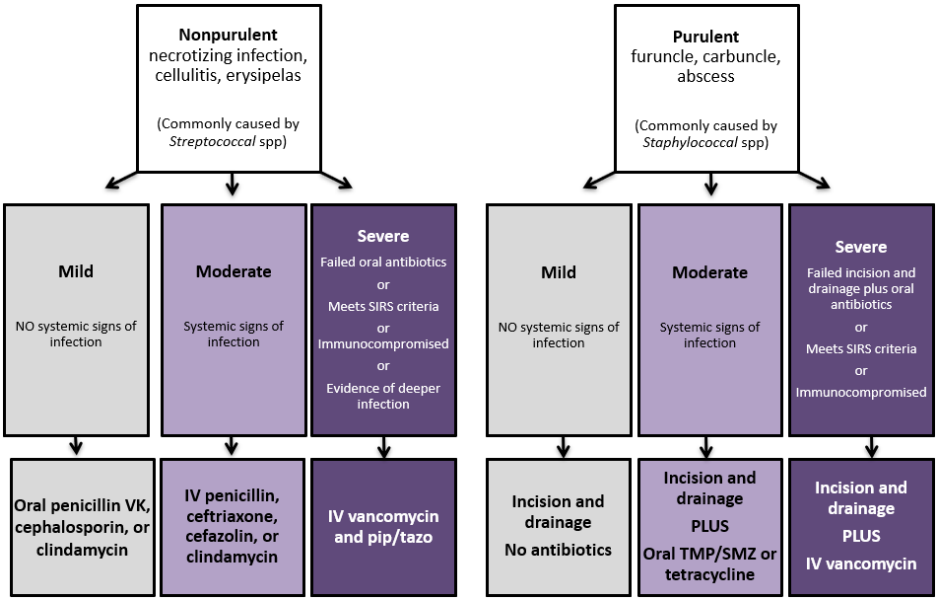
- *Furuncle*: Infection of the hair follicle also known as boils
- *Carbuncle*: Infection involving several adjacent furuncles
- *Abscess*: Collection of pus within the dermis and deeper skin tissues
- *Erysipelas:* Infection limited to the upper dermis, including the superficial lymphatics
- *Cellulitis:* Infection which involves the deeper dermis and subcutaneous fat
- *Necrotizing infection*: Deep infection which involves the fascial and/or muscle compartments and are potentially devastating due to major tissue destruction and death

Empiric Treatment

- See flow chart below

Recommended Duration of Therapy

Classification	*Treatment Duration*
Furuncles/carbuncles	No treatment usually required; self-limiting
Recurrent abscesses	5 – 10 days
Erysipelas/cellulitis	5 days; treatment should be extended if the infection has not improved within this time period
Recurrent cellulitis	Consider prophylactic antibiotics for 4–52 weeks
Necrotizing infections	Antimicrobial therapy should be administered until further debridement is no longer necessary, the patient has improved clinically, and fever has been absent for 48–72 hours



Stevens DL, Bisno AL, Chambers HF, et al. Practice Guidelines for the Diagnosis and Management of Skin and Soft Tissue Infections: 2014 Update by the Infectious Diseases Society of America. *Clin Infect Dis* 2014; 59 (2): e10-e52.

INFLUENZA TREATMENT

Diagnosis

- Based on the clinical presentation of the patient and the results of diagnostic testing
- History of influenza vaccination does NOT preclude influenza infection when signs and symptoms are compatible with the clinical syndrome

Clinical Presentation

Common symptoms of influenza include abrupt onset of fever, chills, myalgias, headache, and/or fatigue

Signs and Symptoms	*Influenza*	*Cold*
Symptom onset	Abrupt	Gradual
Fever	Usual, lasts 3-4 days	Rare
Aches	Usual, often severe	Slight
Chills	Fairly common	Uncommon
Fatigue, weakness	Usual	Sometimes
Sneezing	Sometimes	Common
Stuffy nose	Sometimes	Common
Sore throat	Sometimes	Common
Chest discomfort/cough	Common; can be severe	Mild to moderate
Headache	Common	Rare

Treatment

- Decision to treat should not wait for the confirmation of laboratory results
- Treatment should be continued in the setting of negative diagnostic results in patients with signs/symptoms suggestive of influenza infection. False negative results are possible

Antiviral treatment should begin within 48 hours of symptom onset

Recommended Treatment (based on renal function)

Treatment regimen	*Estimated Creatinine Clearance (ml/min)*
Oseltamivir 75 mg PO BID x 5 days	>60
Oseltamivir 30 mg PO BID x 5 days	31-60
Oseltamivir 30 mg PO daily x 5 days	11-30
Oseltamivir 30 mg immediately and then 30 mg after every hemodialysis session for 5 days (assuming three HD sessions in the 5-day period	ESRD on hemodialysis
Oseltamivir 30 mg PO once	Peritoneal dialysis

INFLUENZA PREVENTION

The CDC recommends a yearly flu vaccine as the first and most important step in protecting against influenza

Post-exposure prophylaxis is an option for select patients who meet **ALL** three of the following criteria:

1. High-risk for influenza complications (any of the following)
   - Age ≥ 65 years old
   - Immunosuppression caused by medication or HIV infection
   - Pregnant women (and women up to two weeks postpartum)
   - Chronic health conditions including chronic pulmonary, cardiovascular (except hypertension alone), renal, hepatic, hematologic (including sickle cell disease), metabolic disorders (including diabetes mellitus), neurologic conditions (disorders of the brain, spinal cord, nerve, muscle, epilepsy, stroke, or intellectual disability)
   - American Indian/Alaskan Natives
   - Body mass index ≥40
   - Residents of nursing homes/LTCFs
2. Did NOT received this year's influenza vaccine
3. Present within 48 hours of close contact with an infected individual

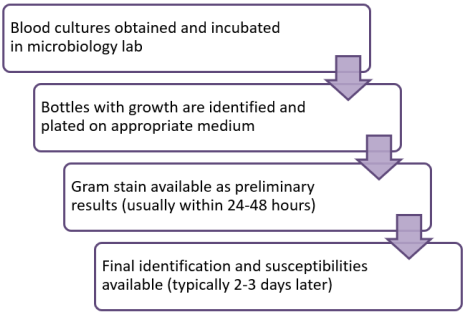
Recommended Post-Exposure Prophylaxis (based on renal function)

Regimen	*Estimated Creatinine Clearance (ml/min)*
Oseltamivir 75 mg PO daily x 10 days	>60
Oseltamivir 30 mg PO daily x 10 days	31-60
Oseltamivir 30 mg PO every other day x 10 days	11-30
Oseltamivir 30 mg immediately and then 30 mg after every other hemodialysis sessions for the recommended prophylaxis duration	ESRD on hemodialysis
Oseltamivir 30 mg immediately and additional 30 mg given 7 days later	Peritoneal dialysis

BACTEREMIA

Blood Culture Basics

- 1 blood culture = 2 bottles (1 aerobic and 1 anaerobic bottle)
- Typically order two sets of blood cultures from different anatomical sites = total of four bottles
- Blood cultures take **5 days** to finalize
- Growth in anaerobic bottle does NOT necessarily mean you're growing an anaerobe
- Use the guide to Gram-stain and morphology on page #17 to guide treatment choices before fina identification and susceptibilities are available



Gram stain results	Likely organism (by species)	Contaminant?
Gram positive cocci in clusters	• *Staphylococcus*	Possible; follow up final identification • S. aureus/lugdunensis = Requires treatment • Coagulase negative Staphylococci = May not require treatment
Gram-positive cocci in chains/pairs	• *Streptococcus* • *Enterococcus*	Likely not
Gram-positive rods	• *Bacillus* • *Clostridium* • *Listeria* • *Corynebacterium* • *Propionibacterium*	Possible; follow up final identification • Bacillus anthracis, Listeria monocytogenes, or Clostridium spp = Requires treatment • Bacillus cereus/non-anthracis, Corynebacterium spp., or Propionibacterium acnes = May not require treatment
Gram-negative rods	• *Enterobacteriaceae* family • SPACE/SPICE organisms	Likely not
Yeast	• *Candida* • *Cryptococcus*	Likely not

Staphylococcus aureus in blood cultures is NEVER a contaminant. Formal ID consult is recommended for classification, additional workup, and optimal treatment regimen/duration

Approach to Possible Contaminants

Use clinical judgement

- Is the patient hemodynamically unstable or septic?
- Does the preliminary culture suggest an organism that is known to cause endocarditis?
- How many bottles are positive?

Weigh risk vs benefit

- Risk of not treating "true" bacteremia
- Risk of inappropriate antimicrobial therapy

Call the Infectious Diseases or Antimicrobial Stewardship team for assistance in interpreting positive blood cultures

Factors Suggesting Contaminant	Factors Suggesting True Bacteremia
• Extended time to positivity • Certain bacterial strains • Multiple > single pathogen	• Single > multiple pathogens • Multiple BCx with the same organism • Typical pathogens • Clinical signs of infection • Presence of risk factors

Other Considerations

- Any patient with bacteria in the blood (contaminant or real) should get 2 sets of repeat blood cultures to document clearance. Duration of therapy typically starts from the date of the first negative blood culture
- Blood cultures growing certain organisms may need central line removal and/or work-up to rule out endocarditis
- Use bactericidal antibiotics for treatment
- Avoid PO antibiotics (with the exception of fluoroquinolones for select Gram negative bacteremia) given issues with poor bioavailability and serum concentrations at the site of infection

CHOOSING AN ANTIBIOTIC

What is Minimum Inhibitory Concentration (MIC)?

- Minimum inhibitory concentration is the lowest concentration of an antimicrobial that *inhibits* bacterial growth
- The MIC ranges are different for each antibiotic tested and different for each organism

MICs are NOT directly comparable. Do not simply choose the antibiotic with the lowest MIC.

- Comparing MIC values between antibiotics is similar to comparing "apples to oranges". For example, a ciprofloxacin MIC of 2 is not better than a piperacillin/tazobactam MIC of 8

Guide to Interpreting a Culture and Susceptibility Report

R (resistant)
Choose an alternative agent

I (intermediate)
If no other options available, contact infectious disease specialist to see if resistance can be overcome with high doses

S (susceptible)
Good option in-vitro; examine patient-specific factors

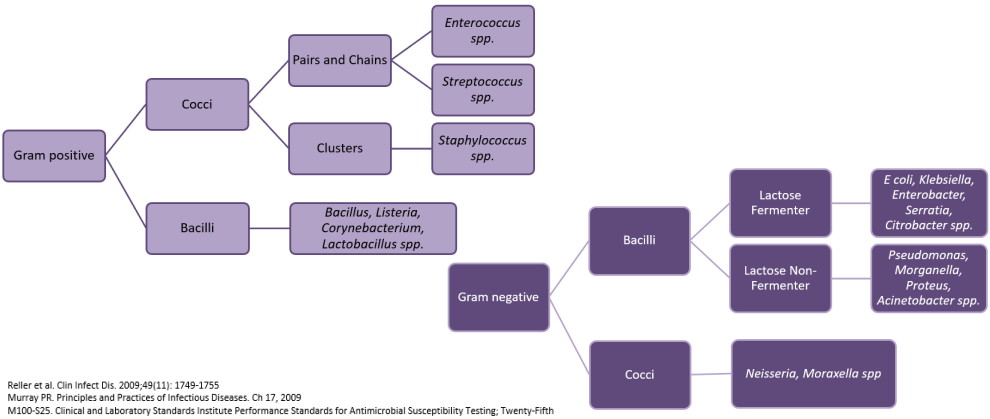
1) Pick the ideal antibiotic for specific situation

2) If that antibiotic is susceptible, consider your patient and whether that choice is appropriate:
   - Drug allergies?
   - Renal function?
   - Liver function?
   - Drug interactions?
   - Site of action?

