RIYADH HOSPITAL

Pharmacy Department

ANTIMICROBIAL GUIDELINES

2ND Version 2025



Approved by Pharmacy and Therapeutics Committee May 2025
Approved by Anti-microbial stewardship-sub-committee 2025

Preface

This is the 2024 edition of the antimicrobial guidelines prepared by antimicrobial stewardship technical subcommittee under Pharmacy and therapeutic committee. The current edition is aimed at guiding physicians who practice across different levels of healthcare acuity to select appropriate empirical antibiotics for treatment of common community & healthcare associated infections. Guidelines are considered supplementary strategy of antimicrobial stewardship and is most helpful in hospitals who lack infectious diseases expertise or stewardship team. I would like to thank all members that contributed to this document and the general administration of pharmaceutical care for its support.

- All the information which is provided has been taken from the authentic references
- **National Antimicrobial Therapy Guidelines for Community and Hospital Acquired Infections in Adults (MOH)**
- **COMMUNITY ACQUIRED PNEUMONIA CHI Formulary Development Project (مجلس الضمان الصحي)**
- **ENDOCARDITIS CHI Formulary Development Project (مجلس الضمان الصح**
- IDSA clinical practice Guideline
- Lexi drugs
- IM manual
- See attachment for other references

Special thanks to Dr. *Alhussein Salem* Dr. Gehad Lotfy for her outstanding contributions in helping to compile this valuable information. Her expertise and dedication have been instrumental in shaping this resource.

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We would like to thank also for those who have directly or indirectly extended their effort upon publication of this manual.

We call upon all healthcare professionals and their valuable suggestions will be warmly welcomed and carefully considered.

Please feel free to give your feedback by forwarding comments and suggestions to stewardship sub-committee chair and co-chair.

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Antibiotics order (Group A Streptococcal Pharyngitis)

Patient group	Therapy (dosing interval in hours) Duration	
Condition	**First line**	**Alternative**
No penicillin allergy	▪ Penicillin V, PO 500 mg q12hr for10 days	1❒ Amoxicillin, PO 500 mgq12hr for 10 days **OR** 2❒ penicillin G Benzathine, IM 1.2 million units single dose
Penicillin allergy	▪ Cephalexin PO 500 mg q12hr for10 days (only for non-immediate-type and non-severe hypersensitivity reactions to penicillin)	1❒ Clindamycin PO 300 mgq8hr for 10 days **OR** 2❒ Azithromycin PO 500 mg q24hr for 5 days **OR** 3❒ Clarithromycin PO 250 mg q12hr for 10 days

Empiric Therapy for Acute Bacterial Rhinosinusitis

Severity	First line	Alternative
Mild cases	Amoxycillin-Clavulanate 1000mg PO q12hr 5-7 days	Cefuroxime axetil 500 mg PO q12hr for 5-7 days **(Only if non-immediate-type and non-severe hypersensitivity reactions to penicillin's) OR**
		Doxycycline 100 mg PO q12hr for 5-7 days
Severe infection requiring hospitalization	Amoxycillin- Clavulanate IV 1g q8hrfor 5-7 days	Ceftriaxone 1–2 g IV q24 hr for5-7 days **(Only if non-immediate-typeand non-severe hypersensitivity reactions to penicillin's) OR**
		Levofloxacin 500 mg PO/IV q24hr for 5-7 days **(if immediate-type and severe hypersensitivity reactions to beta lactams)**

Antibiotics order (Infective Endocarditis)

Patient group	Therapy (dosing interval in hours) (weeks)
Empiric therapy (If patient is not acutely ill and not in heart failure, the preference is to wait for blood culture results)	❒ Vancomycin IV 15 mg/kg q12hr (2wks) PLUS ❒ Ceftriaxone IV/IM 2g q24h (2wks) **OR** ❒ Vancomycin IV 15 mg/kg q12hr (2wks) PLUS ❒ Gentamicin 3 mg/kg IV q24h (2wks)
Streptococcus viridans (Penicillin MIC ≤ 0.12)	❒ Penicillin G IV 2-3 million Unit q4h (4wks) **OR** ❒ Penicillin G IV 2-3 million Unit q4h PLUS ❒ Gentamicin 3 mg/kg IV q24h (2wks) **In patients with non-immediate and non-severepenicillin allergy:** ❒ Ceftriaxone IV/IM 2g q24 hr (4wks) **OR** ❒ Ceftriaxone IV 2 g q24hr PLUS ❒ Gentamicin 3 mg/kg IV q8h (2wks) **In patients with immediate or severe penicillinallergy:** ❒ Vancomycin 15mg/kg q12h (4wks)
Streptococcus viridans (Penicillin MIC: 0.12 - <0.5)	❒ Penicillin G: IV 4 million Unit q4h (4wks) PLUS ❒ Gentamicin 3mg/kg q24h IV/IM (2wks) **In patients with non-immediate and non-severepenicillin allergy:** ❒ Ceftriaxone IV 2 g q24h PLUS (2wks) ❒ Gentamicin 3 mg/kg q24h IV/IM (2wks) **In patients with immediate or severe penicillinallergy:** Vancomycin 15mg/kg q12h (4wks)
Streptococcus viridans (Penicillin MIC > 0.12)	**If ceftriaxone-susceptible:** ❒ Ceftriaxone IV 2 g q24h (4wks) PLUS ❒ Gentamicin 3 mg/kg q24h IV/IM (4wks) **If ceftriaxone-resistant:** ❒ Vancomycin 15mg/kg q12h (4wks)
Staphylococcus methicillin **sensitive**	❒ Cloxacillin IV 2 g q4hr (6wks) OR ❒ Flucloxacillin IV 2g q4hr (6wks) **In patients with non-immediate and non-severepenicillin allergy:** ❒ Cefazolin IV 2 g q8hr (6wks) **In patients with immediate or severe penicillinallergy:** ❒ Vancomycin 15mg/kg q12h (6wks)
Staphylococcus methicillin **resistant**	❒ Vancomycin IV 15mg/kg q12hr (6wks)

Enterococcus— Penicillin sensitive	❒ Ampicillin IV 2g q4h (4-6 wks) PLUS ❒ Gentamicin 1 mg/kg q8hr IV/IM (4-6 wks) **OR** ❒ Penicillin G IV 3-5 million Unit q4h (4-6wks) PLUS ❒ Gentamicin 1mg/kg q8hr IV/IM (4-6wks) **If CrCl<50mL/min:** ❒ Ampicillin IV 2g q4h (6wks) PLUS ❒ Ceftriaxone 2g q12hr IV (6wks)
Enterococcus— penicillin resistant or penicillin allergy	❒ Vancomycin IV15mg/kg q12hr PLUS ❒ Gentamicin 1 mg/kg q8hr IV (6wks)
Gentamicin resistance (MIC > 500 µg/mL): (Penicillin sensitive)	❒ Ampicillin IV 2g q4h (6wks) PLUS ❒ Ceftriaxone 2g q12hr IV (6wks) **If Streptomycin-susceptible:** ❒ Ampicillin IV 2g q4hr PLUS ❒ Streptomycin 15 mg/kg IV q12hr (6wks) **OR** ❒ Penicillin-G IV 3-5 million-unit q4h (4-6 weeks) PLUS ❒ Streptomycin IV/IM 15 mg/kg q12hr (6 weeks)
Enterococcus penicillin, aminoglycoside, and vancomycin resistant	❒ Daptomycin 10-12mg/kg q24hr (>6wks) **OR** ❒ Linezolid IV 600 mg q12hr (>6wks)
HACEK group	❒ Ceftriaxone IV 2g q24 h (4wks) **OR** ❒ Ampicillin IV 2g q4h (4wks) **OR** ❒ Ciprofloxacin IV 400 mg q12h (4wks) **OR** ❒ Ciprofloxacin PO 500mg q12h (4wks)
❒ Prosthetic valve	
Patient group	**Therapy (dosing interval in hours) (weeks)**
Empiric therapy	❒ Vancomycin IV 15 mg/kg q12hr (6wks) PLUS ❒ Gentamicin IV 3 mg/kg q24hr (6wks) PLUS ❒ Rifampin 300 mg PO/IV q8h (6wk)
Streptococcus viridans (Penicillin MIC < 0.5)	❒ Penicillin G IV 4 million Unit q4 h (6wk) PLUS ❒ Gentamicin IV 3mg/kg q24hr (6wk) **In patients with non-immediate and non-severepenicillin allergy:** ❒ Ceftriaxone 2 g q24 h IV (6wk) PLUS ❒ Gentamicin IV 3mg/kg q24hr (6wk) **In patients with immediate or severe penicillinallergy:** ❒ Vancomycin 15mg/kg q12h (6wks)
Streptococcus viridans (Penicillin MIC > 0.5)	**If ceftriaxone-susceptible:** ❒ Ceftriaxone IV 2 g q24h (6wks) PLUS ❒ Gentamicin 3 mg/kg q24h IV/IM (6wks) **If ceftriaxone-resistant:** ❒ Vancomycin 15mg/kg q12h (6wks)

Staphylococcus— methicillin sensitive	❒ Cloxacillin IV 2g q4hr (≥6wks) PLUS ❒ Gentamicin IV 1mg/kg q8h (2wks) PLUS ❒ Rifampin IV/PO 300mg q8h (≥6wks) **OR** ❒ Flucloxacillin IV 2g q4hr (≥6wks) PLUS ❒ Gentamicin IV 1mg/kg q8h (2wks) PLUS ❒ Rifampin IV/PO 300mg q8hr (≥6wks) **In patients with non-immediate or non-severepenicillin allergy:** ❒ Cefazolin IV 2g q8hr (≥6wks) PLUS ❒ Gentamicin 1mg/kg q8hr IV (2wks) PLUS ❒ Rifampin IV/PO 300mg q8hr (≥6wks) **In patients with immediate or severe penicillinallergy:** ❒ Vancomycin 15mg/kg q12h (≥6wks) PLUS ❒ Gentamicin 1mg/kg q8hr IV (2wks) PLUS ❒ Rifampin IV/PO 300mg q8hr (≥6wks)
Staphylococcus— methicillin resistant (MRSA)	❒ Vancomycin 15mg/kg q12h (≥6wks) PLUS ❒ Gentamicin 1mg/kg q8hr IV (2wks) PLUS ❒ Rifampin IV/PO 300mg q8hr (≥6wks)

Osteomyelitis

<table>
<tr><th>Patient Subtype</th><th>Likely Infecting Organism</th><th>Antibiotic</th><th>Duration</th></tr>
<tr><td rowspan="3">Adults</td><td>MSSA</td><td>❒ Cloxacillin IV 1.5-2g q4-6hr OR
❒ Flucloxacillin sodium IV 1.5-2g q4-6hr
OR
❒ Cefazolin IV 2g q8hr</td><td rowspan="3">6 weeks
If signs or symptoms are still present at 6 weeks, therapy should be extended</td></tr>
<tr><td>MRSA</td><td>❒ Vancomycin 15-20mg/kg IV q12h OR
❒ Linezolid 600mg IV/PO q12h</td></tr>
<tr><td>Pseudomonas</td><td>❒ Ceftazidime 2 gm IV q8h
❒ Ciprofloxacin 750mg PO q12h</td></tr>
<tr><td colspan="4">• Submit bone biopsy for histology and culture.
• If hemodynamically and neurologically stable, hold antibiotic therapy until causative organism is identified.
• Start with IV antibiotics and consider switching after few days of improvement to highly bioavailable oral antibiotics.</td></tr>
</table>

DIABETIC FOOT INFECTION

	Suspected pathogen	Antibiotic Therapy	Duration
Oral agents for empiric treatment of mild to moderate early diabetic foot infections (Out-patint)	Streptococci and Staphylococci (MSSA)	❒ Cloxacillin 500mg PO q6h **OR** ❒ Flucloxacillin 500mg PO q6h **OR** ❒ Cephalexin 500mg PO q6h if non-immediate type or non-severe hypersensitivity reaction to penicillin **OR** ❒ Amoxicillin-clavulanate PO 1000mg q12h **OR** Clindamycin PO 300-450 mg q6hr (if immediate type or severe hypersensitivity reaction to beta lactam)	7-10 days
	Streptococci and MRSA	❒ Clindamycin PO 300-450mg q6h **OR** ❒ Trimethoprim-sulfamethoxazole PO 160/800mg [DS] q12h **OR** ❒ Doxycycline PO 100mg q12h	7-10 days
Empiric treatment of moderate (PO or IV agents) to severe (IV agents) diabetic foot infections	Polymicrobial	❒ Vancomycin IV 15mg/kg q12hr **PLUS** ❒ Piperacillin-tazobactam IV 4.5g q6-8hr **OR** ❒ Vancomycin IV 15mg q12hr **PLUS** ❒ Ceftazidime or cefepime IV 2g q8h ± ❒ Metronidazole 500mg PO/IV q8h **OR** ❒ Vancomycin IV 15mg/kg q12h **PLUS** ❒ Imipenem-cilastatin IV 500mg q6hr **OR** ❒ Vancomycin IV 15mg/kg q12h **PLUS** ❒ Meropenem IV 1000mg q8hr **OR** ❒ Ciprofloxacin PO 500-750mg **OR** ❒ Ciprofloxacin IV 400mg q12h **PLUS** ❒ Clindamycin PO/IV 600mg q8h (if moderate)	10-14 days And expand the duration depending on clinical symptom progress

SKIN & SOFT TISSUE INFECTION

Therapy for Purulent Skin and Soft Tissue Infections (Furuncle/Carbuncle/Abscess)

Severity	Empiric Therapy	Duration
Mild	❒ Incision and drainage only or with antibiotics in some cases (similarly to moderate cases)	7–10 days
Moderate	❒ Incision and drainage with: ❒ Trimethoprim-sulfamethoxazole PO160/800 mg [DS] q12h ❒ Doxycycline PO 100mg q12h	
Severe	Incision and drainage with ❒ Vancomycin IV 15mg/kg q12h **OR** ❒ Linezoild PO 600mg q12hr	

Therapy for non-purulent Skin and Soft Tissue Infections (Necrotizing infection/Cellulitis/Erysipelas)

Severity	Empiric Therapy	Duration
Mild	❒ Cloxacillin or Flucloxacillin 500mg PO q6h **OR** ❒ Cephalexin 500mg PO q6h (if non-immediate type or non-severe hypersensitivity reaction to penicillin **OR** ❒ Clindamycin PO 300-450 mg q6hr (if immediate type or severe hypersensitivity reaction to beta-lactam.	7–10 days
Moderate	❒ Penicillin G 2-4 million units IV q4-6h **OR** ❒ Cefazolin 1g IV q8h (if non-immediate-type or non-severe hypersensitivity reaction to penicillin) **OR** ❒ Clindamycin 600mg IV q8h (if immediate-type or severe hypersensitivity reaction to beta-lactam)	
Severe	❒ Vancomycin IV 15mg/kg q12hr **+** Piperacillin-tazobactam IV 4.5g q6-8hr **OR** ❒ Vancomycin IV 15mg/kg q12h **+** Imipenem-cilastatin IV 500mg q6hr **OR** ❒ Vancomycin IV 15mg/kg q12h **+** Meropenem IV 1000mg q8hr **OR** ❒ Vancomycin IV 15mg/kg q12h **+** Ciprofloxacin PO 500-750mg **OR** ❒ Ciprofloxacin IV 400mg q12h **+** Metronidazole PO/IV 500mg q8h	

ANIMAL BITE & HUMAN BITE

Patient Groups	Therapy (dosing interval)	Duration
Animal or human bite	❒ Amoxicillin-clavulanic acid 1000mg PO q12h **OR** ❒ Cefuroxime axetil 500mg POq12h **+** ❒ Metronidazole 500mg PO q8h **OR** ❒ Doxycycline 100mg PO q12h	7 Days

COMMUNITY AQUIRED PNEUMONIA *Refer to RH CPG for Management of Community Acquired Pneumonia*

Patient's condition	First line	Alternative
Previously healthy outpatients; no antibiotic use in past 3months	❒ Azithromycin 500 mg once then 250 mg daily for 4 days	❒ Doxycycline 100 mg PO q12hr 5 days
Outpatients with comorbidities or antibiotic use in past three months	❒ High dose amoxicillin 1 g PO q 8 hrs **+** ❒ Azithromycin 500 mg once then 250 mg daily for 4 days	❒ Levofloxacin 750 mg PO q24h (B-lactam allergy) for 5 days
Inpatients, non-ICU (In previously healthy young (<65 yrs) patient with no antibiotic use or healthcare setting exposure in the last 3 months)	❒ Penicillin G 12 to 24 million unit/day in divided doses every 4 to 6 hours (can be given as 2 million units IV q 4h) **+** ❒ Azithromycin 500 mg IV/PO daily for 3 days	❒ Levofloxacin 750 mg PO q24h (B-lactam allergy) for 5 days
Inpatients, non-ICU (Elderly (>65 yrs), medical comorbidities or recent antibiotics use in the last 3 months use)	❒ Augmentin 1.2 GM IV q 8h **+** ❒ Azithromycin 500 mg IV/PO daily for 5 days	❒ Levofloxacin 750 mg PO q24h (B-lactam allergy) for 5 days **+** ❒ Vancomycin IV loading dose of 25 mg/kg then 15 mg/kg 8-12 hr for 5 days
Inpatients, ICU (admission) With no risk for MRSA and Pseudomonas	❒ Augmentin 1.2 GM IV Q 8 hr **+** ❒ Azithromycin 500 mg IV/PO daily for 7 days	Levofloxacin 750 mg IV q24h for 7 days
Inpatients, ICU (admission) With risk of MRSA: Previous MRSA colonization, necrotizing pneumonia, gross hemoptysis, rapidly increasing pleural fluid empyema, pustules or erythematous rash or recent influenza like illness)	❒ Augmentin 1.2 GM IV Q 8 hr **+** Azithromycin 500 mg IV/PO daily for 7 days **+** ❒ Vancomycin IV loading dose of 25 mg/kg then 15 mg/kg 8-12 hr ***Vancomycin, target trough serum concentration of 15-20 µg/mL*** **If sputum culture (good quality)/nasal PCR grow no MRSA then de-escalate to Augmentin Plus Azithromycin.**	Levofloxacin 750 mg IV q24h for 7 days **+** **If sputum culture (good quality)/nasal PCR grew no MRSA then de-escalate to Augmentin Plus Azithromycin.**