- Keep in mind in vitro susceptibility does not guarantee in vivo efficacy. There are MANY scenarios where an antimicrobial may appear susceptible but would be a poor choice for treatment.
- The MIC values do NOT suggest chance of clinical success. Clinical success is dependent upon:
  - Host responses
  - Site of infection
  - Bacterial toxin production
  - Presence of biofilms
  - Medication pharmacodynamics
  - Other factors
- Susceptibility to a drug within a class does not always correspond to susceptibility to all drugs in that class
- Susceptibility tests are assessed based on plasma levels and may not predict concentrations at the site of infection. They do not take into account local factors such as pus, necrosis, poor perfusion, etc

Guide to Gram Stains and Morphology

- Preliminary culture data is reported as a Gram stain.
- Gram stains can help guide treatment decisions before an organism identification/susceptibilities are known
- The antibiogram (on pages 29-30 & the intranet) can assist you in choosing an appropriate antibiotic



Reller et al. Clin Infect Dis. 2009;49(11): 1749-1755
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M100-S25. Clinical and Laboratory Standards Institute Performance Standards for Antimicrobial Susceptibility Testing; Twenty-Fifth Informational Supplement. Page 24

RENAL DOSING GUIDE

Abbreviations

ABW: Actual body weight
AdjBW: Adjusted body weight
CrCl: Creatinine clearance
GFR: Glomerular filtration rate
IBW: Ideal body weight
SCr: Serum creatinine

Estimating Renal Function Using the Cockcroft Gault Equation

- If the patient's ABW < IBW, use ABW
- If the patient's ABW > 1.3x IBW, use AdjBW

Ideal Body Weight

Men: 50 kg + (2.3 kg per inch over 5 feet)
Women: 45 kg + (2.3 kg per inch over 5 feet)

Adjusted Body Weight

AdjBW = 0.4 (ABW – IBW) + IBW

Cockcroft Gault Equation

$$\text{CrCl (mL/min)} = \frac{(140 - \text{age})\ (\text{weight in kg})\ (0.85 \text{ if female})}{72 \times \text{SCr}}$$

Cystatin-C

- Better estimation of renal function in spinal cord injury patients with low muscle mass

Cystatin-C	*eGFR*
1.0	75-100
1.1	68-86
1.2	62-75
1.3	55-65
1.4	50-58
1.5	46-52
1.6	42-47
1.7	40-43
1.8	37-39
1.9	34-36

Cystatin-C	*eGFR*
2.0	32-34
2.1	30-32
2.2	28-30
2.3	26-28
2.4	25-27
2.5	24-26
2.6	22-24
2.7	21-23
2.8	20-22
2.9	18-21

Cystatin-C	*eGFR*
3.0	17-20
3.1	17-20
3.2	16-19
3.3	15-17
3.4	14-16
3.5	14-16
3.6	13-16
3.7	12-15
3.8	12-15
3.9	11-15

Antimicrobials Typically Not Requiring Renal Dosage Adjustment

Antibiotics		
Azithromycin	Fidaxomicin	Moxifloxacin
Cefuroxime	Fosfomycin	Nafcillin
Ceftriaxone	Isoniazid	Penicillin VK (oral only)
Clindamycin	Linezolid	Rifampin
Doxycycline	Metronidazole	Tigecycline
Erythromycin	Minocycline	Vancomycin (oral only)
Antifungals		
Amphotericin B	Ketoconazole	Posaconazole (oral only)
Isavuconazonium sulfate	Micafungin	Voriconazole (oral only)
Antivirals/Antiretrovirals		
Abacavir	Dolutegravir[§]	Lopinavir/ritonavir
Atazanavir	Efavirenz	Raltegravir
Daclatasvir	Elbasvir/grazoprevir	Rilpivirine
Darunavir	Etravirine	Ritonavir

[§]No dosage adjustments in treatment-naive or treatment-experienced/INSTI-naive patients

DOSING GUIDELINES BASED ON RENAL FUNCTION: **IV AGENTS**

Antimicrobial	Typical Dose (may vary)	CrCl (ml/min)	Suggested Dose Adjustment
Acyclovir	5-10 mg/kg q8h	25-50 10-24 <10	5-10 mg/kg q12h 5-10 mg/kg q24h 2.5-5 mg/kg q24h
*Amikacin	*See aminoglycoside dosing/monitoring guide on pages 26-28*		
Ampicillin	1-2 g q4-6h	10-50 <10	1-2 g q6-12h 1-2 g q12-24h
Ampicillin/sulbactam	1.5-3 g q6h	15-29 <15	1.5-3 g q12h 1.5-3 g q24h
Aztreonam	2 g q8h	10-29 <10	1 g q8h 500 mg q8h
Cefazolin	1-2 g q8h	11-34 <11	0.5-1 g q12h 0.5-1 g q24h
Cefepime	*See alternative dosing on page 23*		
Cefotaxime	1-2 g q6-8h	<20	0.5-1 g q6-8h
Cefotetan	1-2 g q12h	10-30 <10	0.5-1 g q12h 250-500 mg q12h
Cefoxitin	1-2 g q6-8h	30-50 10-29 5-9	1-2 g q8-12h 1-2 g q12-24h 0.5-1 g q12-24h
*Ceftaroline	600 mg q12h	31-50 15-30 <15	400 mg q12h 300 mg q12h 200 mg q12h
Ceftazidime	1-2 g q8h	31-50 16-30 ≤15	1-2 g q12h 1-2 g q24h 0.5-1 g q24h
*Ceftazidime/avibactam	2.5 g q8h	31-50 16-30 6-15 ≤5	1.25 g q8h 0.94 g q12h 0.94 g q24h 0.94 g q48h
*Ceftolozane/tazobactam	1.5 g q8h (most indications)	30-50 15-29	750 mg q8h 375 mg q8h
	3 g q8h (HAP/VAP or serious multi-drug resistant *Pseudomonal* infections)	30-50 15-29	1.5 g q8h 750 mg q8h
Cefuroxime	1.5 g q8h	10-20 <10	1.5 g q12h 1.5 g q24h
Ciprofloxacin	400 mg q12h (most indications)	<30	400 mg q24h
	400 mg q8h (anti-*Pseudomonal* dosing)	<30	400 mg q12h
***Colistimethate**	*Consult ID PharmD*		
*Daptomycin	4-12 mg/kg q24h	<30	4-12 mg/kg q48h
*Ertapenem	1 g q24h	<30	500 mg q24h
Fluconazole	200-800 mg q24h	<50	Same LD → 100-400 mg q24h
Gentamicin	*See aminoglycoside dosing/monitoring guide on pages 26-28*		
*Imipenem/cilastatin	1 g q8h	60-89 30-59 15-29	500 mg q6h 500 mg q8h 500 mg q12h
Levofloxacin	500 mg q24h (most indications)	20-49 <20	500 mg LD → 250 mg q24h 500 mg LD → 250 mg q48h
	750 mg q24h (anti-*Pseudomonal* dosing)	20-49 <20	750 mg q48h 750 mg LD → 500 mg q48h
*Meropenem	*See alternative dosing on page 23*		
***Meropenem/vaborbactam**	4 g q8h	30-49 15-29 <15	2 g q8h 2 g q12h 1 g q12h
Penicillin G	2-4 million units q4h	10-50 <10	75% of the normal dose 20% to 50% of the normal dose
Piperacillin/tazobactam	*See alternative dosing on page 23*		
***Polymyxin B**	*Consult ID PharmD*		
TMP/SMZ	8-20 mg/kg/TMP/day divided q6-12h	15-30 <15	Reduce dose to 50% usual dose Reduce dose 25-50% usual dose
*Tobramycin	*See aminoglycoside dosing/monitoring guide on pages 26-28*		
Vancomycin	*See vancomycin dosing/monitoring guide on pages 25*		
*Voriconazole	4 mg/kg q12h	<50	Avoid use, consider alternative or use PO

* = Restricted to Infectious Diseases/Antimicrobial Stewardship
BOLD = Nonformulary; requires PADR consult approval
LD = loading dose

DOSING IN DIALYSIS

Antimicrobial	Hemodialysis (HD) *(Regimens assume three complete HD sessions per week. Dose after HD when applicable)*	Peritoneal dialysis *(IV doses given below. Contact Renal service for intraperitoneal dosing)*	CVVHDF
Acyclovir	2.5-5 mg/kg q24h	2.5-5 mg/kg q24h	5-10 mg/kg q12-24h
*Amikacin	7.5 mg/kg LD → 5-7.5 mg/kg post-HD. Re-dose when pre-HD level <10mcg/mL	Consider 7.5 mg/kg LD then follow levels	10 mg/kg LD → 7.5 mg/kg q24-48h Re-dose when level < 10 mcg/mL
Ampicillin	1-2 g q12-24h	1-2 g q12-24h	2 g LD → 1-2 g q6-8h
Ampicillin/sulbactam	1.5-3 g q12-24h	1.5 g q12h or 3 g q24h	3 g q8-12h
Aztreonam	500 mg q12h	25% of usual dose at the usual interval	1 g q8h or 2 g q12h
Cefazolin	Daily: 1 g q24h 3x/week: 2 g/2 g/2 g or 2 g/2 g/3 g post-HD	500 mg q12h	1 g q8h or 2 g q12h
Cefepime	Daily: See dosing on page 23 3x/week: 2 g/2 g/2 g post-HD	1 g q24h	2 g q8-12h
Cefotaxime	1-2 g q24h	1 g q24h	1-2 g q6-8h
*Ceftaroline	200 mg q12h	No data	400-600 mg q12h
Ceftazidime	Daily: 1 g q24h 3x/week: 1 g/1 g/1 g or 1 g/1 g/2 g post-HD	1 g q24h	2 g q8-12h
*Ceftazidime/avibactam	0.94 g q24-48h based on eCrCl	No data	1.25 g q8h
*Ceftolozane/tazobactam	750 mg LD → 150 mg q8h (normal dose 1.5g q8h) 2.25 g LD → 450 mg q8h (normal dose 3g q8h)	No data	3 g LD → 750 mg q8h
Ciprofloxacin	PO: 250-500 mg q24h IV: 200-400 mg q24h	PO: 250-500 mg q24h IV: 200-400 mg q24h	PO: N/A IV: 400 mg q12h
***Colistimethate**	Contact ID PharmD	No data	Contact ID PharmD
*Daptomycin (based on 6 mg/kg dose)	Preferred:6 mg/kg-6 mg/kg-9 mg/kg post-HD Alternative: 6 mg/kg q48h	6 mg/kg q48h	6 mg/kg q24h
*Ertapenem	Daily: 500 mg q24h 3x/week: 1 g/1 g/1 g post-HD	500 mg q24h	1 g q24h
Fluconazole (based on 400 mg dose)	800 mg LD → 400 mg 3x/week post-HD	800 mg LD → 200 mg q24h	800 mg q24h
Gentamicin	2-3 mg/kg LD → 1-2 mg/kg post-HD. Re-dose when pre-HD level <1 (synergy/mild infxn), <1.5-2 (moderate infxn), or <3-5 (severe infxn)	Consider 2-3 mg/kg LD then follow levels	2-3 mg/kg LD → 1-2 mg/kg q24h. Re-dose when level <1 (synergy/mild infxn), <1.5-2 (moderate infxn), or <3-5 (severe infxn)
Levofloxacin (500 mg q24h)	500 mg LD → 250 mg q48h	500 mg LD → 250 mg q48h	500 mg LD → 250 mg q24h
Levofloxacin (750 mg q24h)	750 mg LD → 500 mg q48h or 250 mg q24h	750 mg LD → 500 mg q48h or 250 mg q24h	750 mg LD → 500 mg q24h
*Meropenem	See dosing on page 23	0.5-1 g q24h	1 g LD → 0.5-1 g q8h
***Meropenem/vaborbactam**	1-2 g q12h based on eCrCl	No data	No data
Penicillin G (mu=million units)	Typical LD → 25-50% normal dose q4-6h	No data	4 mu LD → 2-4 mu q4-6h
Piperacillin/tazobactam	See dosing on page 23	See dosing on page 23	See dosing on page 23
***Polymyxin B**	Contact ID PharmD	No data	Contact ID PharmD
Tobramycin	Same dosing as for gentamicin above	Same dosing as for gentamicin above	Same dosing as for gentamicin above
TMP/SMZ	Reduce dose to 25-50% usual dose	Reduce dose to 25-50% usual dose	No dose adjustment necessary
Vancomycin	25 mg/kg LD → 500-1000 mg or 5-10 mg/kg 3x/week post-HD	1000 mg q4-7 days	25 mg/kg LD → 1000 mg q24h or 7.5-10 mg/kg q12h