	Inpatients, ICU (admission) With risk of MRSA: Previous MRSA colonization, necrotizing pneumonia, gross hemoptysis, rapidly increasing pleural fluid empyema, pustules or erythematous rash or recent influenza like illness)	❒ Augmentin 1.2 GM IV Q 8 hr PLUS Azithromycin 500 mg IV/PO daily for 7 days **+** ❒ Vancomycin IV loading dose of 25 mg/kg then 15 mg/kg 8-12 hr ***Vancomycin, target trough serum concentration of 15-20 µg/mL*** **If sputum culture (good quality)/nasal PCR grow no MRSA then de-escalate to Augmentin Plus Azithromycin.**	Levofloxacin 750 mg IV q24h for 7 days **+** **If sputum culture (good quality)/nasal PCR grew no MRSA then de-escalate to Augmentin Plus Azithromycin.**
	Inpatients, ICU with risk factors for Pseudomonas: Severe Structural lung disease (e.g. bronchiectasis), recent hospital admission / antibiotics use in the previous 3 months or steroid use (>10 mg of prednisolone daily in the last 2 weeks, immunocompromised)	❒ Piperacillin/tazobactam 4.5g IV q6h **PLUS** ❒ Azithromycin 500 mg IV/PO daily **PLUS** ❒ Amikacin IV 15 mg/kg (if amikacin drug monitoring is available) **If sputum culture (good quality) grew no pseudomonas then de-escalate to Augmentin Plus Azithromycin.**	❒ Piperacillin/tazobactam 4.5g IVq6h + Ciprofloxacin 400 mg IV q8h + Azithromycin 500mg IV q24hr **If sputum culture (good quality) grew no pseudomonas then de-escalate to Augmentin Plus Azithromycin.**
	Influenza virus	❒ Oseltamivir (Tamiflu) 75mg q12hr for 5 days	N/A

Table 6. Newer Antibiotics for the Treatment of Community Acquired Pneumonia

Drug name	Class	Activity	Dose (Intravenous)
Ceftaroline	5th generation Cephalosporin	Gram-positive including resistant pneumococcus and MRSA and Gram-negatives	600 mg every 12 hours
Ceftobiprole	5th generation Cephalosporin	Extended spectrum activity against Gram-positive, MSSA, Methicillin resistant coagulase negative Staph, DRSP, and Gram-negatives including Pseudomonas and Enterobacteriaceae. No activity against MRSA.	500 mg every 8 hours
Solithromycin	4th generation macrolide	S. pneumoniae, H. influenzae, atypical pathogens and macrolide resistant organisms	400 mg every 24 hours
Nemonaxacin	Non-fluorinated quinolone	MRSA, DRSP and ertapenem-non-susceptible Enterobacteriaceae	750 mg every 24 hours
Delafloxacin	Novel fluoroquinolone	Gram-positives including drug resistant S. pneumoniae (penicillin-, macrolide-, multiple-drug resistant), fastidious Gram-negative pathogens including Hemophilus	300 mg every 12 hours
		species (β-lactamase producing, macrolide-non-susceptible) and S. aureus (MRSA, fluoroquinolone-non-susceptible MSSA)	
Omadacycline	Aminomethycycline	H. influenzae, M. catarrhalis, Legionella, Chlamydia, Mycoplasma, MRSA, DRSP, Streptococcus pyogenes, Streptococcus agalactiae and VRE. Not effective against Proteus, Providencia, Pseudomonas, and Morganella.	100 mg every 12 hours for two doses, then 100 mg every 24 hours
Lefalumin	Semi-synthetic Pleuromutilin	Gram-positive pathogens including DRSP and MRSA, fastidious Gram-negative pathogens and atypical pathogens including M. pneumoniae (including macrolide-resistant strains), C. pneumoniae, and L. pneumophila.	150 mg every 12 hours

PERITONITIS

Primary peritonitis: Spontaneous bacterial peritonitis (SBP)=Primary infection

Patient's condition	First line	Alternative	Duration
For treatment	❒ Ceftriaxone IV 2 gm q24h	❒ Ciprofloxacin 400 mgIV q12h (β-lactam allergy)	5-7 days
Prevention of SBPin patients with chronic ascites	Indications of antibiotic prophylaxis: 1- Patients with cirrhosis and gastrointestinal bleeding. 2- Patientswho have had one or more episodes of SBP.		
	❒TMP-SMX-960mg tab PO 5 days/week	❒ Ciprofloxacin 750 mg PO once/week	
Resistant *E. coli*, Klebsiella species(e.g., ESBL):	❒ Ertapenem 1g IV q 24 hrs	❒ Imipenem 500mg IV q6h	5-7 days

Secondary Peritonitis Therapy (bowel perforation, ruptured appendix, ruptured diverticula) Sourcecontrol is essential

Patient's condition	First line	Alternative	Duration
Mild/Moderate Peritonitis, inpatient, Hemodynamically stable	❒ Cefuroxime 750 mg IV q8h **+** ❒ Metronidazole 500 mg IV q8h	❒ Ciprofloxacin 400 mg IV q8h (β-lactam allergy) **+** ❒ Metronidazole 500 mg IV q8h	7 days
Severe Disease: Patient admitted to ICU	❒ Piperacillin-Tazobactam IV 4.5 gm every 6hours	❒ Imipenem 500 mg IV q6 hrs	10 days with good source controlled

Peritonitis, Dialysis (CAPD) Associated

Patient's condition	First line	Alternative	Duration
Mild – moderate	❒ Cefazolin IP 15-20 mg/kgdaily **+** ❒ Gentamycin 2mg/kg loading then 0.6mg/kg in one bag q24h	❒ Aztreonam 2gIP daily **+** ❒ Vancomycin 15-30 mg/kg IP every 5-7 days for penicillin allergy)	*S. aureus:* **21 days** Enterococci, G (-) NOT Pseudomonas. Pseudomonas: **21-28 days** Streptococci and Coagulase negative Staph: **14days**
Severe	❒ Vancomycin IV 20mg/kg LD then 20mg/kg every 4-7 days **+** ❒ Piperacillin-tazobactam IV 2.25 g q12h (14 days)	❒ Vancomycin IV 15mg/kg q8hr **+** ❒ Aztreonam 1-2 g LD then 250- 500mg q6-12h	

TUBERCULOSIS

1) First-line Treatment of Active TB, Initial phase

Condition	Drugs	Adult Dosage		Alternative
		Daily	Intermittent	
Empiric initial treatment should include 4 drugs:	Isoniazid	5 mg/kg	15 mg/kg 1-3x/wk	
	Rifampin (RIF)	10 mg/kg	10 mg/kg 2-3x/wk	Rifabutin (RPT 5 mg/kg
	pyrazinamide	40-55 kg: 1000 mg 56-75 kg: 1500 mg 76-90 kg: 2000 mg	40-55 kg: 2000 mg 56-75 kg: 3000 mg 76-90 kg: 4000 mg 2x/wk	
	Ethambutol	40-55 kg: 800 mg 56-75 kg: 1200 mg 76-90 kg: 1600 mg	40-55 kg: 2000 mg 56-75 kg: 2800 mg 76-90 kg: 4000 mg	
When M. TB is susceptible to isoniazid, rifampin and pyrazinamide	Isoniazid(INH)	5 mg/kg	15 mg/kg 1-3x/wk	
	Rifampin	10 mg/kg	10 mg/kg 2-3x/wk	Rifabutin 5 mg/kg
	Pyrazinamide	40-55 kg: 800 mg 56-75 kg: 1200 mg 76-90 kg: 1600 mg	40-55 kg: 2000 mg 56-75 kg: 2800 mg 76-90 kg: 4000 mg	
Patients who cannottake pyrazinamide, such as those with severe liver disease or gout	Isoniazid Rifampin ethambutol	The same dose as above	The sameas dose above	Rifabutin 5 mg/kg

Treatment of Pulmonary TB, cont'd

Duration of Continuation Therapy (For treatment of drug-susceptible disease after two months of initial therapy):

Cavity on Chest (x-ray)	**Sputum Culture (Taken at 2 Months)**	**Drugs**	**Duration (months)**
No	Negative	INH PLUS RIF	4
No	Positive	INH PLUS RIF	7
Yes	Negative	INH PLUS RIF	4

Yes	Positive	INH PLUS	7

		RIF	
Patients who could not take pyrazinamideas part of the initial regimen		INH PLUS RIF	7

Some Second-Line Drugs for Active Tuberculosis

Streptomycin	15 mg/kg IM or IV (max 1 g)
Capreomycin (Capastat)	15 mg/kg IM or IV (max 1 g)
Kanamycin (Kantrex,	15 mg/kg IM or IV (max 1 g)
Amikacin	15 mg/kg IM or IV (max 1 g)
Cycloserine (Seromycin)	10-15 mg/kg PO
Ethionamide (Trecator)	15-20 mg/kg in 1 or 2 divided doses PO (max 500 mg) q12hr)
Levofloxacin	500-1000 mg PO/ IV
Moxifloxacin	400 mg PO or IV
Para-aminosalicylic acid	8-12 g in 2-3 doses PO

Resistance to Rifamycin's Check with the WHO reference	-At least 12 months of treatment with isoniazid, ethambutol
Multidrug Resistance Isolates with resistance to at least isoniazid and rifampicin.	
Extensively drug-resistant TB (XDRTB) Isolates with resistance not only to isoniazid and rifampicin, but also to any fluoroquinolone and at least one of three injectable second line drugs (i.e, amikacin, kanamycin or capreomycin).	Refer to the specialized infectious diseases or expert Pulmonologist.

BRUCELLOSIS

Site of Infection	First line	Alternative/ comments
Non-Localizing disease	❒ Doxycycline 100 mg PO q12hr x 6weeks **PLUS** ❒ Streptomycin 1gm IMq24hr x 14-21 days.	❒ Doxycycline 100 mg PO q12hr x 6 weeks **PLUS** ❒ TMP-SMX 960mg PO q 12hr x 6weeks
Spondylitis/sacroiliitis/arthritisInpatient	❒ Doxycycline 100 mg PO q12hr for 6-8 weeks PLUS ❒ Gentamicin IV 3mg/kg q24hrs for 2-3weeks. Gentamicin Target trough <1mcg/ml	❒ Doxycycline 100 mg PO q12hr PLUS ❒ TMP-SMX 5mg/kg of TMP Component IV q 12hr both for 6-8 weeks.

Outpatient	❒ Doxycycline 100 mg PO q12hr for 6-8 weeks PLUS ❒ Streptomycin 1gm IMq24hr for 2-3 weeks.	❒ Doxycycline 100 mg PO q12hr PLUS ❒ TMP-SMX 960mg PO q12hr both for 6-8 weeks.
Brucella during Pregnancy	❒ TMP-SMX 960mg PO q 12hr PLUS ❒ Rifampicin 900mg q24hrs for both x 6 weeks. *TMP-SMX may cause kernicterus if given in last week of pregnancy*.	If > 38 weeks ❒ Rifampicin 900mg q24hrs x 12 weeks. After delivery, consider changing to ❒ Doxycycline 100 mg PO q12hr x 6 weeks PLUS ❒ Streptomycin 1gm IMq24hr for 2 weeks.
Neurobrucellosis	Doxycycline 100 mg IV/PO q12hr x 12-24weeks PLUS Rifampicin 900 mg PO/IV q 24hrs x12-24 weeks PLUS TMP-SMX 960 mg POq12h x 12-24 weeks PLUS Ceftriaxone 2 gm IV q12h x 4 WK.	Continue until CSF is sterile
Endocarditis	Doxycycline 100 mg IV/PO q12hr x12-24 months PLUS Gentamycin 5 mg/kg IV q 24h x 2-3 weeks PLUS TMP-SMX 5 mg/kg IV q12hx 12-24 weeks PLUS Rifampicin 600mgIV/PO q 12 hrs for 12-24 weeks Gentamycin trough level < 1µg/mL	Surgical intervention combined with Antimicrobial therapy is superior to medical treatment alone.

Early recognition and prompt initiation of antibiotics are crucial.

BACTERIAL MENINGITIS & ENCEPHALITIS

- **Blood cultures and LP should be obtained emergently before starting antimicrobial therapy**
- **Antimicrobial therapy, along with adjunctive dexamethasone when indicated, should be initiated as quickly as possible after the performance of the lumbar puncture (LP) or**, if a computed tomography (CT) scan of the head is to be performed before LP, **as quickly as possible after blood cultures are obtained.**
  Dexamethasone 0.15 mg/kg IV q6h X2-4 days (first dose before or with 1st dose of antibiotics

Patient group	First line	Alternative/ comments
≤ 50 years	❒ Vancomycin IV loading dose of 25 mg/kg then 15 mg/kg/dose IV q8hr PLUS ❒ Cefotaxime IV 2g q4–6h **Vancomycin calculated dose** Vancomycin target trough serumconcentration of 15-20 µg/mL	❒ Vancomycin IV loading dose of 25 mg/kg Then, 15 mg/kg/dose IV q8hr PLUS ❒ Ceftriaxone 2g IV q 12 h **Vancomycin calculated dose** Vancomycin target trough serumconcentration of 15-20 µg/mL
≥ 50 years	☐ Vancomycin IV 15 mg/kg q8h PLUS ☐ Ampicillin IV 2g q4h PLUS Cefotaxime IV 2g q4–6h **Vancomycin calculated dose** ☐ Vancomycin target trough serum concentration of 15-20 µg/mL	☐ Vancomycin IV 15 mg/kg q8hPLUS ☐ Ampicillin IV 2g q4h PLUS ❒ Ceftriaxone IV 2g q12h **Vancomycin calculated dose** Vancomycin target trough serumconcentration of 15-20 µg/mL
Head trauma: Basilar skull fracture	❒ Vancomycin IV 15-20 mg/kg q8h PLUS ❒ Ceftriaxone IV 2g q12h. **Vancomycin calculated dose** …… Vancomycin target trough serumconcentration of 15-20 µg/mL	❒ Meropenem 1 gm IV q8h PLUS ❒ Vancomycin IV 15-20 mg/kg q8h **Vancomycin calculated dose** …… Vancomycin target trough serumconcentration of 15-20 µg/mL
Penetrating injury or post-neurosurgery meningitis	❒ Meropenem 1 gm IV q8h PLUS ❒ Vancomycin IV 15 mg/kg q8h **Vancomycin calculated dose** ❒ Vancomycin target trough serum concentration of 15-20 µg/mL	❒ Cefepime 2 gm IV q8h PLUS ❒ Vancomycin IV 15 mg/kg q8h. **Vancomycin calculated dose** ❒ Vancomycin target trough serum concentration of 15-20 µg/mL
Shunt or external ventricular drain (EVD) related infection (EVD should be changed)	❒ Meropenem 1 gm IV q8h PLUS ❒ Vancomycin IV 15 mg/kg q8h **Vancomycin calculated dose** …… ❒ Vancomycin target trough serum concentration of 15-20 µg/mL	❒ Cefepime 2 gm IV q8h PLUS ❒ Vancomycin IV 15 mg/kg q8h. **Vancomycin calculated dose** …… ❒ Vancomycin target trough serum concentration of 15-20 µg/mL If sever beta lactam allergy: ❒ Ciprofloxacin 400 mg IV q8h PLUS ❒ Vancomycin IV 15 mg/kg q8h **Vancomycin calculated dose** …… ❒ Vancomycin target trough serum concentration of 15-20 µg/mL

Meningoencephalitis	❒ Vancomycin IV 15 mg/kg q8hPLUS ❒ Ampicillin IV 2g q4h PLUS ❒ Meropenem 2 g q8h PLUS ❒ Acyclovir 10 mg/kg/dose IV q8hfor 10 days **Vancomycin calculated dose** …… ❒ Vancomycin target trough serum concentration of 15-20 µg/mL	❒ Vancomycin IV 15-20 mg/kg q8h PLUS ❒ Ampicillin IV 2g q4h PLUS ❒ Cefepime IV 2g q 8h PLUS ❒ Acyclovir 10 mg/kg/dose IV q8hr for10 ays **Vancomycin calculated dose** …… ❒ Vancomycin target trough serum concentration of 15-20 µg/mL

Specific Organism			Antibiotic Therapy	Duration
S. pneumoniae	Penicillin MIC < 0.1 mg/mL	❒ ❒	Penicillin G 4 million Unit IV q4hr OR Ampicillin IV 2 g q4hr	10-14 days
	Penicillin MIC 0.1–1.0 mg/mL	❒	Ceftriaxone IV 2 gm q12hr	
	Penicillin MIC ≥ 1.0 mg/mL	❒ ❒	Vancomycin IV loading dose of 25mg/kg then 1g q8hr PLUS Ceftriaxone IV 2 g q12hr Vancomycin, target trough serum concentration of 15-20 µg/mL	
Neisseria meningitis		❒	Ceftriaxone IV 2 g q12hr	7 days
Listeria monocytogenes		❒ ❒ ❒	Ampicillin IV 2 gm q4h ± Gentamicin 2 mg/kg loading dosethen 1.7 mg/kg q8h OR Trimethoprim-sulfamethoxazole IV 5mg/kg [based on the trimethoprimcomponent] q6-12 hr Calculateddose: .....OR Meropenem IV 2 g q 8hr	21 days
Hemophilus influenzae		❒	Ceftriaxone IV 2 gm q12h	7 days
Staphylococcus aureus	***Methicillin susceptible (MSSA)***	❒ ❒	Flucloxacillin IV 2g oral q4-6hr OR Cloxacillin IV 2 g oral q4-6hr	14days
	Methicillin Resistance (MRSA)	❒	Vancomycin IV loading dose of25 mg/kg then 1 g q8hr ± Rifampin PO 600 mgq24hr OR Linezolid IV 600 mg q12h Vancomycin, target trough serum concentration of 15-20 µg/mL	

Staphylococcus epidermidis		❒ ❒	Vancomycin IV loading dose of 25mg/kg then 1g q8hr Vancomycin, target trough serum concentration of 15-20 µg/mL OR linezolid IV 600 mg q12hr	14da ys
Enterococcus species	Ampicillin susceptible	❒ ❒	Ampicillin IV 2 g q4h ± Gentamicin IV 1 mg/kg q8h Gentamicin dose:.....(trough levels of <1 mcg/mL)	14-21 days
	Ampicillin resistant	❒ ❒	Vancomycin IV loading dose of 25 mg/kg then 1g q8hr ± Gentamicin IV 1 mg/kg q8h Gentamicin Calculated dose: …….. (trough levels of <1 mcg/mL)	
	Ampicillin and vancomycin resistant	❒	Linezolid IV 600 mg q 12hr	28 days
Gram negative		❒ ❒	Meropenem 2 gm IV q8h OR Ciprofloxacin 400 mg IV q8h	
Meningitis prophylaxis ***N. meningitidis***		❒ ❒ ❒	Only indicated for "close contact" whohave had prolonged (>8 hours) contact while in close proximity (<1 meter) to the patient or who have been directly exposed to the patient's oral secretions during the 7 days before the onset of thepatient's symptoms and less than24 hours of initiation of appropriate antibiotictherapy. Ciprofloxacin 500 mg PO one dose **OR** Ceftriaxone 125-250 mg IM one dose **OR** Rifampicin 600mg PO q12hr for 4 doses	

BRAIN ABSCESS

Empiric (Origin of abscess)		Therapy (dosing interval in hours)	Duration
Oral source; Otogenic; or sinus source		❒ Ceftriaxone IV 2 g q12hr PLUS ❒ Metronidazole 500 mg IV q8hr OR ❒ Penicillin G 3-4 million units IV q4h PLUS ❒ Metronidazole 500 mg IV q8hr	Duration of treatment is unclear. Treat until response by neuroimaging (CT/MRI).
Hematogenous Spread suspect *Staph. aureus*	*M SSA*	❒ Flucloxacillin IV 2g oral q4-6hr OR ❒ Cloxacillin IV 2 g oral q4-6hr	
	MRSA	❒ Vancomycin IV loading dose of 25 mg/kg then 1 gq8hr ± ❒ Metronidazole IV 500 mg q8hr (Vancomycin target trough serum concentration of 15-20 µg/mL)	
Postoperative neurosurgical patients		❒ Vancomycin IV loading dose of 25 mg/kg then 1g q8hrPLUS ❒ Meropenem IV2 g q8hr OR ❒ Vancomycin IV loading dose of 25 mg/kg 1g q8hrPLUS ❒ Ceftazidime IV 2 g q8hr (vancomycin target trough serum concentration of 15-20 µg/mL)	
Penetrating trauma OR unknowing source		❒ Vancomycin IV loading dose of 25 mg/kg then 1g q8hrPLUS ❒ Ceftriaxone IV 2 g q12hr (Vancomycin target trough serum concentration of 15-20 µg/mL) If the paranasal sinuses are involved, add ❒ Metronidazole 500 mg IV q8hr	

GENITOURINARY TRACT INFECTION

Bacterial Urinary Tract Infections (UTI)

1.1.1.1.1 Management of Patients without a Urinary Cathetor

Infection Type	First Line Therapy	Alternative Therapy
Asymptomatic Bacteriuria (Positive urine culture ≥100,000 CFU/with no signsor symptoms)	**No treatment unless patient is:** • Pregnant • About to undergo a urologic procedure • Neutropenia **Notes:** ▪ **Obtain routine cultures in asymptomatic patients is not recommended Antibiotics do not decrease asymptomatic bacteriuria or prevent subsequent development of UTIs**	
Acute cystitis	**Uncomplicated:** (female, no urologic abnormalities, no stones, no catheter) ▪ If local prevalence of resistance to TMP/SMX is <20% ☐ TMP/SMX double strength 1tab orally twice daily for 3 days ▪ If sulfa allergy or > 20% *E.coli* resistance to TMP/SMX ☐ Nitrofurantoin (**Macrobid**®) 100 mg orally every 12 hours for 5 days (Not in patients with CrCl <50 ml/min) **Complicated:** (male gender, possible stones, urologic abnormalities, pregnancy) ☐ Same as above except duration for 7-10 days	☐ **Amoxicillin-clavulanate** 875/125 mg oral tab every 12 hours for 5 days **OR** ☐ **Cefuroxime 500 mg oral tabevery 12** hours for 5 days
Acute pyelonephritis	**Out patients:** ☐ Ceftriaxone 1 g IV every 24 hours for 7 days ☐ Ertapenem 1 g IV every 24hours for 7 days (if history of ESBL) **Hospitalized >48 hours** ☐ Piperacillin /Tazobactam IV 4.5 g every 6 hours for 14 days **OR** ☐ Ceftazidime 2 gm IV every 8 hours	**If penicillin Allergy** ☐ Gentamicin 5mg/kg IV as extended interval dosing **Out patients:** ☐ Amoxicillin-clavulanate 875/125 mg oral tab every 12 hours for 14 days **OR** ☐ TMP/SMX double strength 1 tab orally twice daily for 14 days (If local prevalence of resistance to TMP/SMX is <20%) **OR** ☐ Ciprofloxacin 500 mg oral tab every 12 hours **for 7 days (if susceptible) OR** **Hospitalized >48 hours** Imipenem 500 mg IV every 6 hours for 14 days

Urosepsis (hypotension, tachypnea (≥ 20/min), tachycardia (≥ 90/min), altered mental state)	☐ Imipenem 500 mg IV every 6hours for 14 days	**If penicillin Allergy** Levofloxacin (750 mg every 24hour + metronidazole (500 mg q 8h)
Management of patients WITH a urinary catheter		
Infection Type	**First Line Therapy**	**Alternative Therapy**
Asymptomatic Bacteriuria (Positive urine culture ≥100,000 CFU/Ml with no signs or symptoms)	☐ **Remove the catheter when possible** ☐ **No treatment needed**	
Catheter-associated UTI: (Fever with no other source is most Common patients may also have suprapubic or flank pain **AND** Pyuria (>10 WBC/hpf) **AND** Positive urine culture ≥ 1000 CFU/mL	☐ **Remove the catheter when possible for all** **For Cystitis** ☐ Cefepime 2 gm IV every 8 hours **For Pyelonephritis** ☐ Piperacillin / Tazobactam IV 4.5 g every 6 hours for 14 days **Duration** ☐ 5-7 days for cystitis ☐ 10-14 days for pyeleonephritis ☐ 14-21 days for complicated infection	☐ **For Cystitis** ☐ Ertapenem 1 g IV every 24hours for 7 days **For Pyelonephritis** ☐ Imipenem 500 mg IV every 6 hours for 10-14 days ☐
Management of patients Candiduria (Urinary catheter removal will resolve the candiduria in 40% of cases)		
Type of infection	**First Line Therapy**	**Alternative Therapy**
Asymptomatic cystitis	☐ **Therapy not usually indicated** **Treatment if patient is:** ❖ Urinary obstruction or abnormal GU tract ❖ About to undergo a urologic procedure ❖ Neutropenia ☐ Fluconazole 400 mg PO oncedaily for 7 days	☐ Amphotericin B IV 0.3 mg/kgdaily for 7 days

Symptomatic cystitis	☐ Fluconazole 400 mg PO oncedaily for 7 days	☐ Amphotericin-B IV 0.5 mg/kg daily for 7 days
Pyelonephriti s	☐ Fluconazole 400 mg PO oncedaily for 14 days	☐ Amphotericin B IV 0.7 mg/kgdaily for 14 days
Candidavaginitis	☐ Fluconazole 150 mg orally assingle dose	☐ Miconazole 2% cream 5 g intravaginally once daily for 7 days

GENITOURINARY TRACT INFECTION

1.1.1.1.2 Antibiotic order (Pelvic Inflammatory Disease)

Empiric therapy	**Therapy (dosing interval)**	
Outpatient	1	Ceftriaxone 250 mg IM x 1 dose followed by Azithromycin 1 gm PO weekly x2 weeks
	2	Cefoxitin 2 gm IM with Probenecid PO 1 gm both as single dose + Doxycycline 100 mg PO q12hr with Metronidazole 500 mg q12hr both x 14
Inpatient	1	Ceftriaxone IV 2 g q24 h + Doxycycline IV/PO 100 mg q12h Clindamycin 900 mg IV q8h + Gentamicin 1mg/kg IV/IM q8hr , then Doxycycline 100 mg PO q12hr x 14 days
	2	Gentamicin Calculated dose: …… Target trough <1 µg/mL

ANTIMICROBIAL EMPIRICAL GUIDELINES FOR HOSPITAL AQUIRED INFECTIONS IN(ADULTS)

Central line associated Blood Stream Infection (CLABSI)

1.1.1.1.3 Management of Patient with Tunneled Line

Infection Type	**First Line Therapy**	**Alternative Therapy Empiric**
Empiric Therapy	☐ Piperacillin-Tazobactam 4.5 gm ❒ Vancomycin 1gm IV q 12h. OR ❒ Meropenem 1 gm IV q8h PLUS ❒ **V**ancomycin-1 gm IV q12hr. (target trough 15-20/ml)	☐Cefepime 2 gm iv q8h IV q6h PLUS ☐ Vancomycin 1gmIV q 12h

Patient requiring long term alimentation, or high risk for candida sp. Infection.	Add to any of the above regimen ❒ Caspofungin 70mg IV on day 1, then 50mg q24hr OR ❒ Anidulafungin 200mg IV on day 1 followed by 100mg q24hr

Management of Patient with Non-Tunneled Line

Infection Type	First Line Therapy	Alternative Therapy
Staphylococcus aureus Remove catheter **MRSA**	☐ Oxacillin 2 gm IV q4h. ☐ Cephazolin 2 gm IV q8h. ☐ Vancomycin 1gm IV q 12h. (target trough 15-20/ml)	☐ Piperacillin-Tazobactam 4.5 gm IV q6h ☐ Daptomycin 6 mg/kg IV q24h (Not for Lung Infection) OR ☐ Linezolid 400 mg IV q12h.
Coagulase negative Staphylococcus	☐ Vancomycin 1gm IV q12h ☐ (target trough 15-20/ml)	☐ None
Enterococcus sp.	Penicillin susceptible strains ☐ Ampicillin 2 gm IV q4h. Penicillin resistant strains ☐ Vancomycin 1gm IV q 12h. (target trough 15- 20/ml)	☐ Linezolid 400 mg IV q12h. OR ☐ Daptomycin 8 mg/kg IV q24h (Not for Lung Infection)
Enterobacteriaceae Remove catheter	☐ Piperacillin-Tazobactam 4.5 gm IV q6h OR ☐ Meropenem 1 gm IV q8hif suspected carbapenem resistance add Colistin or aminoglycoside	☐ Cefepime 2 gm IV q8h.
Patient requiring **Long term alimentation, or high risk for Candida sp. Infection** (**Remove Catheter)**	Add to any of the above regimen ☐ Caspofungin 70 mg IV on day 1, then 50 mg q24h, or Anidulafungin 200 mg IV on day 1 followed by 100 mg q24h.	

HOSPITAL AQUIRED PNEUMONIA (HAP)
VENTILATOR AQUIRED PNEUMONIA (VAP)

1.1.1.1.3.1 *Risk Factors for Multidrug-Resistant Pathogens:*

***Risk factors for multi-drug resistance (MDR) VAP**

Prior intravenous antibiotic use within 90 days Septic shock at time of VAPARDS

preceding VAP

Five or more days of hospitalization prior to the occurrence of VAP Acute renal replacement therapy prior toVAP onset

***Risk factors for MDR HAP**

Prior intravenous antibiotic use within 90 days

***Risk factors for methicillin-resistant staphylococcus aureus (MRSA) VAP/HAP**

Prior intravenous antibiotic use within 90 days

Patient Group	First Line	Alternative	Duration
VAP (hemodynamically stable)	❒ Piperacillin-tazobactam 4.5 g IV q6h PLUS ❒ Amikacin 15 mg/kg IV q24h **Target amikacin trough level less than 4 mcg/ mL**	❒ Cefepime 2 g IV q8h PLUS ❒ Ciprofloxacin 400 mgIV q8h	7 days
VAP (hemodynamically unstable)	❒ Vancomycin 15 mg/kg IVq12 (consider a loading dose of 25mg/kg × 1 for severe illness) PLUS ❒ Imipenem 500 mg IV q6h PLUS ❒ Colistin 9 million loading dose followed by 4.5 million IV q 12 hrs **Target amikacin trough level less than 8 mcg/ mL**	❒ Vancomycin 15 mg/kgIV q12 (consider a loading dose of 25mg/kg × 1 for severe illness PLUS ❒ Aztreonam 2 g IV q8h PLUS ❒ Colistin 9 million loading dose followed by 4.5 million q 12 hrs	7 days
HAP Not at high risk of mortality and no factors increasing the likelihood of MRSA	❒ Cefepime 2 g IV q8h	❒ Levofloxacin 750 mg IV q24h (**If penicillin allergic)**	7 days

Not at high risk of mortality but with factors increasing the likelihood of MRSA	❒ Piperacillin-tazobactam 4.5 g IV q6h PLUS ❒ Vancomycin loading dose of 25 mg/kg then 15 mg/kg IVq8-12h **goal to target vancomycin tough level of 15–20 mcg/ml** Vancomycin calculated dose:……..	❒ Cefepime 2 g IV q8h PLUS ❒ Vancomycin loading dose of 25 mg/kg then 15 mg/kg IV q8– 12h **goal to target vancomycin tough level of 15–20 mcg/ml** Vancomycin calculated dose:……..	7-10 days
Sepsis/septic shock, (Receipt of intravenous antibiotics during the last 90 days)	❒ Imipenem 500 mg IV q6h PLUS ❒ Vancomycin loading dose of 25mg/kg then 15 mg/kg IV q8–12h with goal to target 15– 20 mcg/ml PLUS ❒ Amikacin 15 mg/kg IVq24h **Target amikacin trough lessthan 8** Vancomycin calculated dose:…… Vancomycin trough level: …….. Gentamicin calculated dose:…… Gentamicin trough level ……<1 mcg/ml	❒ Imipenem 500 mg IV q6h PLUS ❒ Linezolid 600 mg IV q12h PLUS ❒Gentamicin 5–7 mg/kgIV daily Gentamicin calculate dose: …… **Gentamicin trough level <1mcg/ml**	10-14 days

HOSPITAL AQUIRED COMPLICATED INTRA-ABDOMINAL INFECTIONS			
Patient Group	**First line**	**Alternative**	**Duration**
Empiric therapy	❒ Tigecycline 100mg IV infusion then 50mg IV infusion q12hr PLUS ❒ Ciprofloxacin 400 mg IV q12h	Imipenem 500 mg IV q6h PLUS Gentamicin IV 3-5mg/kg q24h Gentamicin calculated dose: _____ Gentamicin trough level ……..<1 mcg/ml	4-7 days

MANAGEMENT OF PATIENTS WITH SEPSIS

Infection Type	First Line Therapy	Alternative Therapy
Source is unclear	☐ Ertapenem 1 g IV every 24 hours (if history of ESBL) + Vancomycin1gm IV q 12h. ☐ Meropenem 1 gm IV q8h + Vancomycin 1gm IV q 12h. ☐ Imipenem 0.5 gm IV q6h + Vancomycin 1gm IV q 12h.	If low prevalence of ESBL or carbapenemase aerobic gram-negative bacilli: ☐ Piperacillin-Tazobactam4.5 gm IV q6h + Vancomycin1gm IV q 12h. If high prevalence of ESBL or carbapenemase aerobic gram-negative bacilli: ☐ Colistin IV +Meropenem 1 gm IV q8h + Vancomycin 1gm IV q 12h.
Suspect biliary source	☐ Piperacillin-Tazobactam4.5 gm IV q6h	
Suspect community acquired pneumonia source	☐ Piperacillin-Tazobactam4.5 gm IV q6h + Vancomycin 1gm IV q 12h.	
Suspect illicit IV drug use source	☐ Meropenem 1 gm IV q8h + Vancomycin 1gm IV q 12h.	
Suspect petechial rash source	☐ Ceftriaxone 2gm IV q12h.	

2 ANTIMICROBIAL GUIDELINES(PEDIATRIC) EMPIRICAL THERAPY

2.1.1 Empiric Therapy of Skin and Soft Tissue Infections

Subset	Usual pathogens	Preferred IV Therapy	Alternate IV Therapy	PO or IV-to-PO Switch
Cellulitis, Impetigo	S.aureus Group A Streptococci	Cefazolin **or** Nafcillin **or** Oxacillin 7-10 days	Clindamycin 7-10 days	Cephalexin **or** Cefadroxil **or** Dicloxacillin **or** Amoxicillin/ Clavulanate **or** Erythromycin **or** Azithromycin 7-10 days
Severe Pyodermas abscesses	CA-MRSA	Vancomycin **Plus** Clindamycin 7-10 days	Vancomycin **or** Linezolid 7-14 days	TMP-SMX **or** Doxycycline 7-14 days**
Animal bite wounds (dog/cat)	Group A Streptococci P.Multocida- Capnocytophage	Amoxicillin/Clavulanic acid 7-10 days	Piperacillin **or** Ticarcillin 7-10 days	Amoxicillin-clavulanate 7-10 days **Penicillin allergy:**

	S.aureus			Clindamycin Plus TMP-SMX 7-10 days (dog bites) Doxycycline or Cefuroxime 7-10 days (cat bites)
Human Bite Wounds	Oral anaerobesE.corrodens Group A Streptococci S.aureus	Amoxicillin/Clavulanic Acid 5-7 days	Piperacillin **or** Ticarcillin 5-7 days	Amoxicillin-Clavulanate **or** Doxycycline 5-7 days **Penicillin allergic patient:** Clindamycin **Plus** TMP-SMX 5-7 days

**** In children >8 years of age.**

 # Preferred therapy for patient in geographic regions with a high prevalence of MRSA or for those with Penicillin /Cephalosporin allergy.