Other dosing regimens may be appropriate. Above regimens compiled from individual package inserts, Lexicomp®, expert opinion, Heinz et al *Pharmacotherapy* 2009;29(5):562-577, and Pistolesi et al. *Antimicrob. Agents Chemother.* 2019;63(8):1-18

DOSING GUIDELINES BASED ON RENAL FUNCTION: **PO AGENTS**

Antimicrobial	Typical Dose (may vary)	eCrCl (ml/min)	Suggested Dose Adjustment
Acyclovir	400-800 mg q12h (neutropenic ppx)	<10	200 mg q12h
	All other indications → use valacyclovir		
*Adefovir	10 mg q24h	30-49 10-29	10 mg q48h 10 mg q72h
Amoxicillin	500 mg q8h (most indications) or 1000 mg q12h (part of *H pylori* regimen)	10-29 <10	500 mg q12h 500 mg q24h
	1000 mg q8h (*Actinomycosis*)	10-29 <10	1000 mg q12h 500 mg q12h
Amoxicillin/clavulanate	875 mg q12h or 500 mg q8h	<30 10-30 <10	Avoid 875 mg tablets 250-500 mg q12h 250-500 mg q24h
*Cefadroxil	500-1000 mg q12h	25-50 10-25	500 mg q12h 500 mg q24h
Cefdinir	300 mg q12h	<30	300 mg q24h
*Cefpodoxime	100-400 mg q12h	<30	100-400 mg q24h
Cephalexin	500 mg q6h	30-59 15-29 5-14	500 mg q12h 250 mg q8-12h 250 mg q24h
Ciprofloxacin (IR)	500 mg q12h (most indications) or 750 mg q12h (anti-*Pseudomonal* dosing)	30-50 <30	250-500mg q12h 500mg q24h
Clarithromycin (IR)	500 mg q12h	<30	250 mg q12h
*Entecavir	0.5-1 mg q24h	30-49 10-29 <10	0.5-1 mg q48h 0.5-1 mg q72h 0.5-1 mg q 7 days
Ethambutol	15-25 mg/kg q24h	10-50 <10	15-25 mg/kg q24-36h 15-25 mg/kg q48h
*Famciclovir	500 mg q8h (Herpes zoster dosing)	40-59 20-39 <20	500 mg q12h 500 mg q24h 250 mg q24h
Fluconazole	200-800 mg q24h	<50	Same LD → 100-400 mg q24h
*Flucytosine	25 mg/kg/dose q6h	21-40 10-20 <10	25 mg/kg/dose q12h 25 mg/kg/dose q24h 25 mg/kg/dose q48h
Lamivudine	100 mg q24h (HBV treatment; See page 22 for dosing considerations for HIV)	30-49 15-29	100 mg LD → 50 mg q24h 100 mg LD → 25 mg q24h
Levofloxacin	500 mg q24h (most indications)	20-49 <20	500 mg LD → 250 mg q24h 500 mg LD → 250 mg q48h
	750 mg q24h (anti-*Pseudomonal* coverage)	20-49 <20	750 mg q48h 750 mg LD → 500 mg q48h
Nitrofurantoin	100 mg q12h	30-60 <30	Limit to short course (≤7 days) Use not recommended
Oseltamivir	*See dosing on page 15*		
Trimethoprim/sulfamethoxazole (TMP/SMZ)	1 DS tablet q12h (most indications)	15-30	1 DS tablet → 1 SS tablet q12h
	1 DS tablet q24h or 3x/week (PCP ppx)	15-30	1 SS tablet q24h or 3x/week
Valacyclovir	1000 mg q12h (HSV) or 1000 mg q8h (herpes zoster)	30-49 10-29 <10	1000 mg q12h 1000 mg q24h 500 mg q24h
*Valganciclovir	900 mg q12h (induction dose)	40-59 25-39 10-24	450 mg q12h 450 mg q24h 450 mg q48h
	900 mg q24h (maintenance/prevention dose)	40-59 25-39 10-24	450 mg q24h 450 mg q48h 450 mg twice weekly

* = Restricted to Infectious Diseases/Antimicrobial Stewardship
BOLD = Nonformulary; requires PADR consult approval
LD = loading dose

OVERVIEW OF COMMON ANTIRETROVIRAL THERAPY

When used for treatment or post-exposure prophylaxis (PEP), a complete antiretroviral regimen contains medications from 2, 3, or more drug classes to prevent the development of resistance.

- Many ARV tablets are combination pills which include more than 1 medicine in a single pill.
- In general, if 1 medication needs to be held, the entire regimen should be held. Infectious Diseases and Antimicrobial Stewardship teams can assist with choosing an alternative regimen.
- The preferred PEP regimen is raltegravir PLUS emtricitabine/tenofovir x28-30 days. PEP must be started within 72 hours of possible exposure.

When used for pre-exposure prophylaxis (PrEP) only two medications are needed.

- The only FDA-approved options for PrEP are emtricitabine/tenofovir alafenamide or emtricitabine/tenofovir disoproxil.

Any initiation of/change to antiretroviral therapy must be done in consultation with Infectious Diseases team. Use care to ensure the entire outpatient regimen is ordered upon admission/discharge from the hospital.

Refer to the "Crushing and Liquid ARV Formulations" link at www.hivclinic.ca for an up-to-date list

Medication	Brand Name	Typical Dose	Renal Dose Adjustment per eCrCl	Can be crushed, split, or opened?	Miscellaneous Info
Abacavir 300 mg TAB	Ziagen®	600 mg q24h	N/A	Yes	
Abacavir/lamivudine/dolutegravir 600/300/50 mg TAB	Triumeq®	1 tablet q24h	<50: Not recommended, use individual components	Yes	Separate from cations.
Bictegravir/emtricitabine/tenofovir AF 50/200/25 mg TAB	Biktarvy®	1 tablet q24h	<30: Not recommended	No	Separate from cations.
Darunavir 600, 800 mg TAB	Prezista®	600 mg q12h or 800 mg q24h	N/A	Not recommended	Give with food. Give with ritonavir or cobicistat booster.
Darunavir/cobicistat 800/150 mg TAB	Prezcobix®	1 tablet q24h	N/A	No	Give with food.
Dolutegravir 50 mg TAB	Tivicay®	1 tablet q24h	<30: Use with caution, consider alternative	Yes	Separate from cations.
Dolutegravir/lamivudine 50/300 mg TAB	Dovato®	1 tablet q24h	<50: Not recommended	No	Separate from cations.
Dolutegravir/rilpivirine 50/25 mg TAB	Juluca®	1 tablet q24h	<30: Use with caution, consider alternative	No	Give with food. Separate from cations
Doravirine 100 mg TAB	Pifeltro®	1 tablet q24h	N/A	No	
Efavirenz 600 mg TAB	Sustiva®	1 tablet qHS	N/A	No	Give on empty stomach.
Efavirenz/lamivudine/tenofovir DF 600/300/300 mg TAB	Symfi®	1 tablet qHS	<50: Not recommended	No	Use in place of Atripla®. Give on empty stomach at bedtime
Elvitegravir/cobicistat/emtricitabine/tenofovir AF 150/150/200/10 mg TAB	Genvoya®	1 tablet q24h	<30: Not recommended	No	Give with food. Separate from cations.
Elvitegravir/cobicistat/emtricitabine/tenofovir DF 150/150/200/300 mg TAB	Stribild®	1 tablet q24h	<70: Initial use not recommended <50: Cont'd use not recommended	No	Give with food. Separate from cations.
Emtricitabine/tenofovir AF 200/25 mg TAB	Descovy®	1 tablet q24h	<30: Not recommended	No	Avoid use for PrEP for patients engaging in receptive vaginal intercourse.
Emtricitabine/tenofovir DF 200/300 mg TAB	Truvada®	1 tablet q24h	<60: Not recommended (PrEP only) 30-49: 1 tablet q48h <30: Not recommended	Yes	Used for pre- or post-exposure prophylaxis (PrEP/PEP).
Emtricitabine/rilpivirine/tenofovir AF 200/25/25 mg TAB	Odefsey®	1 tablet q24h	<30: Not recommended	No	Give with food. Do not use if HIV VL>100k or CD4<200
Etravirine 200 mg TAB	Intelence®	200 mg q12h	N/A	Yes	Give AFTER meals
Lamivudine 100, 150 mg TAB	Epivir®	300 mg q24h	30-49: 150 mg q24h 15-29: 150 mg x1 → 100 mg q24h 5-14: 150 mg x1 → 50 mg q24h <5/HD: 50 mg x1 → 25 mg q24h	Yes	
Lopinavir/ritonavir 200/50 mg TAB	Kaletra®	2 tablets q12h	N/A	No	
Raltegravir 400 mg TAB	Isentress®	400 mg q12h	N/A	No	400 and 600 mg tablets should not be interchanged
Raltegravir 600 mg TAB	Isentress® HD	1200 mg q24h			
Ritonavir 100 mg TAB	Norvir®	100 to 400 mg per day in 1-2 divided doses	N/A	No	Tablets and capsules NOT bioequivalent. Used to "boost" protease inhibitors. Give with food
Tenofovir AF 25 mg TAB	Vemlidy®	25mg q24h	<15: Not recommended	No	Give with food
Tenofovir DF 300 mg TAB	Viread®	300 mg q24h	30-49: 300 mg q48h 10-29: 300 mg q72-96h	Yes	

ALTERNATIVE DOSING: SELECT ANTIMICROBIALS

Cefepime (see SOP 119-42)

Indication	*CrCl >50 ml/min*	*CrCl 30-50 ml/min*	*CrCl 10-29 ml/min*	*CrCl <10 or HD*
CNS infections Neutropenic fever Elevated cefepime MIC (4-8)* Empiric HAP/VAP coverage	2 g q8h	2 g q12h	1 g q12h	1 g q24h
CAP (not *Pseudomonas*) Mild to moderate UTI	1 g q12h	1 g q24h	1 g q24h	500 mg q24h
All other indications	1 g q6h	1 g q8h	1 g q12h	1 g q24h

*For *Enterobacteriaceae*

Meropenem (see SOP 119-42)