2.1.2 Skin and Soft Tissue Infections

Subset	Usual pathogens	Preferred IV Therapy	Alternate IV Therapy	Iv-to-PO Switch or PO Therapy
Cat Scratch disease (CSD)	Bartonella henselae	Gentamicin x 10-14 days	-	Azithromycin x5 days **or** TMP-SMX **or** Ciprofloxacin **or** Rifampin x 10-14 days
Chicken pox Immuno-compromised host Immuno-competenthost Herpes zoster (shingles)	VZV	Acyclovir x 7-10 days	Acyclovir or Valacyclovir x 7-10 days	
	VZV	Acyclovir x 5 days	Acyclovir or Valacyclovir x 5 days	
	VZV	Same as for chicken pox	Acyclovir or Valacyclovir x 10 days (for individuals ≥ 12 years of age	

*No well-controlled trials of antibiotic treatment for CSD to demonstrate benefit.

Duration of therapy represents total time IV, PO, or IV+PO. Most patients on IV therapy able to take PO medsshould be switched to PO therapy soon after clinical improvement.

Skin and Soft Tissue Infection

Acute Unilateral Cervical Lymphadenitis

Subset	Usual pathogens	Preferred IV Therapy	Alternate IV Therapy	PO
Moderate symptoms (non- hospitalized patient)	S.aureus (CA-MRSA) Group A Streptococcus (GAS)	---------	----------	**1st Choice:** Cephalexin **or** Cefadroxil **2nd Choice:** Clindamycin*
Severe Symptoms (hospitalized patient)	S,aureus Group A Streptococcus (GAS)	Clindamycin 40mg/kg/day (IV) Divided q 6-8h max. 4-8 gm / day Cefazolin 50-100 mg/kg/day (IV) divided q 8h (max. 6gm / day) **Or** Cloxacillin	Vancomycin 45-60 mg/kg/day divided q 6-8 h max. 2-4 gm / day	

		150mg/kg/day (IV) divided Q 4-6 h (max 12gm/day)		

*TMP-SMX is another option for CA-MRSA but should not be used initially because it is not active against GAS.

Empiric Therapy of CNS Infections

Subset (age)	Usual pathogens	Preferred IV Therapy	Alternate IV Therapy
Neonate (0-30 days)	Group B Streptococci E.coli Listeria Monocytogenes Other gram-negatives (e.g. Citrobacter, Serratia) and gram-positives (e.g. Enterococci)	Ampicillin **Plus** Cefotaxime **Or** Ceftriaxone 14-21 days	Ampicillin **Plus** Gentamicin
1-3 months	Overlap neonate and >3 months	Vancomycin **Plus either** Cefotaxime **or** Ceftriaxone	Ampicillin **Plus either** Cefotaxime **or** Ceftriaxone
>3 months	S. pneumoniae N. meningitidis	**Before culture result:**	Meropenem

	H. influenzae (very rare) (hib)	Cefotaxime 300 mg/kg/day (IV) max. 12gm/day in 3-4 divided doses **or** Ceftriaxone 100mg/kg/day (IV) in 1or 2 divided doses max. 4gm/day **Plus** Vancomycin 60mg/kg/day max. 4gm/day in 4 divided doses	**Severe penicillin allergy:** Vancomycin **Plus** **either** Rifampin **or** Chloramphenicol

Acute bacterial Meningitis

Subset	Usual pathogens	Preferred IV Therapy	Alternate IV Therapy
CNS Shunt Infection (Treat Initially for S.epidermidis,if later identified as MSSA, treat accordingly)	S.epidermidis S.aureus (MRSA) Staphylococcus coagulase negative Coliform	Vancomycin***** **with or without** Rifampin 10mg/kg (IV or PO) q12hrs x 7-10 days after shunt removal	Linezolid x 7-10 days after shunt removal
	S.aureus (MSSA)	Nafcillin x 7-10 days after shunt removal	Vancomycin x 7-10 days after shunt removal
	Enterobacteriaceae	Cefotaxime OR	Meropenem x 7-10 days after shunt removal

		Ceftriaxone x 7-10 days after shunt removal	

*vancomycin should be administered 2 hours prior to device placement (for patient allergic to vancomycin, givesingle dose of Cefazolin 1 hour prior to incision).

Encephalitis

Subset	Usual pathogens	Preferred IV Therapy	IV-to-PO Switch
Herpes	HSV-1	Acyclovir ≥28 days to ≤12 years 20mg/kg q 8h x 14-21 days	Treat IV only
Mycoplasma	M.pneumoniae	----------	Doxycycline **Or** Minocycline 2-4 weeks

Sinusitis

Subset	Usual pathogens	Preferred IV Therapy	IV-to-PO Switch
Acute	S. pneumoniae H. influenzae M. catarrhalis	Ceftriaxone **Or** Cefuroxime x1-2 weeks	Amoxicillin **or** Amoxicillin/Clavulanic Acid x 14-21 days **Or** Cephalosporin **or** Clarithromycin* x 10-14 days **or** Azithromycin x 5 days
Chronic	Same as acute + oral anaerobes	Requires prolonged antimicrobial therapy (2-4 weeks)	

*Macrolides may be less affective and should be reserved for penicillin and cephalosporin–allergic patient.

3 ACUTE OTITIS MEDIA

Subset	Usual pathogens	Preferred IV Therapy	PO Therapy
Initial Uncomplicated Bacterial Infection	S. pneumoniae H. influenzae M. catarrhalis	Ceftriaxone x1 dose	Amoxicillin x 10 days **or** Cefdinir x 10 days **or** Azithromycin (1-3- or 5-days regimen) **or** Erythromycin-sulfisoxazole x 10 days **or** TMP-SMX x 10 days
Treatment failure or resistant organism	MRSP Beta-lactamase Positive H. influenzae	Ceftriaxone q24 h x 3 doses	Amoxicillin/clavulanic acid **Or** ES-600 x 10 days **Or** Cephalosporin x 10 days

Mastoiditis

Subset	Usual pathogens	Preferred IV Therapy	Alternate IV Therapy	PO or IV-to-PO Switch
Acute	S. pneumoniae S. aureus Group A Streptococci H. influenzae	Ceftriaxone **or** Cefotaximex 10-14 days **Plus either**	Ampicillin-Sulbactam x 10-14 days	Amoxicillin-clavulanate or Cefpodoxime or Cefdinir x 10-14 days

		Nafcillin **or** Vancomycin (if MRSA suspected)		
Chronic	Polymicrobial, Including P. aeruginosa, S. aureus, Anaerobes, Enterobacteriaceae	Piperacillin **or** Ticarcillin x 10-14 days	Ceftazidime **Or** Meropenem **Or** Imipenem x 10-14 days	None

Pharyngitis

Subset	Usual pathogens	IV or IM Therapy	Po Therapy or IV-to-PO switch
Exudative (culture)	Group A Streptococci	Benzathine penicillin IM x 1 dose	Penicillin V or Amoxicillin x10 days. **Alternate:** Azithromycin 12mg/kg/day x5 days **Or** Cephalexin **or** Cefadroxil **or** Erythromycin **or** Clarithromycin **or** Clindamycin x 10 days
Persistent/recurrent disease	Group A Streptococci	Clindamycin	Amoxicillin-clavulanate x 10 days **or Combination therapy with either** penicillin V **or** Amoxicillin x 10 days plus Rifampin **added on days 7-10.**
Vesicular ulcerative	Enteroviruses HSV 1 or 2	Primary HSV: Acyclovir x 5-7 days	Primary HSV: Acyclovir or Valacyclovir x 5-7 days

3.1.1 Empiric Therapy of lower Respiratory Tract Infection

Subset (age)	Usual pathogens	IV Therapy	Po Therapy or IV-to-PO switch
Community-acquired Pneumonia Birthto 20 days	Group B Streptococci, Gram-negative enteric bacteria	Ampicillin **pluseither** Gentamicin **or** Cefotaxime x 10-21 days	Not applicable
3 weeks to 3 months	RSV Parainfluenza Human Metapneumovirus (HMPV)	None (supportive care)	None
	C. trachomatis S. pneumoniae B. Pertussis	Cefotaxime or Ceftriaxone x 10-14 days* Alternative: Ampicillin	**Afebrile:** Azithromycin x 5-7 days **or** Erythromycin x 14 days **Lobar, febrile:** Amoxicillin **or** Amoxicillin/clavulanic **or** Cefdinir **or** Cefuroxime **or** Cefpodoxime x 10-14days
	Viruses (RSV, parainfluenza, Influenza, adenovirus, rhinoviruses)	**RSV:** Supportive therapy. For infants at highest risk forsever RSV infection, consider palivizumab# 15mg/kg/month x 1-2 seasons for prevention. **Influenza:** Oseltamivir (influenza A,B), Routine immunization for infants 6-23 month of age.	
3 month to < 5 years	S. pneumoniae H. influenzae S. aureus/MRSA	Ceftriaxone or Cefotaxime 10-14 days*	Ampicillin **or** Amoxicillin-clavulanate **or** Clarithromycin **or** Azithromycin **or** Clindamycin x 10-14 days

5-15 years	M. pneumoniae		
	M. pneumoniae C. pneumoniae S. pneumoniae Group A Streptococci	Ceftriaxone or Cefotaxime 10-14 days*	Azithromycin **or** Erythromycin **or** Clarithromycin **or** Augmentin **or** Cefuroxime**or** Doxycycline (age> 8years) x 10-14 days

*if chronic cough of more insidious onset, consider adding IV or PO macrolide (Azithromycin, Clarithromycin, Erythromycin) to cover Pertussis/C. trachomatis (3 weeks-3 months of age), Mycoplasma (3 months- 5 years of age) or Mycoplasma/C. pneumoniae (5-15 years of age).

As per AAP guidelines, prophylaxis with Palivizumab is indicated for infants with chronic lung disease or congenital heart disease ≤1 years of age at start of RSV season (November through March).

3.1.2 Community-Acquired Pneumonia (continued----------)

Pertussis (patient +Contact)	Bordetella spp. certain Adenoviruses M. pneumoniae C. trachomatis C. pneumoniae	Azithromycin x 5 days **or** Erythromycin x 14 days	Erythromycin estolate x 14 days **or** Clarithromycin x 7 days **or** Azithromycin x 5 days. **<u>If macrolide-intolerant:</u>** TMP-SMX x 14 days

Swine Influenza (H1 N1) Antiviral Medication Dosing Recommendations

Antiviral	Treatment		Chemoprophylaxis
Oseltamivir			
Adults	75 mg capsule twice per day x 5 days		75 mg capsule once per days x 10 days
Children (Age, 12 month	15 kg or less	60 mg per day divided into2 doses	30 mg once per day

or older) weight	15-23 kg	90 mg per day divided into2 doses	45 mg once per day
	24-40 kg	120 mg per day dividedinto 2 doses	60 mg once per day
	>40 kg	150mg per day divided into2 doses	75 mg once per day

3.1.3 Tuberculosis

Subset	Pathogen	PO or IM therapy
Latent infection (positive PPD), clinically well, negative chest X-ray)	M. tuberculosis	INH x 9 months or Rifampin x 6 months (if INH resistant)
Pulmonary and extrapulmonary TB (except meningitis and osteomyelitis)	M. tuberculosis	INH **plus** Rifampin **plus** PZA x 2 months followed by INH **plus** Rifampin x 4 month
Meningitis	M. tuberculosis	INH plus Rifampin plus PZA plus either streptomycin (IM) or Ethionamide x 2 month, followed by INH plus Rifampin x 7-10 months(i.e., 9-12 months total therapy)
Osteomyelitis	M. tuberculosis	INH plus Rifampin plus PZA plus Ethambutol(EMB) x 2 months followed by INH plus Rifampicin x 7-10 months

Tuberculosis (continued ------)

Subset	Pathogen	PO or IM therapy
Exposure		
< 4 years	M. tuberculosis	Do PPD If negative start INH then repeat PPD in 3months If negative, discontinue INH If positive, treat as latent infection.
>4 years		Do PPD If negative and clinically well, no therapy. If positive, treat as latent infection.

TB Drugs

TB Drugs	Daily Dosage (mg/kg)	Twice weekly dosage (mg/kg)
Isoniazid (INH)	10-15	20-30
Rifampin (RIF)	10-20	10-20
Ethambutol (EMB)	15-25	50
Pyrazinamide (PZA)	20-40	50
Streptomycin (SM)	20-40 (IM)	-
Ethionamide	15-20 (in 2-3 divideddoses/day)	-

3.1.4 Sepsis/Bacteremia (exclude meningitis)

Subset	Usual pathogens	Preferred IV Therapy	Alternate IV Therapy
Children who cannot receive penicillin or who have recently received broad-spectrum antibiotics		Vancomycin plus Meropenem	Vancomycin plus Aztreonam or Ciprofloxacin
Patient at risk of fungal infection		Liposomal Amphotericin or Echinocandin (Caspofungin, Micafungin)	
Sickle cell disease	S. Pneumoniae E. coli S. aureus Klebsiella H. influenzae	Ceftriaxone ± Vancomycin (for unstable patient)	**For Cephalosporin-allergic patient:** Clindamycin ± Vancomycin
Febrile neutropenia	**Gram-positive & gram-negative Pathogens** S. Aureus S. pneumoniae S. viridians Coagulase-negative Staphylococcus E. coil	Monotherapy with Piperacillin/Tazobactam or Cefepime or Meropenem add Vancomycin plus Gentamicin (for hemodynamically unstable)	Ceftazidime (for low-risk patients)

	P. aeruginosa Klebsiella		
Immunocompromised host on Central venous catheter	S. epidermidis S. aureus Enterobacteriaceae Pseudomonas Viridans Streptococci Enterococcus	Meropenem **or** Piperacillin/Tazobactam **or** Cefepime x 7-14 days	Piperacillin/Tazobactam **plus** an aminoglycoside x 7-14 days

Empiric Therapy of Genitourinary Infections

Subset	Usual pathogens	Preferred IV Therapy	Alternate IV Therapy
Pyelonephritis	E. coil P. Mirabilis Klebsiella P. aeruginosa Enterococci	Ampicillin **Plus** Gentamicin	Ampicillin **Plus** Ceftriaxone (in renal failure)

Empiric Therapy of Gastrointestinal Infection

Acute Diarrheal Syndromes (Gastroenteritis)

Subset	Usual pathogens	Preferred Therapy	Alternate Therapy
Community-acquired	Viruses (Rotavirus, Norwalk agent, enteric adenovirus, enteroviruses)	No specific therapy indicated	No specific therapy indicated
	Salmonella non-typhi	Ceftriaxone (IV) **or** Cefotaxime (IV) x 10-14 days	TMP-SMX (IV or PO) **or** Amoxicillin (PO) **or** Cefixime (PO) x 10-14 days
	Shigella	Ceftriaxone (IV) or Azithromycin (PO) x 5 days	TMP-SMX (PO) **or** Cefixime (PO) **or** Ampicillin (PO) x 5 days
	Campylobacter	Erythromycin (PO) x 7 days**or** Azithromycin (PO) x5 days	Doxycycline (PO)(>8 years old) x 7 days
	Yersinia enterocolitica	TMP-SMX (PO) x 5-7 days	Cefotaxime (IV) **or** Tetracycline (PO) **or** Doxycycline (PO) x 5-7days

Acute Diarrheal Syndromes (Gastroenteritis)

Subset	Usual pathogens	Preferred Therapy	Alternate Therapy
Traveler's diarrhea	E. coli	TMP-SMX (PO) x 3 days	Azithromycin (PO) x 3 days
Typhoid (Enteric) fever	Salmonella typhi	Ceftriaxone (IV) **or** Cefotaxime (IV) x10-14 days	TMP-SMX (IV or PO) **or** Amoxicillin (PO) **or** Cefixime (PO) x 10-14 days
Antibiotic-associated colitis	Clostridium difficile	Metronidazole (PO) x 7-10 days **or** Nitazoxanide (PO) x 3 days	Vancomycin (PO) x 7-10 days
Chronicwatery diarrhea	Gardia lambia	Metronidazole (PO) x 5-7 days **or** Nitazoxanide (PO) x 3 days	Tinidazole (PO) 1 dose **or** Furazolidone (PO) 7-10 days **or** Albendazole x 5-7days
Acute dysentery	E. histolytica	Metronidazole (PO) x 10 days **followed by either** Iodoquinol (PO) x 20 days **or** Paromomycin (PO) x 7 days	Tinidazole (PO) x 3-5 day **followed by either** Iodoquinol (PO) x 20 days**or** Paromomycin (PO) x 7days

Note:

Because viruses are the cause of acute diarrhea, antibiotics should not be used unless diagnostic test establish a treatable bacterial or parasitic agent as the cause of the syndrome

4 ANTIMICROBIAL SURGICAL PROPHYLAXIS

4.1.1.1.1 Table 1. Factors Associated with Increased Risk of Infection

Patient	Operation
Extremes of age Malnutrition Obesity, Diabetes Smoking, Remote infection. Colonization with resistant Microorganisms Immunosuppressive therapy Length of preoperative stay.	Preoperative skin preparation. Site, duration and complexity of surgery. Suturing quality. Implantation of prosthetic materials. Surgical drains, Surgical Technique.