Indication	*CrCl >50 ml/min*	*CrCl 26-50 ml/min*	*CrCl 10-25 ml/min*	*CrCl <10 or HD*
CNS infections Neutropenic fever Elevated carbapenem MIC (≥4)	2 g q8h	2 g q12h	1 g q12h	1 g q24h
Uncomplicated UTI	500 mg q8h	500 mg q12h	250 mg q12h	500 mg q24h
All other indications	500 mg q6h	500 mg q8h	500 mg q12h	500 mg q24h

Piperacillin/tazobactam (see SOP 119-24)

CrCl	*Indication*	*Intermittent Dosing*	*Extended Infusion Dosing*
>20 ml/min and piperacillin/tazobactam intermediate or resistant *Pseudomonas aeruginosa* (breakpoints: S≤16, I 32-64, R ≥128)		Not recommended	4.5 g IV q6h over 3 hours (recommend additional anti-*Pseudomonal* coverage)
>40 ml/min	HAP or critical illness	4.5 g IV q6h over 60 min	4.5 g IV q8h over 4 hours
	Other indications	3.375 g IV q6h over 30 min	3.375 g IV q8h over 4 hours
20 – 40 ml/min	HAP or critical illness	3.375 g IV q6h over 30 min	3.375 g IV q8h over 4 hours
	Other indications	2.25 g IV q6h over 30 min	2.25 g IV q8h over 4 hours
<20 ml/min	HAP or critical illness	2.25 g IV q6h over 30 min	2.25 g IV q8h over 4 hours
	Other indications	2.25 g IV q8h over 30 min	2.25 g IV q12h over 4 hours
Hemodialysis (HD) and peritoneal dialysis (PD)	HAP or critical illness	2.25 g IV q8h over 30 min & 0.75 g post-dialysis	2.25 g IV q8h over 4 hours
	Other indications	2.25 g IV q12h over 30 min & 0.75 g post-dialysis	2.25 g IV q12h over 4 hours
Continuous Renal Replacement Therapy (CRRT)		Follow CrCl > 40 ml/min dosing	Follow CrCl > 40 ml/min dosing

Home IV Antimicrobial Procedures

- Physician enters the "HOME IV ANTIBIOTIC NOTE" by searching by progress note title and then fills out the required template. Choose "CVS/Coram" under the Infusion Company drop down list
- Any changes to the regimen must be documented on the above note and cosigned by the attending physician
- Orders must be entered and signed by 12pm if patient is leaving the same day
- Transition patients to ideal dosing schedule → 08:00 for Q24H dosing, 08:00/20:00 for Q12H dosing
- Schedule labs and serum monitoring for early in the week (Mondays through Wednesdays)

CVS/Coram Specialty Infusion Contact Information

- Phone (813) 639-4500; fax (877) 602-6777
- Case managers: Katie Sullivan & Jessica Yanta

Types of Home Infusion:

IV Push

- Convenient
- Does NOT restrict mobility
- Medication is provided in a pre-filled syringe
- The patient or caregiver manually infuses the medication over several minutes

Antimicrobials available via this method:

- Aztreonam
- Cefazolin
- Cefepime
- Cefotetan
- Cefoxitin
- Ceftazidime
- Ceftriaxone
- Daptomycin

Continuous Infusion Pump

- Convenient
- Does NOT restrict mobility
- Medication is provided in either a pre-filled syringe or an IV bag
- The patient or caregiver places the medication in the pump which then infuses over a programmed amount of time, usually 24 hours
- The medication/pump may be placed in a backpack or fanny pack so the patient can perform daily activities

Antimicrobials available via this method:

- Cefazolin
- Oxacillin
- Penicillin G
- Piperacillin/tazobactam

Elastomeric Pump

- Convenient
- Does NOT restrict mobility
- Medication provided in a pre-filled eclipse ball
- The patient or caregiver connects the pump which infuses the medication over a programmed amount of time
- The ball may be placed in a pocket or backpack so the patient can perform daily activities

Antimicrobials available via this method:

- Amikacin
- Aztreonam
- Cefazolin
- Cefepime
- Cefotetan
- Cefoxitin
- Ceftazidime
- Ceftriaxone
- Clindamycin
- Daptomycin
- Ertapenem
- Gentamicin
- Oxacillin
- Penicillin G
- Piperacillin/tazobactam
- Tobramycin
- Vancomycin

Gravity IV

- NOT convenient
- Restricts mobility
- Medication is provided in an IV bag
- Patient or caregiver must spike the bag, prime the line, set rate, and hang the medication on an IV pole for the duration of infusion. In some cases, the patient or caregiver must also reconstitute the medication

Antimicrobials available via this method:

- Ampicillin
- Ampicillin/sulbactam
- Azithromycin
- Ceftaroline
- Ciprofloxacin
- Doxycycline
- Imipenem/cilastatin
- Levofloxacin
- Linezolid
- Meropenem
- Metronidazole
- Minocycline
- Tigecycline
- TMP/SMZ

VANCOMYCIN DOSING & MONITORING

Remember to place a Therapeutic Drug Monitoring (TDM) consult for patients on vancomycin or aminoglycosides. Pharmacy service will dose, monitor, and adjust the regimen as needed. Be sure to include your indication for use!

Empiric Dosing:

1. **Determine pharmacokinetic targets based on indication.**

*Goal AUC (mg*hr/L)*	*Infection Classification*	*Example(s)*
400 – 450	Mild	Uncomplicated cystitis, cellulitis without systemic infection
450 – 500	Moderate	Pyelonephritis, cellulitis with systemic infection
500 – 550	Severe	Pneumonia, bacteremia, endocarditis, sepsis, osteomyelitis

2. **Input patient data into the vancomycin calculator.**
   - (S:) Pharmacy → Clinical → Vancomycin Kinetics → Vancomycin Calculator
   - Select the volume of distribution (Vd) factor and clearance method suggested by the calculator
   - If unable to access the above calculator, use the calculator here: https://www.vancopk.com/

3. **Select a one-time loading dose (if necessary)**
   - 20-35 mg/kg actual body weight if BMI <30 kg/m^2 or 20-25 mg/kg actual body weight if BMI ≥30 kg/m^2
   - Consider a loading dose for patients with severe infection
   - Maximum single loading dose = 3000 mg

4. **Select maintenance dose and dosing interval**
   - Choose the 'best fit' or 'next best fit' regimen as suggested by the calculator
   - Maximum single maintenance dose = 2000 mg.
   - Minimum infusion rate is 30 minutes per each 500 mg. Consider extending infusion time in the setting of Redman's syndrome.

Monitoring:

Determine if using traditional trough-based or AUC-based monitoring

Monitoring is recommended for all patients with serious MRSA infections, those at high risk for nephrotoxicity, patients with variable renal function, or those receiving more than 3-5 days of therapy. Monitoring is typically not necessary for patients receiving vancomycin for surgical prophylaxis, uncomplicated UTI, cellulitis without bacteremia, or other indications where anticipated duration of therapy is less than 3-5 days.

Trough-based monitoring	AUC-based monitoring
• Meningitis or CNS infection • Variable renal function, HD, or CRRT	• All other indications

What levels should be drawn?

Trough level only	Both peak and trough levels

When should levels be drawn?

Obtain level at steady state*	Obtain levels at steady state§
• Draw trough 30 minutes prior to next dose *For HD patients, obtain a pre-HD level prior to 2nd or 3rd supplemental dose. Consider obtaining with morning labs if patient has no residual renal function.	• Draw peak 2 hours after the infusions ENDS • Draw trough 30 minutes prior to next dose §May draw levels after the 1st maintenance dose if a loading dose of ≥20 mg/kg actual body weight was given.

Once at goal, surveillance troughs should be monitored weekly (unless pharmacokinetic parameters change)

What are the target/goals?

• Trough 10-15 mcg/mL: UTIs and SSTIs • Trough 15-20 mcg/mL: All other indications	• AUC 400-550 mg*hr/L and • Trough 10-20 mcg/mL

Rybak MJ et al. Therapeutic monitoring of vancomycin for serious methicillin-resistant *Staphylococcus aureus* infections: A revised consensus guideline and review by the American Society of Health-System Pharmacists, the Infectious Diseases Society of America, the Pediatric Infectious Diseases Society, and the Society of Infectious Diseases Pharmacists. *Am J Health-Syst Pharm*. 2020; Mar:1-31

AMINOGLYCOSIDE DOSING & MONITORING: CONVENTIONAL

Conventional Dosing

1. **Calculate the patient's ideal body weight (IBW).** Use equation on page #18.

2. **Calculate an initial dose.** Use IBW to calculate the dose unless…
   - Patient weighs less than their IBW, then use actual body weight (ABW)
   - Patient weighs more than 120% of their IBW, then use adjusted body weight (AdBW)

Tobramycin and Gentamicin	1 - 2.5 mg/kg
Amikacin	5 - 7.5 mg/kg

3. **Calculate the patient's creatinine clearance.** Use equation on page #18. Consider using cystatin-C to estimate creatinine clearance in spinal cord injury patients (http://www.touchcalc.com/calculators/cystatin)

4. **Select a dosing interval based on the creatinine clearance.**

Creatinine clearance (mL/min)	*Suggested Dosing Interval*
>60	Q8h
40-59	Q12h
20-39	Q24h
<20	Loading dose then follow levels
Dialysis	See dialysis dosing on pages 20

5. **Once at steady state, draw a trough level 30 minutes prior to the next infusion and a peak level 30 minutes after the infusion has ended.** Adjust the regimen as necessary.

Infection	*Desired Peak (mcg/mL)*		*Desired Trough (mcg/mL)*	
	Tobra/gent	*Amikacin*	*Tobra/gent*	*Amikacin*
Pneumonia	8-10	25-35	<1	<4-8
Other gram negative infections	6-8	25-35	<1	<4-8
Cystitis, synergy in gram positive infections	3-5	20-25	<1	<4-8

Useful PK Equations (when levels available)

Patient-specific Ke:

$$Ke = \frac{\ln(C_{peak\ measured} / C_{trough\ measured})}{\Delta t}$$

Δt = time between measured peak and measured trough OR time interval between 2 levels with no doses given in between

Half-life:

$$t_{1/2} = 0.693 / K_e$$

True peak/trough:

$$True\ C_{peak} = \frac{C_{peak\ measured}}{e^{-(Ke)(t)}}$$

Where t = the time peak was drawn minus time infusion ended

$$True\ C_{trough} = [C_{trough\ measured}] \times [e^{-(Ke)(t)}]$$

Where t = time infusion began minus time trough was drawn

Volume of distribution:

$$Vd = (dose/t/K_e) \times \frac{1 - e^{-(Ke)(t)}}{C_{true\ peak} - (C_{true\ trough} \times e^{-(Ke)(t)})}$$

Where t = the time of infusion (usually 0.5 or 1 hour)

New dosing interval

$$\tau = \frac{-1}{K_e} \times [\ln(C_{trough\ desired} / C_{peak\ desired}) + t]$$

New dose

$$New\ dose = (K_e \times Vd \times C_{peak\ desired}) \times \frac{1 - e^{-(Ke)(t)}}{1 - e^{-(Ke)(\tau)}}$$

Where t = the time of infusion (usually 0.5 or 1 hour)

AMINOGLYCOSIDE DOSING & MONITORING: EXTENDED INTERVAL

Determine if using Barnes-Jewish or Hartford Hospital nomogram

Extended interval dosing is not recommended for burn, pregnant, or trauma patients nor those with endocarditis, ascites, or unstable/fluctuating renal function. Avoid extended interval dosing when using aminoglycosides for synergy and for patients with ESRD/on dialysis

Barnes-Jewish Nomogram	Hartford Hospital nomogram
• Use for most patients • Gentamicin/tobramycin 5 mg/kg • Amikacin 15 mg/kg	• Use for pneumonia or severe sepsis • Gentamicin/tobramycin 7 mg/kg

Calculate an initial dose

See ideal body weight (IBW) and adjusted body weight (AdBW) equations on page 18

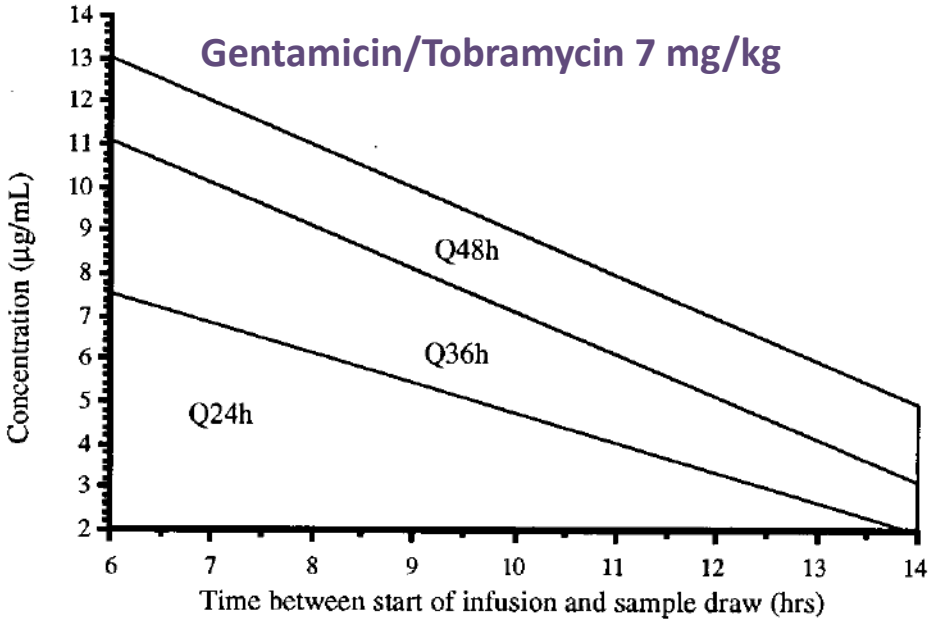
Use ideal body weight, unless…	Use actual body weight, unless…
• Patient weighs less than IBW, then use actual body weight • Patient weighs >20% IBW, then use adjusted body weight	• Patient weighs >20% IBW, then use adjusted body weight

Draw a post-dose level

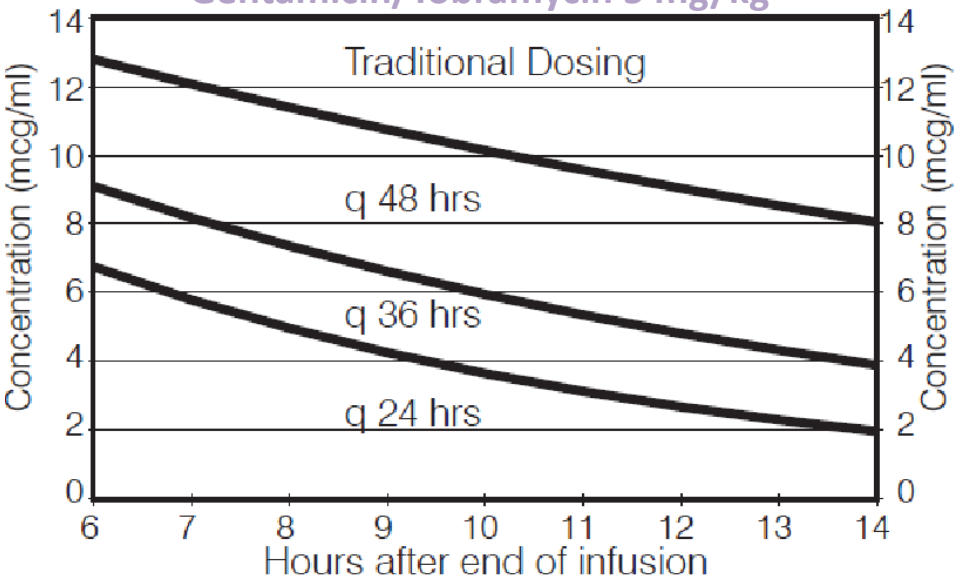
Draw a level 6-14 hours AFTER the infusion has ended	Draw a level 6-14 hours after the START of the infusion

Plot the level on the appropriate nomogram and adjust patient's dosing interval

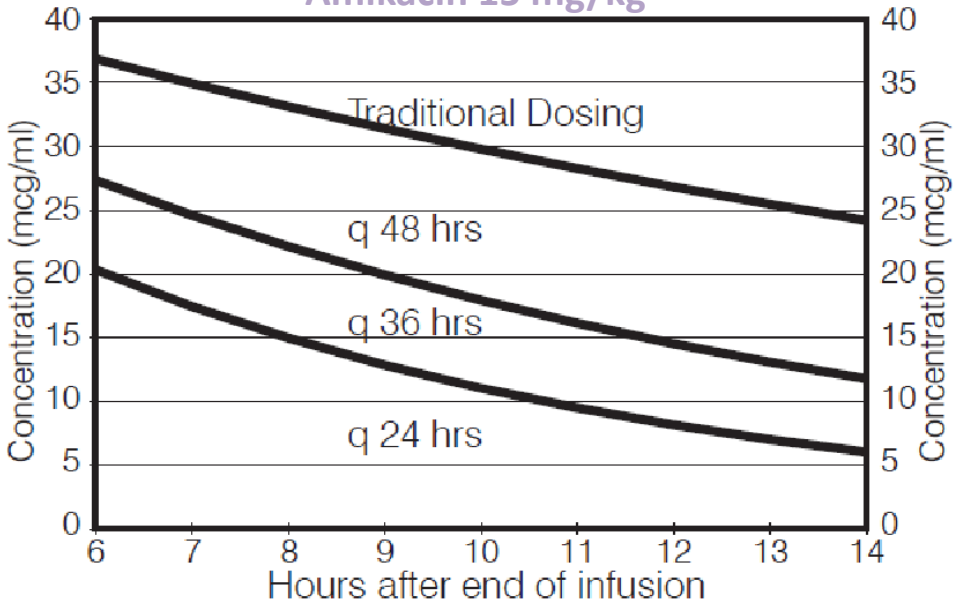
Barnes-Jewish nomograms to the right	Hartford Hospital nomogram below



Gentamicin/Tobramycin 5 mg/kg



Amikacin 15 mg/kg



Bailey TC, et al. A Meta-Analysis of Extended-Interval Dosing Versus Multiple Daily Dosing of Aminoglycosides. *Clin Infect Dis.* 1997;24:786-95

Nicolau DP, et al. Experience with a Once-Daily Aminoglycoside Program Administered to 2,184 Adult Patients. *Antimicrob Agents Chemother.* 1995;36(3):650-655

GRAM POSITIVE ISOLATES (2018)

Gram Positive Organisms 2018	***ENTEROCOCCUS FAECALIS***	***ENTEROCOCCUS FAECIUM***	***STAPHYLOCOCCUS AUREUS***	***STAPHYLOCOCCUS CAPITUS***	***STAPHYLOCOCCUS EPIDERMIDIS***	***STAPHYLOCOCCUS HAEMOLYTICUS***	***STAPHYLOCOCCUS HOMINIS***	***STAPHYLOCOCCUS LUGDUNENSIS***
AMPICILLIN	99	23						
CIPROFLOXACIN	73	9	50	71	47	50	55	98
CLINDAMYCIN			70	71	64	52	70	70
DAPTOMYCIN	100		100	100	100	100	100	100
DOXYCYCLINE			96					
ERYTHROMYCIN	10	2	34	68	35	37	30	70
GENTAMICIN			99	82	92	92	100	100
LEVOFLOXACIN	75	11	51	71	48	55	55	98
LINEZOLID	92	96	100	100	100	100	100	100
NITROFURANTOIN			69	93	77	79	80	98
OXACILLIN			46	71	43	55	55	90
RIFAMPIN			99	100	98	95	100	98
TETRACYCLINE	19	15	91	86	80	71	95	92
TIGECYCLINE	100	100	100	100	100	100	100	100
TRIMETHOPRIM/SULFA			87	93	57	82	65	73
VANCOMYCIN	94	38	99	100	99	100	100	100

GRAM NEGATIVE ISOLATES (2018)

Gram Negative Organisms 2018	*ACINETOBACTER BAUMANNII COMPLEX*	*CITROBACTER FREUNDII*	*CITROBACTER KOSERI*	*ENTEROBACTER AEROGENES*	*ENTEROBACTER CLOACAE*	*ESCHERICHIA COLI*	*KLEBSIELLA OXYTOCA*	*KLEBSIELLA PNEUMONIAE*	*MORGANELLA MORGANII*	*PROTEUS MIRABILIS*	*PROVIDENCIA STUARTII*	*PSEUDOMONAS AERUGINOSA*	*SALMONELLA GROUP*	*SERRATIA MARCESCENS*	*STENOTROPHOMONAS MALTOPHILIA*
AMIKACIN		100	100	100	100	100	100	99	98	100	100	99		99	
AMPICILLIN						49				72			100		
AMPICILLIN/SULBACTAM	81					56	51	72	11	86	35				
CEFAZOLIN			89			82	57	81		85					
CEFEPIME	69	98	98	97	97	95	100	92	90	96	100	87		8	
CEFTAZIDIME	63	81	98	88	82	88	99	85	97	91	100	89		95	30
CEFTRIAXONE	13	86	98	88	82	88	99	84	95	91	97		100	92	
CIPROFLOXACIN	56	95	98	95	94	66	97	85	67	65	52	81		97	
ERTAPENEM		98	98	98	98	100	100	98	98	96	100			99	
GENTAMICIN	75	91	100	100	96	89	97	93	82	92		95		95	
IMIPENEM	81	98	97	70	97	100	100	98	45	13	45	87			
LEVOFLOXACIN	56	98	98	94	95	66	99	85	67	67	39	76		97	88
NITROFURANTOIN		90	88	16	43	96	86	30							
PIPERACILLIN/TAZOBACTAM	56	88	98	54	82	94	99	90	93	98	100	92			
TOBRAMYCIN	75	91	100	100	96	89	96	87	84	92		98		90	
TRIMETHOPRIM/SULFA	44	91	98	100	92	77	97	81	65	73	81		100	99	88

At the time of printing, an updated antibiogram with 2019 isolates was not yet available. Please refer to the antibiogram on the Intranet homepage for most updated version.