Table2. Dosing and Timing of Antibiotic Agents used for Surgical Prophylaxis

Antibiotics	Adult Intravenous Dose	Pediatric Intravenous Dose	Infusion Time (Minutes)	Timing of FirstDose (Before Incision)	Recommended Re-dosing Interval
Cefazolin	If wt <120kg: 2g If wt >120kg: 3g	30mg/kg	30	60 min or less	4
Cefuroxime	1.5g	50 mg/kg	30	60 min or less	4
Ciprofloxacin	400 mg	10 mg/kg	60	60-120 min	N/A
Clindamycin	900mg	10mg/kg	30	60 min or LESS	6
Co-Amoxiclav	1.2 g	30mg/kg	30	60 min or less	N/A
Gentamycin	5 mg/kg based on dosing weight	2.5 mg/kg based on dosing weight	30	60 min or less	N/A

Metronidazole	500 mg	15mg/kg Neonates weighing <1200 mg should receive a single 7.5mg/kg dose	30	60 min or less	N/A
Vancomycin	15mg/kg	15 mg/kg	60	60-120 min	N/A

Table 3. Recommended Intravenous Antibiotics for surgical Procedures

SURGICAL ANTIBIOTICS PROPHYLAXIS TABLES:

Refer to APP-IPC-053 Prevention of surgical site infection (SSI) Policy

Refer to RH CPG for the Management of Surgical Site Infection (SSI)/ Antibiotic Classifications

- Pre-operative systematic antibiotics should be infused and completed 60 minutes prior to first incision to (except vancomycin and fluoroquinolones should be infused 120 minutes prior to first incision to prevent RED MAN Syndrome).

- Patients undergoing Cardiothoracic and spinal surgery should be screened for MRSA nasal carriage preoperatively, if positive to use nasal mupirocin ointment (2%) at the evening before, day of surgery and bid x 5 days post-op, with (2 or 4%) chlorhexidine bodywash the night before the surgery and daily after for 5 days.

- Postoperative duration of antimicrobial prophylaxis should be limited to less than 24 hours from surgery end time, regardless of the presence of indwelling catheters, drains or prosthesis.

Type of Surgery	Preferred regimen	Alternative
Colorectal **Appendoctomy (uncomplicated)**	Cefazolin 2 g IV stat (weight≤120 kg) Cefazolin 3 g IV stat for weight ≥ 120kg) Children dose: Cefazolin 30mg/kg) IV single dose **PLUS** Metronidazole 500mg IV stat Children Metronidazole	Metronidazole 500mg IV Children dose:15mg/kg, IV single dose **PLUS** Gentamicin 4.5 mg/kg IV Children gentamicin dose 2.5mg/kg IV **single dose completely infused 60 minutes prior to incision**

▪ ▪ ▪ ▪ ▪ ▪ ▪ ▪ ▪ ▪ ▪ ▪ ▪ ▪ ▪ ▪ **Hernia repair** ▪ ▪ **Laproscopic (elective, high risk or** ▪ **cholecystectomy** ▪ **bariatric surgery Whipple procedure**	dose:15mg/kg IV, ▪ **single dose completely infused 60 minutes prior to incision** ▪ ▪ For colorectal surgery: In addition to systemic antibiotics and mechanical bowel preparation (if no contraindication), the following oral antibiotic regimen is administered: ▪ Neomycin 1 g of PO ▪ **PLUS** ▪ Erythromycin base 1 g at 1 PM, 2 PM, and 11 PM ▪ **OR** ▪ Neomycin 2 g PO ▪ **PLUS** ▪ Metronidazole 2 g PO at 7 PM and 11 PM the day before an 8 AM operation. ▪ Cefazolin 2g (wight≥120 kg: 3g) (children dose: 30mg/kg) IV single dose ▪ Cefazolin 2g (wight≥120 kg: 3g) IV single dose ▪ **PLUS** ▪ Metronidazole 500mg (children dose:15mg/kg, 7.5mg/kg if < 1.2kg) IV **single dose completely**	▪ ▪ ▪ ▪ ▪ ▪ ▪ ▪ ▪ ▪ ▪ ▪ ▪ ▪ ▪ ▪ Vancomycin IV 15-20 mg/kg q8h (target trough 15-20/ml) **single dose completely infused 120 minutes prior to first incision** ▪ Calculated vancomycin dose…… ▪ **OR** ▪ Clindamycin 900mg ▪ Children dose: 10mg/kg) IV ▪ **PLUS** ▪ Ciprofloxacin 400mg IV ▪ Children dose: 10mg/kg) **single dose** ▪ **completely infused within 120 minutes prior to first incision**

	infused 60 minutes prior to first incision	
▪ **Cardiothoracic**	▪ Cefazolin 2 g IV stat (weight≤120 kg) ▪ Cefazolin 3 g IV stat for weight ≥ 120kg) ▪ Children dose: Cefazolin 30mg/kg) IV **single dose completely infused 60 minutes prior to incision** ▪ ▪	▪ Vancomycin IV 15-20 mg/kg q8h (target trough 15-20/ml) single dose completely infused 120 minutes prior to first incision ▪ Calculated vancomycin dose……
▪ **Cesarean delivery** ▪ **Vaginal or abdominal hysterectomy/other** ▪ **Obstetric procedure** ▪ ▪ ▪ ▪ ▪ **Abortion, surgical**	▪ Cefazolin 2 g IV stat (weight≤120 kg) ▪ Cefazolin 3 g IV stat for weight ≥ 120kg) **single dose completely infused 60 minutes prior to incision** ▪ ▪ ▪ Doxycycline 100 mg orally one hour before procedure and 200 mg orally after procedure	▪ Clindamycin 900mg IV ▪ **PLUS** ▪ Gentamycin 4.5 mg/kg **single dose completely infused 60 minutes prior to incision** ▪ Vancomycin 1 g IV **single dose completely infused 120 minutes prior to incision** ▪ Metronidazole 500 mg orally twice daily for five days.
▪ **Head / Neck**	▪ Cefazolin 2 g IV stat (weight≤120 kg) Cefazolin 3 g IV stat for weight ≥ 120kg) **single dose completely infused 60 minutes prior to incision** ▪ **OR** ▪ Cefuroxime 1.5 gm IV as single dose ▪ **PLUS** ▪ Metronidazole 500 mg IV as a single	▪ Clindamycin 900mg IV stat ▪ Children Clindamycin dose:10mg/kg IV single dose ▪ **PLUS** ▪ Gentamycin 4.5 mg/kg ▪ Children Gentamicin dose: 2.5mg/kg) **single dose completely infused 60 minutes prior to incision**

	dose for clean-contaminated surgery	
▪ **Neurosurgery: Elective craniotomy and cerebrospinal fluid-shunting Procedures, Implantation of intrathecal pumps**	▪ Cefazolin 2 g IV stat (weight≤120 kg) Cefazolin 3 g IV stat for weight ≥ 120kg) **single dose completely infused 60 minutes prior to incision**	▪ Clindamycin 900mg IV stat ▪ Children Clindamycin dose:10mg/kg IV single dose ▪ If MRSA colonization is present: ▪ Vancomycin 1 g IV stat ▪ ▪ Children Vancomycin dose:15mg/kg IV **single dose completely infused 120 minutes prior to incision**
▪ **Orthopedic (spinal procedure with or without instrumentation)** ▪ ▪ **Joint replacement & limb amputation**	▪ Cefazolin 2 g IV stat (weight≤120 kg) Cefazolin 3 g IV stat for weight ≥ 120kg) **single dose completely infused 60 minutes prior to incision**	▪ Vancomycin 1 g IV stat ▪ Children Vancomycin dose:15 mg/kg IV **single dose completely infused within 120 minutes prior to incision**
▪ **Vascular**	▪ Cefazolin 2 g IV stat (weight≤120 kg) ▪ Cefazolin 3 g IV stat for weight ≥ ▪ 120kg) **single dose completely infused 60 minutes prior to incision**	▪ Vancomycin 1 g IV stat ▪ Children Vancomycin dose:15 mg/kg IV **single dose completely infused within 120 minutes prior to incision**
▪ **Genitourinary: open or laparoscopic including percutaneous renal surgery.** ▪ ▪ ▪ **Cystoscopy with manipulation or upper tract instrumentation .** ▪	▪ Cefazolin 2 g IV stat (weight≤120 kg) ▪ Cefazolin 3 g IV stat for weight ≥ 120kg) **single dose completely infused 60 minutes prior to incision** ▪ ▪ Ciprofloxacin 500 mg orally ▪ ▪ **OR** ▪	▪ Ciprofloxacin 400mg (children dose:10mg/kg) IV single dose completely infused 120 minutes prior to incision ▪ ▪ ▪ ▪ ▪ Trimethoprim-sulfamethoxazole Once 160/800 mg (double strength, DS) tablet orally

▪ **or Cystoscopy alone but with positive urine cultures or preoperative catheter, transrectal prostatic biopsy, or placement of prosthetic material**	▪ Ciprofloxacin 400 mg IV	
▪ **Plastic**	▪ Clean with risk factors or clean-contaminated ▪ Cefazolin 2 g IV stat (weight≤120 kg) ▪ Cefazolin 3 g IV stat for weight ≥120kg) **single dose completely infused 60 minutes prior to incision**	▪ Clindamycin 900mg IV stat ▪ Children Clindamycin dose:10mg/kg IV single dose ▪ **OR** ▪ Vancomycin 1 g IV stat ▪ Children Vancomycin dose: 15 mg/kg) IV **single dose within 120 minutes prior to incision**
▪ **Ophthalmic**	▪ Topical Moxifloxacin 1 drop every 5– 15 min for 5 doses at the end of procedure ▪ Cefazolin 100 mg by subconjunctival injection	▪ Cefazolin 1–2.5 mg Intracameral

▪

Breast Surgery

Surgery	Common Pathogen	1st Line Regimen	Alternative Regimen
1. **Breast cancer surgery** 2. **Breast reshaping procedures**	• Staphylococcus aureus • Coagulase-negative Staph	**Cefazolin** 1-2g iv 30-60 minutes prior to procedure	**Vancomycin** 15mg/kg iv to commence infusion 90-120 minutes prior to procedure

If MRSA positive		**Vancomycin** 15mg/kg iv to commence infusion 90-120 minutes prior to procedure	**Clindamycin**[#] 900mg iv 30-60 minutes prior to procedure
3. Breast surgery with implant	• Staphylococcus aureus Coagulase-negative Staph	**Vancomycin** 15mg/kg iv to commence infusion 90-120 minutes prior to procedure	**Clindamycin** iv 900mg iv 30-60 minutes prior to procedure

*Cefazolin dose 2g if body weight <120 kg, 3g if body weight ≥ 120 kg

[#]Discuss with ID Team if vancomycin cannot be used and MRSA is clindamycin resistant

Cardio-Thoracic Procedures			
Thoracic procedures	**Common Pathogen**	**1st Line Regimen**	**Alternative Regimen**
1. Pulmonary resection (e.g. lobectomy, pneumonectomy, lung resection **2. Thoracotomy** **3. Video-assisted thoracoscopy (VATS)**	• Staphylococcus aureus • Coagulase-negative staphylococcus • less common Enterobacteriaceae	**Cefazolin* 2-3g** iv 30-60 minutes prior to procedure	**Vancomycin** 15mg/kg iv to commence infusion 90-120 minutes prior to procedure
If MRSA positive		**Vancomycin** 15mg/kg iv to commence infusion 90-120 minutes prior to procedure	**Clindamycin**[#] 900mg iv 30-60 minutes prior to procedure
4. Mediastinoscopy	Routine antibiotic prophylaxis is not recommended		

Cardiac Procedures	Common Pathogen	1st Line Regimen	Alternative Regimen
1. Open heart surgery (e.g. Coronary artery bypass) **2. Cardiac device insertion procedures** (e.g. PPM insertion, ICD Implantation **If MRSA positive**	• Staphylococcus aureus • Coagulase-negative staphylococcus • less common Enterobacteriaceae	**Cefazolin*** 2-3g iv → Give the dose 30-60 minutes prior to procedure → Continue on same dose iv q8h for a total of 24 hours **Vancomycin** 15mg/kg iv → Commence infusion 90-120 minutes prior to procedure → Give another dose 12 hours later	**Vancomycin** 15mg/kg iv → Commence infusion 90-120 minutes prior to procedure → Give another dose 12 hours later **Clindamycin#** 900mg iv → Give the dose 30-60 minutes prior to procedure → Followed by 600mgiv q8h for a total of 24 hours
3. Cardiac catheterization	Routine antibiotic prophylaxis is not recommended		

*Cefazolin dose 2g if body weight <120 kg, 3g if body weight ≥ 120 kg
#Discuss with ID Team if vancomycin cannot be used and MRSA is clindamycin resistant

Head and Neck Surgery (ENT, Maxillofacial

Neurosurgery Procedures	Common Pathogen	1st Line Regimen	Alternative Regimen
1. Craniotomy **2. CSF shunt** **If MRSA positive**	• Staphylococcus aureus • Coagulase-negative Staph	**Cefazolin* 2-3g** iv 30-60 minutes prior to procedure **Vancomycin** 15mg/kg iv to commence infusion 90-120 minutes prior to	**Vancomycin** 15mg/kg iv to commence infusion 90-120 minutes prior to procedure **Clindamycin#** 900mg iv 30-60 minutes prior to procedure

		procedure	
ENT Procedures	**Common Pathogen**	**1st Line Regimen**	**Alternative Regimen**
1. Ear Surgery (clean/clean-contaminated)	Routine antibiotic prophylaxis is not recommended		
2. Tympanostomy tube insertion (grommet)		Topical Ciprofloxacin drops – single dose after procedure	

3. Complex septo-rhinoplasty (including grafts)	• Staphylococcus species • Streptococci (aerobic and anaerobic species), • Other oral anaerobes	**Cefazolin*** 2-3g iv **plus** **Metronidazole** 500mg iv 30-60 minutes prior to procedure	**Clindamycin#** 900mg iv **plus** **Gentamicin** 3mg/kg iv within 30 -60 minutes prior to the procedure
4. Incision through oral, sinus, or pharyngeal mucosa **5. Tonsillectomy** **6. Adenoidectomy**	• Streptococci (aerobic and anaerobic species), • Other oral anaerobes • Staphylococcus species • Streptococcus species.	**Cefazolin*** 2-3g iv **plus** **Metronidazole** 500mg iv 30-60 minutes prior to procedure	**Clindamycin#** 900mg iv 30-60 minutes prior to procedure

Maxillo-Facial Surgery	**Common Pathogen**	**1st Line Regimen**	**Alternative Regimen**
1. Head & neck surgery (clean, benign) **2. Facial surgery** (clean)	Routine antibiotic prophylaxis is not recommended		
3. Head & neck surgery → malignant,neck dissection → contaminated/clean-contaminated **4. Orthognathic surgery** **5. Facial surgery** (contaminated/clean-contaminated) **6. Facial surgery with implant** **7. Open reduction and internal fixation of mandibular fractures**	• Streptococci (aerobic and anaerobic species), • Other oral anaerobes • Staphylococcus species • Streptococcus species.	**Cefazolin*** 2-3g iv **plus** **Metronidazole** 500mg iv 30-60 minutes prior to procedure	**Clindamycin** 900mg iv **plus** **Gentamicin** 3mg/kg iv within 30 -60 minutes prior to the procedure

*Cefazolin dose 2g if body weight <120 kg, 3g if body weight ≥ 120 kg

Orthopedic & Spinal Surgery

Orthopedic	Common Pathogen	1st Line Regimen	Alternative Regimen
1. Joint replacement surgery **If MRSA positive**	• Staphylococcus aureus • Coagulase-negative Staph	**Cefazolin*** 2-3g iv → Give the dose 30-60 minutes prior to procedure → Give 2 further doses at 8 hourly intervals **Vancomycin** 15mg/kg iv → Commence infusion 90-120 minutes prior to procedure → Give another dose 12 hours later	**Vancomycin** 15mg/kg iv → Commence infusion 90-120 minutes prior to procedure → Give another dose 12 hours later) **Clindamycin#** 900mg iv → Give the dose 30-60 minutes prior to procedure → Followed by 600mg iv q8h for a total of 24 hours
2. Hip fracture repair **3. Insertion of prosthetic device** **4. Internal fixation of closed fractures e.g., nails, screws, plates, wires)** **If MRSA positive**	• Staphylococcus aureus • Coagulase-negative Staph	**Cefazolin* 2-3g** iv 30-60 minutes prior to procedure **Vancomycin** 15mg/kg iv to commence infusion 90-120 minutes prior to procedure	**Vancomycin** 15mg/kg iv to commence infusion 90-120 minutes prior to procedure **Clindamycin#** 900mg iv 30-60 minutes prior to procedure

Orthopedic	Common Pathogen	1st Line Regimen	Alternative Regimen
5. Internal fixation of <u>open</u> fractures **If MRSA positive**	• Staphylococcus aureus • Coagulase-negative Staph	**Cefazolin*** 2-3g iv → Give the dose 30-60 minutes prior to procedure → Continue same dose q8h until wound is closed; usually 2-3 days **Vancomycin** 15mg/kg iv → Commence infusion 90-120 minutes prior to procedure → Continue same dose q 12h until wound is closed; usually 2-3 days	**Vancomycin** 15mg/kg iv → Commence infusion 90-120 minutes prior to procedure → Continue same dose q 12h until wound is closed; usually 2-3 days **Clindamycin#** 900mg iv → Give the dose 30-60 minutes prior to procedure → Followed by 600mg iv q8h or 450mg q8h po for until wound is closed; usually 2-3 days
6. Clean operations involving hand, knee, or foot and not involving implantation of foreign materials (including arthroscopy)	Routine antibiotic prophylaxis is not recommended		