Intranet —> Clinical Links (on right side menu) —> Hospital Antibiogram

IV TO PO CONVERSION

Candidates for Antimicrobial Step-Down Therapy

- The infection is treatable with oral antimicrobial therapy and the indications and spectrum of activity are identical/similar between drugs
- Patient is able to take medications by mouth or has a functional feeding tube in place
- Pt has been on IV therapy ≥48 hours and is showing overall clinical improvement
  - No fever
  - WBC within normal limits or trending down to normal range
  - Hemodynamically stable as evidenced by:
    - Temp. ≤38°C (100.4°F) and ≥36°C (96.8°F)
    - HR <90 beats/minute
    - RR <20 breaths/minute
    - Stable BP

Contraindications for Antimicrobial Step-Down Therapy

- Active NPO order or inadequately absorbing PO medications
  - Vomiting
  - Malabsorption disorder
  - Mechanical swallowing disorder
  - On gastric suction or gastric paralytics
  - GI obstruction or abnormal motility/ileus
- Serious infections requiring prolonged IV antibiotic treatment including, but not limited to:
  - Meningitis
  - Osteomyelitis
  - Endocarditis
  - Bacteremia/sepsis
  - Liver abscess

IV	PO
Acyclovir 5 mg/kg q8h Acyclovir 10mg/kg q8h	Valacyclovir 1000 mg q12h Valacyclovir 1000 mg q8h
Ampicillin 1 g q6h	Amoxicillin 500 mg q8h
Ampicillin/sulbactam 1.5–3gm q8h	Amoxicillin/clavulanate 875/125 mg q12h (except *Acinetobacter* spp.)
Azithromycin 500 mg q24h	Same dose and interval
Cefazolin 1 g q8h	Cephalexin 500 mg q6h
Ceftriaxone 1-2g q24h	Cefdinir 300mg q12h (except *Morganella spp.*)
Ciprofloxacin 200 mg q12h Ciprofloxacin 400 mg q12h Ciprofloxacin 400 mg q8h	Ciprofloxacin 250 mg q12h Ciprofloxacin 500 mg q12h Ciprofloxacin 750 mg q12h
Clindamycin 600 mg q8h Clindamycin 900 mg q8h	Clindamycin 300 mg q8h Clindamycin 450 mg q8h
Doxycycline 100 mg q12h	Same dose and interval
Fluconazole 100–400 mg q24h	Same dose and interval
Levofloxacin 500–750 mg q24h	Same dose and interval
Linezolid 600 mg q12h	Same dose and interval
Metronidazole 500 mg q8h	Same dose and interval
Minocycline 100mg q12h	Same dose and interval
Rifampin 300 mg q12h	Same dose and interval

PNEUMOCOCCAL VACCINE ALGORITHM

IMMUNOCOMPETENT

Age 19-64

PPSV23 x 1 if not previously received[1]

Age 65+

Shared clinical decision-making if patient may benefit from PCV13

If never received PPSV23; give PPSV23 x1 at least 1 year after PCV 13

If received PPSV23 before age 65; give PPSV23 x 1, at least 1 year after PCV13 (and 5 years after last PPSV23)

If received PPSV23 on or after age 65; give PCV13 x 1 at least one year after PPSV23

IMMUNOCOMPROMISED[2]

CSF leak, cochlear implant, chronic renal failure, nephrotic syndrome, immunodeficiency, iatrogenic immunosuppression, generalized malignancy, HIV, Hodgkin disease, leukemia, lymphoma, multiple myeloma, solid organ transplants, congenital or acquired asplenia, sickle cell disease, or other hemoglobinopathies.

Age 19-64

Previously received PPSV23

PCV13 x 1, at least 1 year after PPSV23

If needed[3]: give additional PPSV23, 6-12 months** after PCV13 (and 5 years after last PPSV23)

No prior PPSV23

PCV13 x 1

PPSV23 x 1, 6-12 months** after PCV13

If needed[3]: give additional PPSV23 at least 5 years after last PPSV23)

Age 65+

PCV13 x 1 if never previously received; at least 1 year after last PPSV23

If never received PPSV23; give PPSV23 x1 at least 1 year after PCV 13

If received PPSV23 before age 65; give PPSV23 x 1, at least 1 year after PCV13 (and 5 years after last PPSV23)

If received PPSV23 on or after age 65; give PCV13 x 1 at least one year after PPSV23

PPSV23 = 23-valent pneumococcal polysaccharide vaccine, Pneumovax®, Merck & Co. Inc.
PCV13 = 13-valent pneumococcal conjugate vaccine, Prevnar® , Pfizer Inc.

**Ideally PCV13 and PCV13 should be given 6-12 months apart.. However, minimum acceptable interval is 8 weeks
[1] Routine use of PPSV23 is not recommended for American Indians/Alaska Natives or other persons younger than age 65 unless they have underlying medical conditions that are PPSV23 indications
[2] **PCV13 x 1 Exception**: Hematopoietic stem cell transplant (HSCT) patients should receive PCV13 x 3 doses before receiving PPSV23 (initial PCV13 dose 3–6 months after transplant; subsequent PCV13 doses every 2 months x 2 doses)
[3] **Additional PPSV23 administrations:** give a **TOTAL** of two PPSV23 doses to immunocompromised patients, **EXCEPT** for those with CSF leaks & cochlear implants (whom only receive 1 dose)

MMWR 2019;68(46)

PENICILLIN ALLERGIES

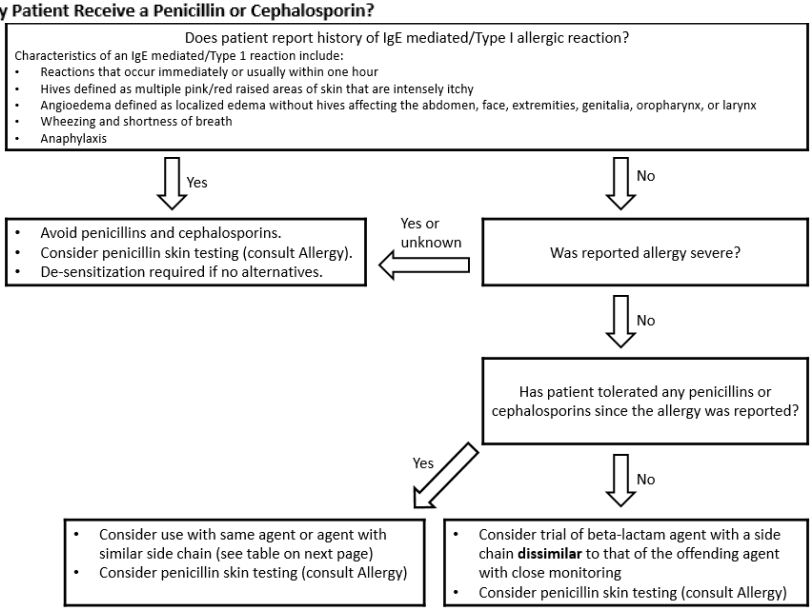
Did You Know?

- Approximately 80% of patients with IgE-mediated penicillin allergy lose their sensitivity after 10 years.

James A. Haley Veterans' Hospital Allergy Assessment Questionnaire

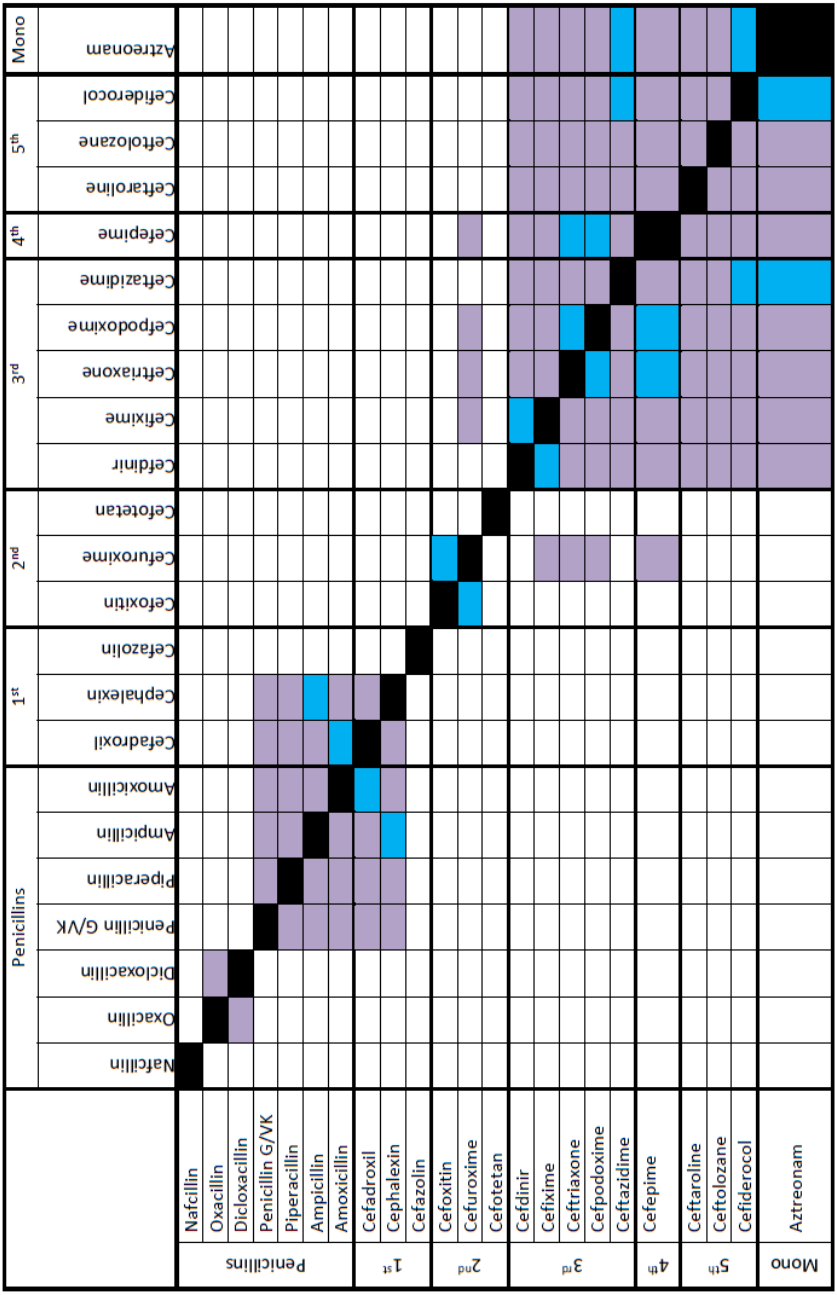
1	What is the name of the specific medication that you had a reaction to?
2	Where did you have the medication filled? If not at JAHVH, what type of medication did you have a reaction to (i.e. oral, IV, topical, etc.)?
3	How long ago did the reaction occur? How soon after taking the medication did you experience the reaction?
4	Describe the reaction that you experienced?
5	Did you require medical treatment for the reaction you experienced (i.e. did you come to the hospital, what medications did you receive)?
6	Were you taking any other new medications at the time of the reaction? If yes, are you still tolerating those medications?
7	Since having your initial reaction have you tolerated the same medication again or a medication in the same class? [provide medication examples]

Can My Patient Receive a Penicillin or Cephalosporin?



Bhattacharya, S. The Facts About Penicillin Allergy: A Review. *J Adv Pharm Technol Res*. 2010 Jan-Mar; 1(1): 11–17.
CDC's "Is it really a penicillin allergy?" Available at:
https://www.cdc.gov/getsmart/week/downloads/getsmart-penicillin-factsheet.pdf Accessed May 2017

BETA LACTAM CROSS REACTIVITY



Adapted from Zagursky RJ et al. Cross-reactivity in B-lactam allergy. *J Allergy Clin Immunol Pract*. 2018;6:72-81

HOSPITAL PRECAUTIONS

Illnesses Requiring Contact Precautions:

Agents/Diseases

- Adenovirus
- Antibiotic-resistant organisms: MRSA, VRE, or key multi-drug resistant gram negatives[§]
- Clostridium difficile ("C. diff")
- Diarrhea, acute, unknown cause
- Diphtheria, cutaneous form (Note: pharyngeal diphtheria requires droplet)
- Ebola fever
- Hepatitis A
- Herpes simplex, disseminated mucocutaneous
- Herpes zoster (shingles) localized in immunocompetent patient
- Lassa fever
- Lice
- Marburg virus
- Respiratory Syncytial virus (RSV)
- Rotavirus
- Scabies
- Shingles
- Staphylococcal skin/wound/burn infection, major
- Streptococcal skin/wound/burn infection, major

[§] Infection Control flags gram negatives of epidemiological significance

Clinical Syndromes

- Abscess, draining major
- Cellulitis, acute (uncontained)
- Conjunctivitis, viral
- Decubitus ulcer, major, infected
- Diarrhea, acute, unknown cause*
- Enterocolitis, *Clostridium difficile*
- Hemorrhagic fevers
- Impetigo
- SARS (also Airborne precautions)
- Shingles, localized in immunocompetent pt
- Skin/wound or burn infections, with hard to control drainage
- Wound infection, major

*Gastroenteritis (acute diarrhea) in incontinent patients caused by any of the following: *Campylobacter, Clostridium difficile, Cryptosporidium, Escherichia coli, Giardia*, Hepatitis A virus, Norovirus, Rotavirus, *Salmonella, Shigella, Vibrio cholerae* (cholera), *Vibrio parahaemolyticus, Yersinia enterocolitica* –OR – if the cause of acute diarrhea is unknown, but an infectious cause is suspected.