Spinal	Common Pathogen	1st Line Regimen	Alternative Regimen
1. **Spinal procedures with instrumentation** 2. **Spinal procedures without instrumentation** **If MRSA positive**	• Staphylococcus aureus • Coagulase-negative Staph	**Cefazolin* 2-3g** iv 30-60 minutes prior to procedure **Vancomycin** 15mg/kg iv to commence infusion 90-120 minutes prior to procedure	**Vancomycin** 15mg/kg iv to commence infusion 90-120 minutes prior to procedure **Clindamycin#** 900mg iv 30-60 minutes prior to procedure

*Cefazolin dose 2g if body weight <120 kg, 3g if body weight ≥ 120 kg
#Discuss with ID Team if vancomycin cannot be used and MRSA is clindamycin resistant

Urological Surgery

Surgery	Common Pathogen	1st Line Regimen	Alternative Regimen
1. **Percutaneous nephrolithotomy** 2. **Shock wave lithotripsy** 3. **Major open or laparoscopic urological procedures** 4. **Endo-urological procedures** (e.g. TURP, stone fragmentation or removal)	• Enterobacteriaceae • Enterococci	**Cefuroxime** 1.5g iv 30-60 minutes prior to procedure	**Clindamycin#** 900mg iv **plus** **Gentamicin** 3mg/kg iv 30 - 60 minutes prior to the procedure
MRSA positive		**Vancomycin** 15mg/kg iv to commence infusion 90-120 minutes prior to procedure **plus** **Gentamicin** 3mg/kg iv 30 -60 minutes prior to the procedure	**Clindamycin#** 900mg iv **plus** **Gentamicin** 3mg/kg iv 30 - 60 minutes prior to the procedure
	• Enterobacteriacea	**Ciprofloxacin**	**Gentamicin**

Trans-rectal prostate biopsy	• Enterococci • Anerobes	750mg po q12h **plus** **Metronidazole** 500mg po q8h for a total of 24 hours	5mg/kg iv (single dose) 30 -60 minutes prior to the procedure **plus** **Metronidazole** 500mg po or iv q8h for a total of 24 hours
Cystography **Urodynamic study** **Simple cysto-urethroscopy**	Antibiotic prophylaxis is not recommended unless urine culture prior to procedure is positive, in which case the choice of antimicrobial prophylaxis should be based on the susceptibility of the isolated micro-organisms		
Cystourethroscopy with manipulation	• Enterobacteriaceae • Enterococci	**Ciprofloxacin** 500mg po, repeat 12 hours later **or** **Trimethoprim-Sulfamethoxazole** (Septrin/Bactrim) 960mg po, repeat 12 hours later	**Cefuroxime** 1.5g iv 30 -60 minutes prior to the procedure **or** **Gentamicin** 3mg/kg iv 30 - 60 minutes prior to the procedure
Clean without entry into urinary tract	• Enterobacteriaceae • Enterococci	**Cefazolin* 2-3g** iv 30-60 minutes prior to procedure	**Vancomycin** 15mg/kg iv to commence infusion 90-120 minutes prior to procedure
Clean with entry into urinary tract		**Cefazolin* 2-3g** iv 30-60 minutes prior to procedure	**Clindamycin**[#] 900mg iv **plus** **Gentamicin** 3mg/kg iv 30 - 60 minutes prior to the procedure

[#]Discuss with ID Team if vancomycin cannot be used and MRSA is clindamycin resistant

Vascular Surgery

Surgery	Common Pathogen	1st Line Regimen	Alternative Regimen
1. Abdominal aortic aneurysm repair **2. Carotid Surgery**	• Staphylococcus aureus • Streptococci	**Cefuroxime** 1.5g iv 30-60 minutes prior to procedure	**Vancomycin** 15mg/kg iv to commence infusion 90-120 minutes prior to procedure
MRSA positive		**Vancomycin** 15mg/kg iv to commence infusion 90-120 minutes prior to procedure	**Clindamycin**[#] 900mg iv 30-60 minutes prior to procedure
3. Lower limb arterial reconstruction (vein or graft) **4. Lower limb amputations**		**Cefuroxime** 1.5g iv **plus** **Metronidazole** 500mg iv 30-60 minutes prior to procedure	**Clindamycin** 900mg iv **plus** **Gentamicin** 3mg/kg iv 30 -60 minutes prior to the procedure
MRSA positive		**Vancomycin** 15mg/kg iv to commence infusion 90-120 minutes prior to procedure **plus** **Gentamicin** 3mg/kg iv **and** **Metronidazole** 500mg iv 30-60 minutes prior to procedure	**Clindamycin** 900mg iv **plus** **Gentamicin** 3mg/kg iv 30 -60 minutes prior to the procedure
5. Radiological vascular procedures (e.g., angiography, angioplasty,) **6. IVC filter placement**	Routine antibiotic prophylaxis is not recommended		
7. Vascular stent placement		Prophylaxis is only indicated for high risk patients (i.e., repeat intervention within 7 days, prolonged indwelling arterial sheath or	

		prolonged duration of procedure)	
		Cefazolin* 1-2g iv 30-60 minutes prior to procedure	**Vancomycin** 15mg/kg iv to commence infusion 90-120 minutes prior to procedure
8. AV fistula formation **9. Varicose veins Surgery** **MRSA positive**		**Cefazolin* 2-3g**iv 30-60 minutes prior to procedure **Vancomycin** 15mg/kg iv to commence infusion 90-120 minutes prior to procedure	**Vancomycin** 15mg/kg iv to commence infusion 90-120 minutes prior to procedure **Clindamycin** 900mg iv 30 -60 minutes prior to the procedure

1.1.2 General antibiotic redosing considerations:

- ✓ Redose antibiotic after excessive blood loss (more than 1.5 L) or if two half-lives of the drug have passed during surgery. This helps to maintain blood and tissue levels while the surgical site is open.

- ✓ Redose antibiotics during longer surgeries as:

  - Redose cefazolin, and cefuroxime after four hours.
  - Redose clindamycin after six hours.
  - The time to redose should be measured from the time that the last dose, usually the preoperative dose was started.
  - In most cases, drugs with longer half-lives such as fluoroquinolones and vancomycin will not require redosing.
  - Patients with reduced creatinine clearance may not require redosing of agents that are renally cleared, such as cephalosporins and penicillin's.

- ✓ Consult the clinical pharmacist with regards to selection, dosing, timing and duration of antibiotic

Switching IV antimicrobial to PO

.1.1.1.2.1.1 Why Switch from Intravenous to Oral Antibiotic Therapy?

To manage serious infections in hospital most clinicians use intravenous (IV) antibiotics initially to ensure an optimal concentration of antibiotic at the site of infection. Inappropriate antibiotic use is recognized as a key driver of antimicrobial resistance. Unnecessarily prolonged courses of IV antibiotics are also associated with increased length of hospital stay, increased costs of nursing, pharmacy and medical time in the insertion of IV lines, preparation, dispensing and administration of IV agents and the increased morbidity and mortality associated with IV-line infections.

To optimize antibiotic use, a switch from IV antibiotics to oral therapy in the appropriate patient has several advantages. These include a shorter length of hospital stay with the associated reduction in morbidity and mortality, a reduction in staff workload and a reduction in antibiotic costs.

1.1.1.2.1.2 Terminology for changing from IV to PO antibiotics

- **Sequential therapy:** changing to the oral version of the same compound.
    - Example: Levofloxacin 500mg IV Q24H to levofloxacin 500mg PO Q24H.

Switch therapy: changing to an oral drug that is a different compound and has the same potency.

- Example: Levofloxacin 500mg IV Q24H to ciprofloxacin 500mg PO Q12H.

Step-down therapy: changing to an oral drug that is a different compound and has different frequency, dose, or spectrum of activity.

- Example: Ampicillin-sulbactam 1.5gm IV Q6H to amoxicillin-clavulanic acid 875mg/125mg PO Q12H.

Oral bioavailability: the amount of drug that enters systemic circulation when that drug is consumed orally.

1.1.1.2.1.3 Potential advantages of changing from IV to PO antibiotics:

- Expedite removal of intravenous catheter and reduce chances for central line-associated bloodstream Infections.
- Expedite hospital discharge (*i.e.*, reduce length of stay).
- Reduce volume of fluid administered to patient (can be especially important for patients with congestive heart failure).
- Increase patient satisfaction and comfort.
- Reduce IV-related mobility restrictions.
- Remove possibility for phlebitis / thrombophlebitis.
- Reduce workload on pharmacy and nursing.
- Decreased costs.

When to Switch:

The optimal time to consider switching a patient to oral therapy is after 2 to 4 days of intravenous therapy. This period allows the clinician to evaluate the patient's microbiology results and assess their response to treatment. Many clinical trials support the early switching to oral antibiotics after this period with equal treatment efficacy and no adverse effects on patient outcome.

The flow chart in this guideline aids the clinician in deciding if it is safe to switch a patient to oral antibiotics. A patient must meet several criteria prior to switching:

- Display signs of clinical improvement (Box 1).
- Able to tolerate oral therapy (Box 2).
- Not have a condition in which higher concentrations of antibiotic are required in the tissue or a prolonged course of IV therapy is essential (Box 4).

There are several conditions in which a switch to oral therapy should be considered including:

- Pneumonia.
- Skin and soft tissue infections.
- Urinary tract infections.
- Uncomplicated Gram-negative bacteremia.
- Intra-abdominal infection without deep seated collection.

Patients who have negative blood cultures and have received ≥ 48 hours of IV therapy may be eligible to STOP or switch to oral therapy.
Use this guideline to select appropriate patients - important exclusions apply (see Box 4).

S — **Signs of clinical improvement? (Box 1)**
- NO → **Review therapy and investigations.** Consult ID/micro if necessary.
- YES ↓

T — **Tolerating oral medicines? (Box 2)**
- NO → **Reconsider switch in 24 hours.**
- YES ↓

O — **Oral option available? (Box 3)**
- NO → **Continue IV treatment course.** Contact Infectious Diseases or Clinical Microbiologist if necessary.
- YES ↓

P — **Possible to switch? (Prolonged therapy required for the indications shown in Box 4)**
- NO → **Continue IV treatment course.** Contact Infectious Diseases or Clinical Microbiologist if necessary.
- YES ↓

? — **Is antibiotic therapy still required?**
- NO → **STOP antibiotic**
- YES ↓

SWITCH to oral therapy (See box 3)
(Contact Infectious Diseases, Clinical Microbiology or Clinical Pharmacy for advice)
Local Contact Number _____

Box 1
Signs of clinical improvement

- Afebrile (temp >36°C and <38°C for past 48 hours)
- CRP trending down
- Stable immune response (WCC > 4 and <12 x 10^9 cells/L or trending towards normal range)
- No unexplained tachycardia
- No unexplained hypotension
- No tachypnoea

Box 2
Tolerating oral medicines

- Patient is not nil by mouth
- Patient is tolerating oral food or enteral feeding *
- Oral absorption is not compromised (e.g. diarrhoea, vomiting, malabsorptive disorder, unconscious, swallowing disorder)

* *Enteral feeding: consult pharmacy for advice on suitable formulation and administration method.*

Box 3
Common oral antibiotic options

Use the following guide to select appropriate oral therapy
Note: Doses provided are for normal renal function – refer to the *Australian Medicines Handbook* or the *Therapeutic Guidelines: Antibiotic* for dosing in renal impairment

Current IV therapy	Oral option (adult dose)
Amoxicillin 500mg-1g tds	Amoxicillin 500mg-1g tds
Amoxicillin with clavulanic acid 1.2g tds	Amoxicillin 875mg with clavulanic acid 125mg bd
Benzylpenicillin 600mg-1.2g qid	Amoxicillin 500mg-1g tds
Ceftriaxone 1g-2g daily	Amoxicillin 875mg with clavulanic acid 125mg bd^
Cefazolin 1g-2g tds	Cefalexin 500mg-1g qid
Ciprofloxacin 200mg-400mg bd	Ciprofloxacin 500mg-750mg bd
Clindamycin 600mg tds	Clindamycin 150mg-450mg tds
Flucloxacillin 1g-2g qid	Di/Flucloxacillin 500mg-1g qid
Metronidazole 500mg bd	Metronidazole 400mg bd or tds
Piperacillin with tazobactam 4.5g tds or qid	Amoxicillin 875mg with clavulanic acid 125mg bd **Pseudomonas:** Seek advice from Clinical Microbiology or Infectious Diseases
Amoxycillin + gentamicin ± metronidazole	Amoxycillin 875mg with clavulanic acid 125mg bd or 500/125mg bd or tds
Cefepime, gentamicin, meropenem, vancomycin	Seek advice from Clinical Microbiology or Infectious Diseases

The following IV drugs have equivalent oral doses: Azithromycin, Linezolid, Fluconazole, Trimethoprim/Sulfamethoxazole

^ Consider patient allergy status when converting to a penicillin.

Box 4
Prolonged parenteral therapy is required for the following indications

- Deep-seated infection e.g. abscess/empyema
- Meningitis or encephalitis
- Necrotising soft tissue infection
- Infected implant or prostheses
- *Staphylococcus aureus* bacteraemia
- Osteomyelitis
- Septic arthritis
- Endocarditis

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1.1.2 *Therapeutic Drug Monitoring for Aminoglycosides dosing.*

Aminoglycosides fight against bacteria by interfering with bacterial protein synthesis, which is achieved through irreversible binding to 30S ribosomal subunit.
Aminoglycosides have bactericidal activity against aerobic Gram-negative infections and demonstrates concentration-dependent killing with a prolonged PAE (~4-6 hours).
The best pharmacodynamics parameter to determine the ideal dosing regimen is peak/MIC ratio
Dosing weight: ideal body weight (IBW) unless 20% over IBW (use adjusted body weight instead)

Initial dosing: dependent on traditional versus extended interval dosing

Extended interval dosing in all patients* except patients with altered pharmacokinetics using Traditional dosing

Burns > 20%.

• Morbidly obese.

• Pregnancy.

• Ascites or significant third spacing.

• Hemodynamic instability.

• Unstable renal function and cystic fibrosi.s

***Rationale:** maximize concentration-dependent killing and minimize toxicity (i.e., nephrotoxicity and ototoxicity), ease of administration and monitoring, reductions in administration and monitoring-related costs.

Site of infection OR Indication	**Gram-Positive Infections(Synergy)**	**Gram-Negative Infections (Sepsis/Pneumonia)**
Gentamicin/Tobramycin		
Traditional Initial dose	1mg/kg/dose	1.5-2mg/kg/dose
Desired Peak	3-5mg/L	8-10mg/L (10-12times MIC of infecting organism)
Desired Trough	< 1mg/L	< 2mg/L
Extended Interval dose	NA	7mg/kg/dose
Desired Peak	NA	10-12times MIC of infecting organism
Desired Trough	NA	< 1mg/L
AMIKACIN		
Traditional Initial dose	NA	7.5mg/kg/dose
Desired Peak	NA	30-40mg/L
Desired Trough	NA	< 7mg/L
Extended Interval dose	NA	15mg/kg/dose
Desired Peak	NA	10-12times MIC of infecting organism
Desired Trough	NA	< 7mg/L

4.1.1.3 *Therapeutic Drug Monitoring for Vancomycin Dosing.*

- All vancomycin prescriptions shall be compliant with the outlined guidelines for dosing and therapeutic monitoring.
- The clinical pharmacist/pharmacist has the authority to follow-up patients on vancomycin and to give appropriate recommendations about selection, dosing, and monitoring.

Dose and dosing interval:

The initial dose of Vancomycin and dosing schedule is determined based on the patient's actual body weight and estimated creatinine clearance.

4.1.1.3.1 Step 1: Calculate vancomycin loading dose:

- Give a starting dose of 15-20 mg/kg of actual body weight (ABW).
- In seriously ill patients or those with complicated infections such as **Meningitis, Pneumonia, Osteomyelitis, Endocarditis, and Bacteraemia** and normal renal function, give an **initial loading dose of 20-25 mg/kg of actual body weight.**
- The maximum loading dose is 2000 mg.
- Empiric loading dose guideline based on Actual body weight (Kg):

Actual body weight (Kg)	**Initial Vancomycin Loading Dose (mg)**	**Diluent Volume (mL)**	**Infusion Time (min)**
<60	1000	250	90
60-70	1250	250	90
71-80	1500	500	90
81-100	1750	500	120
>100	2000	500	120

4.1.1.3.2 Step 2: Calculate estimated creatinine clearance (CrCl) using the Cockcroft - Gault equation:

Male: CrCl (ml/min) = $\frac{\text{Age) × BW}}{}$

Female: CrCl (ml/min) = $\frac{\text{Age) × BW}}{} \times 0.85$

Where, **Age** is in years, **BW** is body Weight in Kg and **CrCl** is Serum creatinine (mg/dL)

2.1.2.1 Use Ideal Body Weight (IBW) if height is available.

2.1.2.2 Use Actual Body Weight (ABW) if ABW<IBW.

2.1.2.3 Use Adjusted Dosing Weight (ADW) if obese (if >30% IBW).
ADW= ((ABW-IBW) x 0.4) + IBW.

2.1.2.4 The Cockcroft-Gault method should **only** be used in patients ≥ 18 years old with stable serum creatinine concentrations.

2.1.2.5 Consult the clinical pharmacist/pharmacist for estimating CrCL in the following patient categories:

- Patients < 18 years old.
- Patients with unstable renal function.

2.1.3 Step 3: Calculate Vancomycin maintenance dose and schedule based on the following table:

Actual body weight	**CrCl (mL/min)**			
	60 - 90			**<15 or dialysis (HD, CVVHD)**
40-49	750mg Q12h	750mg Q24h	750mg Q48h	1000mg, then re-dose by level
50-59	1000mg Q12h	1000mg Q24h	1000mg Q48h	1000mg, then re-dose by level
60-75	1000mg Q12h	1000mg Q24h	1000mg Q48h	1000mg, then re-dose by level
76-90	1250mg Q12h	1250mg Q24h	1250mg Q48h	1250mg, then re-dose by level
90-110	1500mg Q12h	1500mg Q24h	1500mg Q48h	1500mg, then re-dose by level
>110	15mg/kg Q12h	15mg/kg Q24h	15mg/kg Q48h	15mg/kg, then re-dose by level

4.1.1.3.3 For patients with CrCl <15 mL/min, on CRRT, or unstable renal function (e.g. acute renal failure) and not receiving haemodialysis:

- Give one dose at 15mg/kg actual body weight.
- Check a random level 24 hour after the dose.
- If random level < 20 mcg/mL, repeat dose.
- If random level > 20 mcg/mL, do not re-dose, repeat random level in 12 hours.

4.1.1.3.4 For patients on intermittent haemodialysis

- Give one dose at 15mg/kg actual body weight.
- Check random level 2 hours after dialysis.
- If random level < 20 mcg/mL, repeat dose.
- If random level >20 mcg/mL, do not re-dose, repeat level after next dialysis.

4.1.1.3.5 Infusion Rate:

- The most common hypersensitivity reaction associated with vancomycin is red man syndrome (RMS), typically presenting as pruritus and erythematous rash over the face, neck, and upper torso. Patients may complain of diffuse burning and itching and of generalized discomfort or become dizzy and agitated. RMS usually occurs within ten minutes of starting vancomycin infusion and is associated with rapid infusion (< 1h).

- The whole vancomycin dose should be given as intravenous infusion over a

4.1.1.3.6 minimum of one hour, at a maximum infusion rate of 15 mg/min.

- The infusion rate should be reduced (i.e. infusion time increased) if the patient experiences red man syndrome (RMS) reaction.

4.1.1.3.7 Vancomycin Monitoring:

- **Peak levels** should **NOT** be routinely checked.

- **Trough levels** are the most accurate and practical method for monitoring Vancomycin effectiveness and toxicity.

4.1.1.3.8 Measuring serum Vancomycin levels:

- Samples for **trough (pre-dose)** levels should be obtained 30-60 minutes **before** the next dose is due.
- The first sample for vancomycin trough levels should be obtained just prior to the next dose at steady state conditions as follows:

- For patients dosed every 8-12 hours, check trough 30 minutes prior to 4th dose.
- For patients dosed every 24 hours, check trough 30 minutes prior to 3rd dose.

- For patients dosed every 48 hours, check trough 30 minutes prior to 2nd dose.
- The time and date of sampling must be specified on the laboratory request form.
- Aim to sample early in the morning - this allows for more rapid results from the laboratory.
- It is not necessary to wait for the results of the level before giving a single further dose, unless renal function is abnormal or previous levels have been high.
- In patients with ESRD on haemodialysis, obtain a random level 2 hours post-haemodialysis.
- Trough levels should be monitored at least every 3-4 days in any the following circumstances**:**
  - Receiving aggressive dosing (>1500 mg Q12H) or Q8H interval
  - Serious infections such as meningitis, endocarditis, osteomyelitis or MRSA pneumonia.
  - Unstable renal function (change in SCr of 0.5 µmol/L or 50% from baseline), dialysis, and CRRT.
  - Concurrent therapy with nephrotoxic agents (e.g. aminoglycosides, Colistin, Amphotericin B)
  - Prolonged courses (>7 days) of therapy.

- Vancomycin trough levels should be monitored at least every 7 days in patients in whom the target trough levels have been achieved and whose renal function is stable.

- More frequent Vancomycin trough levels monitoring is required for patients who are hemodynamically unstable and/or with changing renal function.

4.1.1.3.9 Target Vancomycin Trough Levels:

Diagnosis/Indication	Vancomycin Trough Level
Pneumonia, osteomyelitis, endocarditis, MRSA bactaeremia and CNS infections	15-20 mg/L
Other indications including neutropaenic fever, skin and soft tissue infections	10-15 mg/L

Interpretation and dose adjustments:

The vancomycin trough (pre-dose) level will indicate further action(s) to be taken, depending on the target trough level:

Trough (pre-dose) level	Interpretation	Action(s) required
< 5 mg/L	Too low	Half the dosing interval to next frequency **AND** ↑ daily Vancomycin dose by 250-500mg
5 - <10 mg/L	Low	Half the dosing interval to next frequency **OR** ↑ daily Vancomycin dose by 250-500 mg
10 – 15 mg/L	Good if target trough is 10-15 mg/L	If target trough is 10-15 mg/L → NO change in dosing regimen
	Low if target trough is 15-20 mg/L	If target trough is 15-20 mg/L → half the dosing interval to next frequency **OR** ↑dose by 250-500 mg
15-20 mg/L	High if target trough is 10-15 mg/L	If target trough is 10-15 mg/L → omit the next dose and double the dosing interval **OR** ↓ daily Vancomycin dose by 250-500 mg and re-check trough level 24 hours later
	Good If target trough is 15-20 mg/L	If target trough is 15-20 → No change
>20 mg/L	High	↓ dose by 250-500mg **OR** double the dosing interval to next frequency and resume therapy once level is within target range

4.1.1.3.10 Monitoring for Toxicity:

- Serum creatinine should be measured at least every other day initially, then weekly if patient's renal function remains stable.
- Check full blood count twice weekly.
- Routine formal audiology testing is not recommended for patients receiving Vancomycin, unless signs and symptoms of ototoxicity became apparent.

References:

- Vancomycin Therapeutic Guidelines: A Summary of Consensus Recommendations from IDSA, ASHP and SIDP. Clinical Infectious Diseases 2009;49 :325-7.

- Vancomycin Therapeutic Monitoring: Review and Recommendations from the ASHP, IDSA and SIDP Task Force. American Journal of Healthcare System Pharmacists. 2009; 66:82-98.

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- All Colistin prescriptions shall be compliant with outlined guidelines for dosing and therapeutic monitoring.
- Dosage is express in terms of **Colistin base activity (CBA).**
    - Colistimethate sodium 1 mg is equivalent to 12,500 units of Colistimethate sodium
    - Colistimethate sodium 2.67 mg is equivalent to 1 mg of CBA.
- Any infusion solution containing colistimethate sodium should be freshly prepared and used for **no longer than 24 hours**.

Estimation of Creatinine Clearance (CrCl)

Calculate estimated creatinine clearance (CrCl) using the Cockcroft - Gault equation:

Male: $\text{CrCl (ml/min)} = \frac{\text{Age)} \times \text{BW}}{2}$

Female: $\text{CrCl (ml/min)} = \frac{\text{Age)} \times \text{BW}}{2} \times 0.85$

Where, **Age** is in years, **BW** is body Weight in Kg and **CrCl** is Serum creatinine (mg/dL)

- Use Ideal Body Weight (IBW) if height is available.
- Use Actual Body Weight (ABW) if ABW<IBW
- Use Adjusted Dosing Weight (ADW) if obese (if >30% IBW)

  ADW= (ABW-IBW) x 0.4) + IBW

The Cockcroft-Gault method should **only** be used in patients ≥ 18 years old with stable serum creatinine concentrations.

Consult the clinical pharmacist/pharmacist for estimating CrCL in the following patient categories:

- Patients < 18 years old.
- Patients with unstable renal function.

4.1.1.4.1 Body Weight for Calculating Colistin Dosing:

Use Ideal Body Weight (IBW) to calculate colistin doses:

IBW male (kg) = 50 kg + 2.3 × (height (inches) – 60).
IBW female (kg) = 45.5 kg + 2.3 × (height (inches) – 60).

4.1.1.4.2 Dosing Regimen

Patient with normal renal function:

- Maximum daily dose should not exceed 5 mg/kg/day with normal renal function.
- For obese patients, dosage should be on ideal body weight.

- Patient < 18 years old:
  - **Dose:** 1-2 million units q8h.

- Patient ≥ 18 years old:
  - **Loading dose:** 9 million units (2h infusion).
  - **Maintenance dose:** 4.5 million units q12h.
  - First maintenance dose should be given 24 h after loading dose in non-critically ill patients, and 12 hours after loading dose in critically ill patients.

Patients with renal impairment or who are on renal replacement therapy:

Patient < 18 years old:

Category of patient	Dose
Crcl: 50-90 ml/min	2 million unit q12h
Crcl :10-50 ml/min	2 million unit q24h
< 10 ml/min	2 million unit q36h
IHD	1 million unit after dialysis
CRRT	2 million unit q24h

4.1.1.4.3 Patient ≥ 18 years old and non-critically ill patients:

Consult the clinical pharmacist for dosing colistin

Dose	***Category of patient***	***Dosing***	***Starting time after loading dose***
Loading dose (IV)	**All patient categories**	Loading dose of Colistin (M units) = IBW (kg)÷6 (maximum dose : 12 million units)	
Maintenance dose (IV)	**Not on renal replacement**	▪ Daily dose of Colistin (Munits) = [(1.5 X Crcl)+30] ÷12 ▪ Recommended dosage intervals based on CrCl: >10 ml/min/1.73 m^2 → every 12 (or 8) h depending on severity of infection	24 hours
	Receiving intermittent haemodialysis (IHD)	1 M units q 12hourly plus supplemental dose of 1 M units after each episode of dialysis	24 hours
	Receiving continuous renal replacement (CRRT)	4.5 M units q 12 hourly	8 hours
	Peritoneal dialysis (PD)	2 M units IV daily during peritoneal dialysis	24 hours

4.1.1.4.4 Administration and Pharmacokinetics:

- Loading dose should be given as an IV infusion over 2 hours.
- Maintenance dose should be given as IV infusion and can be given over 30 minutes.
- First maintenance dose should be given 24 hours after loading dose in non-critically ill patients, and 12 hours after loading in critically-ill patients.
- IM administration is not recommended.
- Half-life is 3-4 hours in patients with normal renal function, and up to 2-3 days in patients with renal impairment.
- Time to peak for critically ill patients is 7 hours

4.1.1.4.5 Monitoring Parameters:

- Renal function test: 3 times weekly.
- Review dosing schedule whenever there is a significant change in renal function.

4.1.1.4.6 References:

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Attachment 1: Recommended antimicrobial dosing regimens in patients with normal renal function as well as those recommended for patients with different degrees of renal impairment as well as those on various forms of renal replacement therapy.

Antibacterial Agents:	Adult dose	Estimated creatinine clearance (mL/min)			CRRT	IHD	PD
		>50 - 90	10 - 50	<10			
Penicillins							
Amoxicillin Po	500 mg q8h Up to 3g/day	500 mg q8h	> 30ml/min: 500 mg q8h < 30ml/min: 500 mg 12h	500 mg q24h	500 mg q8-12h	500 mg q12h AD	250 mg q12h
Ampicillin IV	250-500 mg q6h to 2g q4h	250-500 mg 6h	q6-12h	q12-24h	250 mg to 2 g q 6 to 12 h	maintenance dose is recommended after hemodialysis	250 mg q12h
Augmentin Po	1 g q12h		10-30: 250 mg - 500 mg amoxicillin/125 mg clavulanic acid q 12 h	250 or 500 mg amoxicillin/125 mg clavulanic acid q 24 h	500 mg q24h	500 mg q24h	250mg q12h
Augmentin ,IV	1.2 g q8h		> 30ml/min: 1.2g q8h 10-30ml/min: 1.2g LD followed by 600mg q12h	1.2g LD followed by 600mg q24h	No data	1.2g LD followed by 600mg q24h. Additional 600 mg may need to be given during dialysis and at the end of dialysis.	
Flucloxacillin	IV: 250 q6h to 2g q4h, PO: 250 1 g q6h			No adjustment required			
Penicillin G	0.5-4milion U q4h		2MU q4h maximum	1MU q4h maximum	1-2MU q4h maximum	1MU q4h maximum	
Phenoxymethyl penicillin	125-500 mg q8-6h			250mg q6h	No data		
Tazocin	4.5g q8-6h*	4.5g q8-6h	4.5g q8h < 30: 2.25g q8h	2.25g q8h	2.25g q8-6h	2.25g q8-12h	2.25g q8h
Monobactams							
Aztreonam, R	2g q8h	2 g q8h	1g q8h	1g q24h	1g q8 or 2g q 12h	500 mg q 12h. AD	1g q24h
Carbapenems							
Ertapenem, R	1 g q24h	1 g q24h	500 mg q24h		500 mg q 24h	500 mg q24h	500 mg q24h
Imipenem, R	0.5-1 g q6h	500 mg q8-6h	500 mg q12h	250mg q12h	500mg q8-6h	500 mg q12h. AD	250mg q12h
Meropenem, R	0.5-2 g q8h	1g q8h	1 g q12h	500 mg q24h	500-1000mg q8-12h	500 mg q24h	500 mg q24h
Cephalosporins							
Cefazolin	1-2g q8h	1-2 q8h	1-2 g q12h	1-2g q24h	1-2 g q12h	1g q24h. AD	500mg q12h
Cefprozil	250-500 mg q12h		< 30: 50% of the dose		No data	250 mg q12h AD	No data
Ceftazidime, R	1-2g q8h		1-2g q12h	1-2g q24-48h	1-2g q12h	1-2g 3times\week. AD	500 mg q24h
Cefuroxime IV	750-1500 mg q8h	750-1500 mg q8h	750-1500 mg q8h-12h	750-1500 mg q24h	750-1500 mg q8h-12h	750 mg q24h	750-1500 mg q24h
Cefuroxime PO	250-500 mg q12h		250-500 mg q12h	250-500 mg q24h	250-500 mg q12h	250-500 mg q12h or 500 mg q24h	250-500 mg q12h
Ceftriaxone	1-2 g q12-24h	No adjustment required					

AD: After dialysis, **CRRT:** Continuous renal replacement therapy, **I:** Induction dose, **IHD:** Intermittent hemodialysis, **LD:** Loading dose, **MD:** Maintenance dose, **NR:** Not recommended, PD: Peritoneal dialysis, **3tw:** 3 times weekly, **R:** restricted.

Antibacterial Agents:	Adult dose	Estimated creatinine clearance (mL/min)			CRRT	IHD	PD
		>50 - 90	10 - 50	< 10			
Tetracyclines							
Doxycycline	100 mg q12h						
Macrolides							
Azithromycin (PO)	250-500mg q24h	No adjustment required					
Azithromycin (IV)	500 mg q24h	No adjustment required					
Clarithromycin (PO)	250-500 mg q12h	250-500 mg q12h		250 mg q12h			
Clarithromycin (IV)	500 mg q12h			250 mg q12h			
Quinolones							
Ciprofloxacin (PO)	250-750 mg q12h		250-500 mg q12h	500 mg q24h	500 mg q12-24h	250-500 mg q24h	250 mg q8h
Ciprofloxacin (IV), R	400mg q8-12h		400 mg q24h			200-400 mg q24h	200 mg q8h
Moxifloxacin, IV(R) & PO	400 mg q24h	No adjustment required					
Norfloxacin	400 mg q12h		< 30 ml/min: 400 mg q24h		400mg q24h	400 mg q24h	
Miscellaneous							
Clindamycin	600-900 mg q8h (IV) 150-450 mg q8-6h (PO)		No adjustment required				
Colistin, R	See colistin dosing protocol						
Co- trimoxazole (as TMP)	5-20mg/kg/day div q6-12h (15-20 mg/kg/day in PCP & meningitis)		30-50: 5-7.5 mg/kg/dose q8h 10-29:5-10mg/kg /dose q12h	5-10mg/kg/dose q24h	2.5-7.5mg/kg/dose q12h	2.5-10mg/kg/ dose q12h or 5-20 mg/kg/dose 3times/week AD	5-10 mg/kg /dose q24h
Linezolid PO & IV, R	600 mg q12h	No adjustment required					
Metronidazole PO & IV	500 mg q8h			500 mg q12h (C. difficile: 500 mg PO q8h)			
Nitrofurantoin (macrocrystal)	50-100 mg q6h		Avoid				
Teicoplanin, R	6mg/kg q12 h for 3 doses then q24h (severe infection: up to 10 mg\kg q12 for 3 doses then 10 mg \kg q24h)		6mg /kg q48h	6mg /kg q72h	6mg /kg q48h	6mg /kg q72h	
Tigecycline, R	100 mg loading dose then 50 mg q12h		No adjustment required				
Trimethoprim	100-200 mg q12h		>30:100-200mg q12h 10-30: 100-200mg q18h	100-200 mg q24h	100-200 mg q18h	100-200 mg q24h	
Vancomycin	See AHH-S Vancomycin dosing and monitoring guidelines						

AD: After dialysis, **CRRT:** Continuous renal replacement therapy, **I:** Induction dose, **IHD:** Intermittent hemodialysis, **LD:** Loading dose, **MD:** Maintenance dose, **NR:** Not recommended, PD**:** Peritoneal dialysis, **3tw:** 3 times weekly, **R:** restricted.