Illnesses Requiring Airborne Precautions:

- Tuberculosis (*Mycobacterium tuberculosis* complex)
- Chickenpox (Varicella) [also CONTACT precautions]
- Measles (Rubeola)
- Shingles (Herpes zoster) in an immunocompromised patient [also use CONTACT precautions]
- Disseminated shingles (Herpes zoster) [also use CONTACT precautions]
- SARS - Severe Acute Respiratory Syndrome [also CONTACT precautions]
- Smallpox

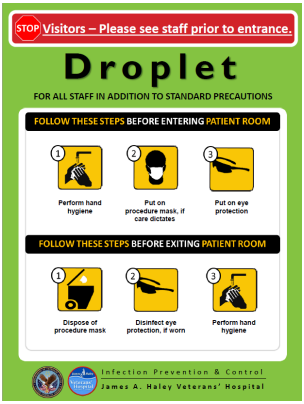
Illnesses Requiring Droplet Precautions:

Agents/Diseases

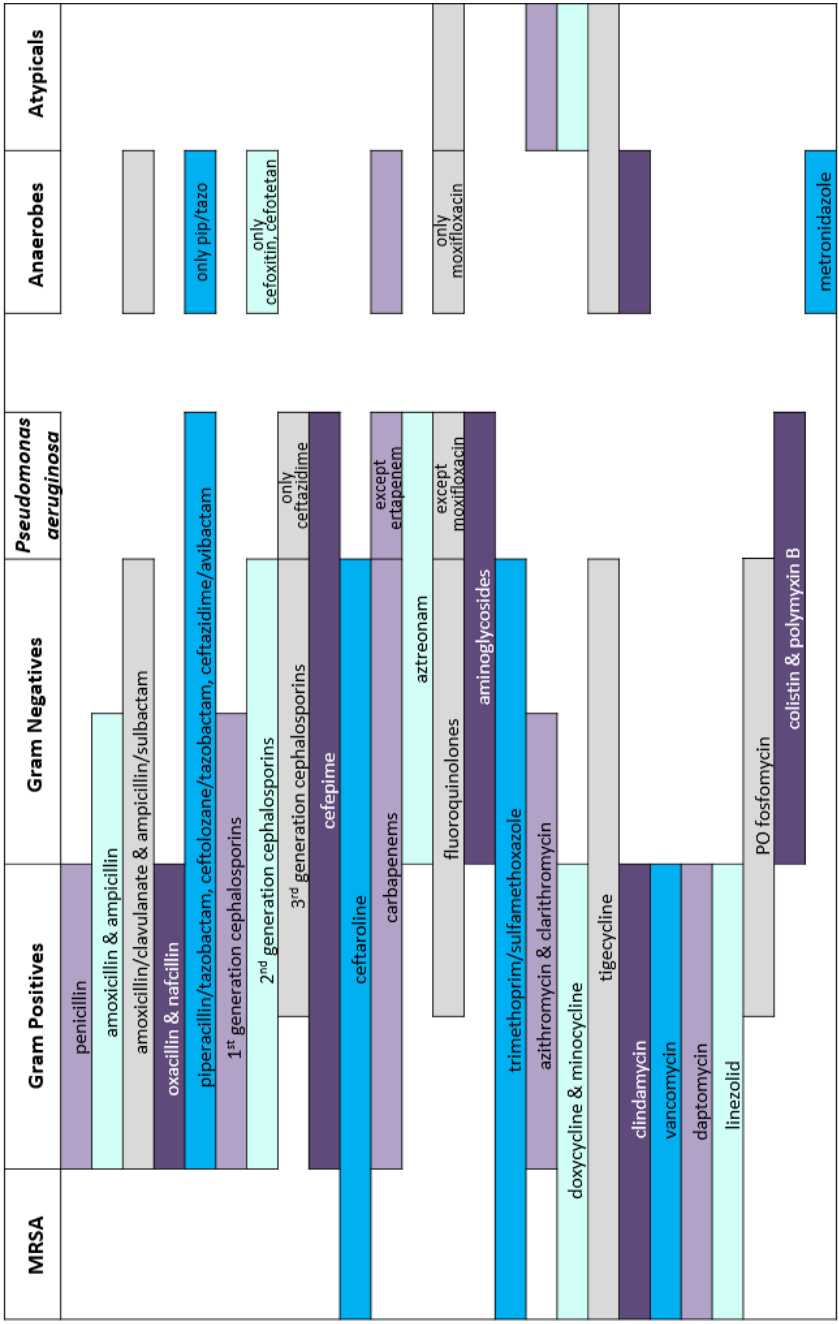
- *Corynebacteria diphtheriae*
- Diphtheria, pharyngeal
- Erythema infectiosum (Fifth Disease)
- Fifth Disease (parvovirus B19)
- *Haemophilus influenzae* meningitis
- *Haemophilus influenzae* pneumonia
- Influenza
- Mumps
- *Mycoplasma pneumoniae*
- *Neisseria meningitidis* bacteremia
- *Neisseria meningitidis* meningitis
- *Neisseria meningitidis* pneumonia
- Parvovirus B19 (erythema infectiosum)
- Pertussis (whooping cough)
- Plague, pneumonic (*Yersinia pestis*)
- Rhinovirus (common cold)
- Rubella, (German measles)
- Viral Hemorrhagic Fevers (due to Lassa, Ebola, Marburg or Crimean-Congo fever viruses
- Whooping cough (pertussis)
- *Yersinia pestis* pneumonia

Clinical Syndromes

- Epiglottitis, *Haemophilus influenzae*
- Influenza ("flu")
- Meningitis, *Neisseria meningitidis*
- Meningitis, *Haemophilus influenzae*
- Meningococcemia, *Neisseria meningitidis*
- Pneumonia – specifically with Adenovirus, *Mycoplasma pneumoniae*, *Neisseria meningitidis*, Streptococcus Group A
- Any "suspected" bacterial meningitis illness



ANTIBIOTIC SPECTRUM OF ACTIVITY: AT A GLANCE



SPECTRUM OF ACTIVITY

Penicillins (penicillin V, penicillin G)	Bactericidal
Good: *Treponema pallidium*, most *Streptococci* Moderate: *Enterococci* Poor: Everything else	
Anti-staphylococcal Penicillins (nafcillin)	Bactericidal
Good: *MSSA*, *Streptococci* Poor: Gram negative rods, *Enterococci*, anaerobes, *MRSA*	
Aminopenicillins (amoxicillin, ampicillin)	Bactericidal
Good: *Streptococci*, *Enterococci* Moderate: Enteric Gram-negative rods, *Haemophilus* Poor: *Staphylococci*, anaerobes, *Pseudomonas*	
Beta-lactam/Beta-lactamase inhibitor combinations (piperacillin/tazobactam, amoxicillin/clavulanate, ampicillin/sulbactam)	Bactericidal
Good: *MSSA*, *Streptococci*, *Enterococci*, anaerobes, Gram negative rods, *Pseudomonas aeruginosa* (only piperacillin/tazobactam) Moderate: Enteric Gram-negative rods with advanced beta-lactamases Poor: *MRSA*, enteric Gram-negative rods with extended-spectrum beta-lactamases (ESBL+)	
Extended Spectrum Beta-lactam/Beta-lactamase inhibitor combinations (ceftazidime/avibactam, ceftolozane/tazobactam)	Bactericidal
Good: *Pseudomonas aeruginosa*, enteric Gram-negative rods Moderate: Some *Streptococci* Poor: Anaerobes, *MRSA*, *MSSA*, *Acinetobacter*	
1st generation cephalosporins (cefazolin, cephalexin)	Bactericidal
Good: *MSSA*, *Streptococci* Moderate: Some enteric Gram-negative rods Poor: *Enterococci*, anaerobes, *MRSA*, *Pseudomonas*	
2nd generation cephalosporins (cefuroxime, cefoxitin, cefotetan)	Bactericidal
Good: Some enteric Gram negative rods, *Haemophilus*, *Neisseria* Moderate: *Streptococci*, *Staphylococci*, anaerobes (only cefoxitin and cefotetan) Poor: *Enterococci*, *MRSA*, *Pseudomonas*	
3rd generation cephalosporins (ceftriaxone, cefotaxime, ceftazidime, cefdinir, cefpodoxime, cefixime)	Bactericidal
Good: *Streptococci*, *Pseudomonas* (ceftazidime only), enteric Gram negative rods Moderate: *MSSA* (except ceftazidime which is poor) Poor: *Enterococci*, *Pseudomonas* (except ceftazidime), *MRSA*, anaerobes	
4th generation cephalosporins (cefepime)	Bactericidal
Good: *MSSA*, *Streptococci*, *Pseudomonas*, enteric Gram negative rods Moderate: *Acinetobacter* Poor: *Enterococci*, anaerobes, *MRSA*	
5th generation cephalosporins (ceftaroline)	Bactericidal
Good: *MSSA*, *MRSA*, *Streptococci*, enteric Gram negative rods Moderate: *Acinetobacter*, *Enterococcus faecalis* Poor: *Pseudomonas*, *Enterococcus faecium*, anaerobes	
Carbapenems (imipenem/cilastatin, meropenem, ertapenem)	Bactericidal
Good: *MSSA*, *Streptococci*, anaerobes, Gram negative rods including ESBL+, *Pseudomonas*/*Acinetobacter* (not ertapenem) Moderate: *Enterococci* (not ertapenem) Poor: *MRSA*	
Monobactams (aztreonam)	Bactericidal
Good: *Pseudomonas*, most Gram negative rods Moderate: *Acinetobacter* Poor: Gram-positive organisms, anaerobes	
Glycopeptides (vancomycin)	Bactericidal*
Good: *MRSA*, *Streptococci*, *Clostridium difficile* (PO only), *MSSA* Moderate: *Enterococci* (*bacteriostatic) Poor: Gram-negative organisms	

Fluoroquinolones (ciprofloxacin, levofloxacin, moxifloxacin)		Bactericidal
Respiratory FQs – levofloxacin and moxifloxacin Good: Gram negative rods, *Haemophilus, Strep. pneumo.* Moderate: *Pseudomonas* (levofloxacin only), *MSSA* Poor: Anaerobes (except moxifloxacin which is moderate), *Enterococci*	Non-respiratory FQs – ciprofloxacin Good: Gram negative rods, *Haemophilus* Moderate: *Pseudomonas*, atypicals Poor: *Staphylococci, Strep pneumo.*, anaerobes, *Enterococci*	
Aminoglycosides (gentamicin, tobramycin, amikacin)		Bactericidal
Good: Gram-negatives Moderate: (in combination with a beta-lactam) *Staphylococci, Streptococci, Enterococci* Poor: Atypicals, anaerobes, gram-positive organisms		
Tetracyclines (doxycycline, minocycline)		Bacteriostatic
Good: Atypicals, *Rickettsia*, spirochetes Moderate: *Staphylococci, Strep pneumo* Poor: Gram negative rods, anaerobes, *Enterococci*		
Glycylcycline (tigecycline)		Bacteriostatic
Good: Atypicals, *Enterococci, Staphylococci, Strep pneumo* Moderate: Gram negative rods, anaerobes Poor: *Pseudomonas, Proteus, Providencia*		
Macrolides (azithromycin, erythromycin, clarithromycin)		Bacteriostatic
Good: Atypicals, *Haemophilus, M. catarrhalis, H. pylori, Mycobacteria* Moderate: *Strep pyogenes* Poor: *Staphylococci*, Gram negative rods, anaerobes, *Enterococci*		
Oxazolidinone (linezolid)		Bacteriostatic
Good: *MRSA, Streptococci, Enterococci, Nocardia, MSSA* Moderate: Some atypicals, some Mycobacteria Poor: Gram-negatives, anaerobes		
Nitroimidazole (metronidazole)		Bactericidal
Good: Anaerobes, protozoa Moderate: *H. pylori* Poor: Aerobes, anaerobes from human mouth flora		
Nitrofurans (nitrofurantoin and fosfomycin)		Bactericidal
Good: *E. coli, Staphylococcus saprophyticus* Moderate: *Citrobacter, Klebsiella, Proteus, Enterococci, Pseudomonas* (fosfomycin), *Serratia* (fosfomycin) Poor: *Acinetobacter*		
Streptogramin (quinupristin/dalfopristin)		Bactericidal (*S. aureus*) Bacteriostatic (*E. faecium*)
Good: *MSSA, MRSA, Streptococci, Enterococcus faecium* Poor: *Enterococcus faecalis*, Gram negative rods		
Cyclic Lipopeptides (daptomycin)		Bactericidal
Good: *MRSA, Streptococci, MSSA, Enterococci* Poor: Gram negative rods		
Folate Antagonists (trimethoprim/sulfamethoxazole)		Bacteriostatic
Good: *Staphylococcus aureus, Haemophilus, Stenotrophomonas, Listeria, Nocardia* Moderate: Gram negative rods, *Strep pneumo, Salmonella, Shigella* Poor: *Pseudomonas, Enterococci*, anaerobes		
Lincosamides (clindamycin)		Bacteriostatic
Good: Gram-positive anaerobes Moderate: *Staphylococcus aureus*, Gram-negative anaerobes, Poor: *Enterococci*, Gram-negative aerobes		
Polymyxins (colistimethate sodium, polymyxin B)		Bactericidal
Good: Multidrug resistant Gram negative rods Moderate: *Stenotrophomonas maltophilia* Poor: Gram-positive organisms, anaerobes		

Gallagher JC, MacDougall C. *Antibiotics simplified*. 4th ed. Burlington, MA: Jones & Bartlett Learning; 2014
Gilbert DN, Chambers HF, Eliopoulos GM, Chambers HF, Saag MS, eds. *The Sanford Guide to Antimicrobial Therapy*. 50th ed. Sperryville, VA: Antimicrobial Therapy; 2019.

AVAILABLE ANTIMICROBIALS

ANTIBIOTICS
Amikacin 250mg/mL INJ
Amoxicillin 250, 500 mg CAP
Amoxicillin 250 mg/5 mL ORAL SUSP
Amoxicillin/clavulanate 875/125mg TAB
Amox/clav 250/62.5 mg/5 mL ORAL SUSP
Ampicillin 1, 2 g INJ
Ampicillin/sulbactam 1.5, 3 g INJ
Azithromycin 250, 500, 600 mg TAB
Azithromycin 500mg INJ
Aztreonam 1, 2 g INJ
Cefadroxil 500 mg CAP
Cefazolin 500 mg, 1 g INJ
Cefdinir 300 mg CAP
Cefepime 1, 2 g INJ
Cefotaxime 1, 2 g INJ
Cefotetan 1, 2 g INJ
Cefoxitin 1, 2 g INJ
Cefpodoxime 100, 200 mg TAB
Ceftaroline 400, 600 mg INJ
Ceftazidime 1, 2 g INJ
Ceftazidime/avibactam 2.5 g INJ
Ceftolozane/tazobactam 1.5 g INJ
Ceftriaxone 1, 2 g INJ
Cefuroxime 750 mg INJ
Cephalexin 250, 500 mg CAP
Ciprofloxacin 200, 400 mg INJ
Ciprofloxacin 250, 500 mg TAB
Clarithromycin 500 mg TAB
Clindamycin 150 mg CAP
Clindamycin 600, 900 mg INJ
*Colistimethate 150 mg INJ
Daptomycin 500 mg INJ
Dicloxacillin 250 mg CAP
Doxycycline 100 mg TAB/CAP/INJ
Ertapenem 1 g INJ
Erythromycin 250 mg TAB
Fidaxomicin 200 mg TAB
*Fosfomycin 3 g SACHET
Gentamicin 80mg/2mL INJ - 2mL
Imipenem/cilastatin 250, 500 mg INJ
Levofloxacin 250, 500, 750 mg TAB
Levofloxacin 500, 750 mg INJ
Linezolid 600 mg TAB/INJ
Meropenem 500 mg, 1 g INJ
*Meropenem/vaborbactam 1g/1g INJ
Metronidazole 250 mg TAB
Metronidazole 500 mg/100mL INJ
Minocycline 100 mg CAP
*Minocycline 100 mg INJ
Moxifloxacin 400 mg INJ/TAB
Nafcillin 1, 2 g INJ
Nitrofurantoin 100 mg CAP
Penicillin G benzathine 1.2 million unit INJ
Penicillin G potassium 5 million unit INJ
Penicillin VK 500 mg TAB
Piperacillin/tazo 2.25, 3.375, 4.5 g INJ
*Polymyxin B 500,000 IU INJ
Tigecycline 50mg INJ
Tobramycin 80mg/2mL INJ
*Tobramycin 300 mg/5 mL INHALATION
TMP/SMZ 800/160 mg TAB/INJ
TMP/SMZ 200/40 mg per 5mL SUSP
Vancomycin 125 mg CAP
Vancomycin 125mg/2.5mL ORAL SOLN
Vancomycin 1 g INJ
ANTIFUNGALS
Ampho. B conventional 50 mg INJ
Ampho. B liposomal 50 mg INJ
Fluconazole 40 mg/mL SUSP
Fluconazole 100 mg TAB
Fluconazole 200, 400 mg INJ
Flucytosine 500 mg CAP
*Isavuconazonium 186 mg CAP
*Isavuconazonium 372 mg INJ
Itraconazole 100mg CAP
Micafungin 50, 100 mg INJ
Posaconazole 200 mg/5mL SUSP
Posaconazole 300 mg TAB
Voriconazole 200 mg INJ/TAB
*Voriconazole 40 mg/mL SUSP
ANTIVIRALS
Acyclovir 200 mg CAP
Acyclovir 200 mg/5ml SUSP
Acyclovir 500 mg INJ
Acyclovir 800 mg TAB
Adefovir 10 mg TAB
Cidofovir 375 mg/5 mL INJ
Entecavir 0.5, 1 mg TAB
Famciclovir 250 mg TAB
Foscarnet 24mg/mL - 500mL INJ
Ganciclovir 500 mg INJ

§Glecaprevir/pibrentasvir TAB
Oseltamivir 30, 75mg CAP
*Peramivir 200 mg INJ
§Velpatasvir/sofosbuvir 100/400 mg TAB
§Velpatasvir/sofosbuvir/voxilaprevir TAB
Valacyclovir 500mg TAB
Valganciclovir 450mg TAB
ANTIRETROVIRALS
Abacavir 300 mg TAB
Abacavir 100 mg/5 mL PO SOLN
Abacavir/lamivudine 600/300 mg TAB
Abacavir/lamivudine/dolutegravir 600/300/50 mg TAB
Abacavir/lamivudine/zidovudine 300/150/300 mg TAB
Atazanavir 150, 200, 300 mg CAP
*Atazanavir/cobicistat 300/150 mg TAB
Bictegravir/emtricitabine/tenofovir AF 50/200/25 mg TAB
Darunavir 600, 800 mg TAB
*Darunavir 100 mg/mL PO SUSP
Darunavir/cobicistat 800/150 mg TAB
Dolutegravir 50 mg TAB
Dolutegravir/lamivudine 50/300 mg TAB
Dolutegravir/rilpivirine 50/25 mg TAB
Doravirine 100 mg TAB
Efavirenz 200 mg CAP
Efavirenz 600 mg TAB
Efavirenz/lamivudine/tenofovir DF 600/300/300 TAB
Elvitegravir/cobicistat/emtricitabine/tenofovir AF 150/150/200/10 mg TAB
Elvitegravir/cobicistat/emtricitabine/tenofovir DF 150/150/200/300 mg TAB
Emtricitabine 200 mg CAP
Emtricitabine/tenofovir AF 200/25 mg TAB
Emtricitabine/tenofovir DF 200/300 mg TAB
Emtricitabine/rilpivirine/tenofovir AF 200/25/25 mg TAB
Emtricitabine/rilpivirine/tenofovir DF 200/25/300 mg TAB
Enfuvirtide 90 mg INJ
Etravirine 200 mg TAB
Lamivudine 100, 150 mg TAB
Lamivudine 50 mg/5 mL PO SOLN
Lamivudine/zidovudine 150/300 mg TAB

Lopinavir/ritonavir 200/50 mg TAB
Maraviroc 150 mg TAB
Raltegravir 400, 600 mg TAB
Ritonavir 100 mg TAB
Tenofovir AF 25 mg TAB
Tenofovir DF 300 mg TAB
Zidovudine 100 mg CAP
*Zidovudine 50mg/5mL PO syrup
MISCELLANEOUS ANTI-INFECTIVES
Albendazole 200mg TAB
Atovaquone 750mg/5mL SUSP
Atovaquone/proguanil 250/100 mg TAB
Bezlotoxumab 1000 mg/40 mL INJ
*Chloroquine phosphate 500 mg TAB
Dapsone 100 mg TAB
§Ethambutol 100, 400 mg TAB
§Hydroxychloroquine 200 mg TAB
Isoniazid 100, 300 mg TAB
Ivermectin 3mg TAB
Miconazole 2% topical POWDER
*Nitazoxanide 500mg TAB
*Nystatin 100,000 units/g topical POWDER
Pentamidine 300mg INJ/INHALATION
*Praziquantel 600 mg TAB
Primaquine 26.3 mg TAB
Pyrazinamide 500 mg TAB
Rifabutin 150 mg CAP
Rifampin 300 mg CAP
Rifampin 600 mg INJ
Rifapentine 150 mg TAB
*Rifaximin 200 mg TAB
Terbinafine 250 mg TAB
*Tinidazole 500 mg TAB
Tolnaftate 1% topical POWDER

Shaded background = Restricted to ID

* = Nonformulary; requires "Prior authorization drug request" consult

§ = Restricted to ID/GI and requires PADR consult

IMPORTANT PHONE EXTENSIONS

Inpatient Pharmacy	x6420
Outpatient Pharmacy	x6767
General Chemistry	x6498
Microbiology Lab	x6501
Infection Prevention/Infection Control	x4827

For questions/comments, please contact ID PharmD:

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For Infectious Diseases Consult or Antimicrobial Stewardship, please refer to the Infectious Diseases call schedule on the Sharepoint

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