Antibacterial Agents:	Adult dose	Estimated creatinine clearance (mL/min)			CRRT	IHD	PD
		>50 - 90	**10 - 50**	**<10**			
Aminoglycosides							
Amikacin, R	See AHH-S aminoglycoside dosing and monitoring guidelines						
Gentamycin	See AHH-S aminoglycoside dosing and monitoring guidelines						
Streptomycin, R	15 mg/kg q24h (max: 1g). IM		15 m/kg q24-72h (max: 1g)	15 mg/kg q72-96h (max: 1g)	15 mg/kg per dose two or three times per week		
Tobramycin, R	See AHH-S aminoglycoside dosing and monitoring guidelines						
Anti-tuberculous agents							
Cycloserine, R	250mg q12 for 14 days then 500- 1000mg/day in 2 divided doses		500-1000mg q24h	250mg q24h	250 mg once daily, or 500 mg/dose three times per week		
Ethambutol, R	15-25mg/kg q24h		15-25mg/kg q24-36h	15-25mg/kg q48h	15-25mg/kg q24-36h	15-25mg/kg q48h	
Isoniazid, R	5 mg/kg/day max:300 mg	No adjustment required					
Pyrazinamide, R	25 mg/kg q24h (max: 2.5g)			25 mg /kg /dose 3tw			
Rifampicin, R	10 mg/kg od (max:600 mg)	No adjustment required					
Anti-fungal agents							
Amphotericin B, R	0.25-1mg/kg q24h			0.25-1mg/kg q24-36h	0.25-1mg/kg q24h		
Amphotericin B liposomal, R	3-5 mg/kg q24h			3-5 mg/kg q24- 36h	3-5 mg/kg q24h		
Caspofungin, R	70 mg x1 day then 50 mg q24h	No adjustment required					
Fluconazole PO & IV(R)	6-12 mg/kg q24h		3-6mg/kg q24h		6-12 mg/kg q24h	6-12mg/kg 3times/ week. AD	3-6mg/kg q24h
Flucytosine	37.5 mg/kg q6h	37.5 mg/kg q12h	37.5 mg/kg q12-24h	37.5 mg/kg 24-48h	37.5 mg/kg q12-24h	37.5 mg/kg 24-48h. AD	500-1000mg q24h
Itraconazole PO	100-200 mg q12-8h	No adjustment required					
Itraconazole IV	200 mg q12h	Do not use due to accumulation of cyclodextrin					
Nystatin	400,000-600,000unit q6h	No adjustment required					
Posaconazole, R	800 mg/day divided dose q6-12h	No adjustment required					
Terbinafine	250-500 mg q12h		500mg q24h	Not recommended			
Voriconazole, R (use IBW)	IV: 6mg/kg q12h for 1 day then 4 mg/kg q12h. PO: 200-300 mg q12h	Accumulation of cyclodextrin, Switch to oral					

AD: After dialysis, **CRRT:** Continuous renal replacement therapy, **I:** Induction dose, **IHD:** Intermittent hemodialysis, **LD:** Loading dose, **MD:** Maintenance dose, **NR:** Not recommended, PD**:** Peritoneal dialysis, **3tw:** 3 times weekly, **R:** restricted.

Antibacterial Agents:	**Adult dose**	**Estimated creatinine clearance (mL/min)**			**CRRT**	**IHD**	**PD**
		>50 - 90	**10 - 50**	**< 10**			
Anti-parasitic agents							
Hydroxyl chloroquine	800 mg then 400 mg in 6 to 8 hr			50% of normal dose prolonged treatment is necessary, the dosage should be further reduced to 50 to 100 mg/day	800 mg then 400 mg in 6 to 8 hr	50% of normal dose prolonged treatment is necessary, the dosage should be further reduced to 50 to 100 mg/day	
Mefloquine, R	1250 mg as a single dose	No adjustment required					
Primaquine, R	15-30 mg od	No data					
Quinine	650 mg q8h	650mg q8-12h		650mg q24h	650mg q8-12h	650mg q24h. AD	
Tinidazole	2g/day	No adjustment required			No data	An additional dose equal to 1/2 the usual dose, should be administered at the end of hemodialysis if tinidazole is administered on a day hemodialysis occurs.	No adjustment required
Albendazole	400-800 mg /day if patient < 60 kg : 15 mg/kg/day in 2 divided dose	No data					
Praziquantel	25 mg/kg 3 times over 1 day (at 4 to 6 hr intervals)	No adjustment required					

AD: After dialysis, **CRRT:** Continuous renal replacement therapy, **I:** Induction dose, **IHD:** Intermittent hemodialysis, **LD:** Loading dose, **MD:** Maintenance dose, **NR:** Not recommended, PD**:** Peritoneal dialysis, **3tw:** 3 times weekly, **R:** restricted.

Antibacterial Agents:	Adult dose	Estimated creatinine clearance (mL/min)			CRRT	IHD	PD
		>50 - 90	10 - 50	< 10			
Antiviral agents							
Abacavir, R	300 mg q12h OR 600 mg daily	No adjustment required					
Acyclovir IV, R (use IBW)	5-12 mg/kg q8h	5-12 mg/kg q8h	5-12 mg/kg q12-24	2.5-6mg /kg q24	5-10mg/kg q12-24	2.5-5mg/kg q24h AD	2.5-6mg /kg q24
Acyclovir PO	Genital herpes treatment: 400 mg q8h Genital herpes prophylaxis: 400 mg q12h Herpes zoster treatment: 800 mg 5 times/day			200 mg q12h Herpes zoster: 800 mg q12h	No data	AD	No data
Adefovir, R	10 mg q 24h po	10 mg od	10 mg q48-72h	10 mg q72h	No data	10 mg every 7 days following dialysis.	No data
Foscarnet, R	Induction: 60 mg/kg q8h Maintenance: 90-120 mg/kg/day	Discuss with Pharmacist					
Gancyclovir, R	I: 5mg/kg q12h IV	I: 5 mg/kg q12h	I:1.25-2.5mg/kg q24h	I: 1.25mg/kg 3 times/wk	I: 2.5 mg/kg q12-24h	I: 1.25mg/kg q48-72h AD	I: 1.25mg/kg 3 times/wk
	M:5mg/kg q24 IV	M: 2.5-5mg/kg q24h	M: 0.6-1.25mg/kg q24	M: 0.625mg/kg 3 times/wk	M: 1.25-2.5mg /kg q24h	M: 0.625mg/ kg q48-72h AD	0.625mg/kg 3 times/wk
Lamivudine, R	HIV:300 mg q24h po OR 150mg q12h HBV: 100 mg od		HIV:50-150mg q24h HBV: 30-49ml/min:100 mg first dose then 50 mg od 15-29ml/min: 100 mg first dose then 25mg od. < 14 ml/min: 35 mg first dose then 15 mg od	HIV: 25-50 mg q24h. HBV: 35 mg first dose then 15 mg od	HIV: 100 mg first day then 50 mg q24h HBV: follow hepatology protocol	HIV: 50 mg first dose then 25-50 mg q24h AD HBV: follow hepatology protocol	HIV: 25-50 mg q24h. HBV: follow hepatology protocol
Oseltamivir, R	75 mg po q12h Up to 150mg q12h		30-60: 30 mg q12h < 30: 30 mg q24h	No data	75 mg q12h	30 mg in non- dialysis days	30 mg once / wk
Raltegravir, R	400 mg q12h	No adjustment required					
Ribavirin, R	As per hepatology protocol						
Valaciclovir	1g q8h	1g q8h	1g q12-24h	500 mg q24h	1g q12-24h	500 mg q24h AD	500 mg q24h
Valgancyclovir, R	900 mg q12h po	900 mg q12h	450 mg q24 to every other day	NR	NR	NR	NR

AD: After dialysis, **CRRT:** Continuous renal replacement therapy, **I:** Induction dose, **IHD:** Intermittent hemodialysis, **LD:** Loading dose, **MD:** Maintenance dose, **NR:** Not recommended, PD**:** Peritoneal dialysis, **3tw:** 3 times weekly, **R:** restricted.

مستشفى الرياض Riyadh Hospital	**TITLE:** Antimicrobial Dose Adjustments in Adult Patients with Renal Impairment
	DOCUMENT: Policy and Procedure **TYPE:** ☐ Corporate ☒Interdepartmental ☐Departmental
	OWNER: Pharmacy Department
	APPLIES TO: Physicians, Pharmacists, Nurses and Other Clinical Staff

1. **Statement of Purpose:** To establish guidelines for antimicrobial dose adjustments in adult patients with renal impairment.

2.Definitions:

2.1. **CrCL**: Creatinine Clearance.
2.2. **SCr**: Serum Creatinine.

3.*Policy:*

3.1 Many antimicrobial agents are eliminated by the kidney and therefore require dosing adjustments in patients with chronic kidney disease.
3.2 The Antimicrobial dosing regimens should be reviewed if there is a significant change in their patient's renal function or if renal replacement therapy is commenced, discontinued, or modified.
3.3 Dosages of antimicrobials cleared renally should be adjusted based on renal function (calculated as creatinine clearance) by using the Cockcroft - Gault equation:

$$\textbf{Male: } \text{CrCL (ml/min)} = \frac{(140 - \text{Age}) \times \text{BW}}{\text{SCr} \times 72}$$

$$\textbf{Female: } \text{CrCL (ml/min)} = \frac{0.85 \times (140 - \text{Age}) \times \text{BW}}{\text{SCr} \times 72}$$

Where, **Age** is in years, **BW** is body Weight in Kg and **CrCL** is Serum creatinine (mg/dL)

3.3.1 Use Ideal Body Weight (IBW) if height is available.
3.3.2 Use Actual Body Weight (ABW) if ABW<IBW.
3.3.3 Use Adjusted Dosing Weight (ADW) if obese (i.e., body weight is ≥ 30% over IBW)
ADW= ((ABW-IBW) x 0.4) + IBW.
3.3.4 The Cockcroft-Gault method should only be used in patients > 18 years old with stable serum creatinine concentrations.
3.3.5 Consult the clinical pharmacist/pharmacist for estimating CrCL in the following patient categories:
3.3.5.1 Patients < 18 years old.
3.3.5.2 Patients with unstable renal function.

3.4 For patients on dialysis, Dosages of Antimicrobial should be adjusted based on the type of dialysis method:
3.4.1 Intermittent Hemodialysis (IHD)
3.4.2 Peritoneal Dialysis (PD)

3.4.3 Continuous Renal Replacement Therapy (CRRT)

4.Procedure:

4.1. The table in Attachment describes the recommended antimicrobial dosing regimens in patients with normal renal function and those recommended for patients with different degrees of renal impairment and those on various renal replacement therapy forms.

4.2. The recommended antibiotic dosing for CRRT patients listed in this guideline is considered as a general recommendation. Consult the clinical pharmacist for individualized dosage recommendations for patients on CRRT.

4.3. The prescribing physician shall:

4.3.1. Familiarize themselves with the policies and guidelines pertinent to prescribing antimicrobial agents in adult patients with renal impairment.

4.3.2. Adhere to and comply with the recommendations and instructions of various antimicrobial therapy guidelines and policies.

4.4. The pharmacy department shall collaborate with concerned clinical departments to enforce the policy and procedure through continuous monitoring and review.

5.Attachments:

5.1 Attachment 1: Antibiotic Renal Dosing Guidelines.

6.References:

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6.3. Heintz et al. Antimicrobial dosing concept in renal replacement therapy. Pharmacotherapy 2009; 29:562-77.

6.4. Lacy CF, Armstrong LL, Goldman MP, Lance LL. Drug Information Handbook, 18th ed. Hudson, Ohio, Lexi-Comp, Inc.; 2010.

6.5. Micromidex 2010-2011. http://www.thomsonhc.com/home/dispatch (accessed on 7 May 2012).

6.6. Gilbert DN, Moellering RC Jr, Eliopoulos GM, Chambers HF, Saag MS, eds. The Sanford Guide to Antimicrobial Therapy, 40th ed. Sperryville, VA: Antimicrobial Therapy; 2010.

6.7. Up to date 2011. http://www.uptodate.com/index (accessed on 7 May 2012).

6.8. British Medical Association and the Royal Pharmaceutical Society of Great Britain. British National Formulary. 60th ed. UK: BMJ Publishing Group. 2010.

6.9. Individual Drug Information leaflets provided by the manufacturers with their corresponding products.

Attachment: Antibiotic Renal Dosing Guidelines:

مستشفى الرياض
Riyadh Hospital

Attachment 1: Recommended antimicrobial dosing regimens in patients with normal renal function as well as those recommended for patients with different degrees of renal impairment as well as those on various forms of renal replacement therapy.

Antibacterial Agents:	Adult dose	Estimated creatinine clearance (ml/min)			CRRT	IHD	PD
		50- > 90	10-50	<10			
Penicillins							
Amoxicillin Po	500 mg q8h Up to 3g/day	500 mg q8h	> 30ml/min: 500 mg q8h < 30ml/min: 500 mg 12h	500 mg q24h	500 mg q8-12h	500 mg q12h AD	250 mg q12h
Ampicillin IV	250-500 mg q6h to 2g q4h	250-500 mg 6h	q6-12h	q12-24h	250 mg to 2 g q 6 to 12 h	maintenance dose is recommended after hemodialysis	250 mg q12h
Augmentin Po	1 g q12h		10-30: 250 mg - 500 mg amoxicillin/125 mg clavulanic acid q 12 h	250 or 500 mg amoxicillin/125 mg clavulanic acid q 24 h	500 mg q24h	500 mg q24h	250mg q12h
Augmentin ,IV	1.2 g q8h		> 30ml/min: 1.2g q8h 10-30ml/min: 1.2g LD followed by 600mg q12h	1.2g LD followed by 600mg q24h	No data	1.2g LD followed by 600mg q24h. Additional 600 mg may need to be given during dialysis and at the end of dialysis.	
Flucloxacillin	IV: 250 q6h to 2g q4h, PO: 250 1 g q6h			No adjustment required			
Penicillin G	0.5-4milion U q4h		2MU q4h maximum	1MU q4h maximum	1-2MU q4h maximum	1MU q4h maximum	
Phenoxymethyl penicillin	125-500 mg q8-6h			250mg q6h	No data		
Tazocin	4.5g q8-6h*	4.5g q8-6h	4.5g q8h < 30: 2.25g q8h	2.25g q8h	2.25g q8-6h	2.25g q8-12h	2.25g q8h
Monobactams							
Aztreonam, R	2g q8h	2 g q8h	1g q8h	1g q24h	1g q8 or 2g q 12h	500 mg q 12h. AD	1g q24h
Carbapenems							
Ertapenem, R	1 g q24h	1 g q24h	500 mg q24h		500 mg q 24h	500 mg q24h	500 mg q24h
Imipenem, R	0.5-1 g q6h	500 mg q8-6h	500 mg q12h	250mg q12h	500mg q8-6h	500 mg q12h. AD	250mg q12h
Meropenem, R	0.5-2 g q8h	1g q8h	1 g q12h	500 mg q24h	500-1000mg q8-12h	500 mg q24h	500 mg q24h
Cephalosporins							
Cefazolin	1-2g q8h	1-2 q8h	1-2 g q12h	1-2g q24h	1-2 g q12h	1g q24h. AD	500mg q12h
Cefprozil	250-500 mg q12h		< 30: 50% of the dose		No data	250 mg q12h AD	No data
Ceftazidime, R	1-2g q8h		1-2g q12h	1-2g q24-48h	1-2g q12h	1-2g 3times\week. AD	500 mg q24h
Cefuroxime IV	750-1500 mg q8h	750-1500 mg q8h	750-1500 mg q8h-12h	750-1500 mg q24h	750-1500 mg q8h-12h	750 mg q24h	750-1500 mg q24h
Cefuroxime PO	250-500 mg q12h		250-500 mg q12h	250-500 mg q24h	250-500 mg q12h	250-500 mg q12h or 500 mg q24h	250-500 mg q12h
Ceftriaxone	1-2 g q12-24h	No adjustment required					

AD: After dialysis, **CRRT:** Continuous renal replacement therapy, **I:** Induction dose, **IHD:** Intermittent hemodialysis, **LD:** Loading dose, **MD:** Maintenance dose, **NR:** Not recommended, **PD:** Peritoneal dialysis, **3tw:** 3 times weekly, **R:** restricted.

Antibacterial Agents:	Adult dose	Estimated creatinine clearance (ml/min)			CRRT	IHD	PD
		50- > 90	10-50	< 10			
Tetracyclines							
Doxycycline	100 mg q12h						
Macrolides							
Azithromycin (PO)	250-500mg q24h	No adjustment required					
Azithromycin (IV)	500 mg q24h	No adjustment required					
Clarithromycin (PO)	250-500 mg q12h	250-500 mg q12h		250 mg q12h			
Clarithromycin (IV)	500 mg q12h			250 mg q12h			
Quinolones							
Ciprofloxacin (PO)	250-750 mg q12h		250-500 mg q12h	500 mg q24h	500 mg q12-24h	250-500 mg q24h	250 mg q8h
Ciprofloxacin (IV), R	400mg q8-12h		400 mg q24h			200-400 mg q24h	200 mg q8h
Moxifloxacin, IV(R) & PO	400 mg q24h	No adjustment required					
Norfloxacin	400 mg q12h		< 30 ml/min: 400 mg q24h		400mg q24h	400 mg q24h	
Miscellaneous							
Clindamycin	600-900 mg q8h (IV) 150-450 mg q8-6h (PO)	No adjustment required					
Colistin, R	See colistin dosing protocol						
Co- trimoxazole (as TMP)	5-20mg/kg/day div q6-12h (15-20 mg/kg/day in PCP & meningitis)		30-50: 5-7.5 mg/kg/dose q8h 10-29:5-10mg/kg /dose q12h	5-10mg/kg/dose q24h	2.5-7.5mg/kg/dose q12h	2.5-10mg/kg/ dose q12h or 5-20 mg/kg/dose 3times/week AD	5-10 mg/kg /dose q24h
Linezolid PO & IV, R	600 mg q12h	No adjustment required					
Metronidazole PO & IV	500 mg q8h			500 mg q12h (C. difficile: 500 mg PO q8h)			
Nitrofurantoin (macrocrystal)	50-100 mg q6h	Avoid					
Teicoplanin, R	6mg/kg q12 h for 3 doses then q24h (severe infection: up to 10 mg\kg q12 for 3 doses then 10 mg \kg q24h)		6mg /kg q48h	6mg /kg q72h	6mg /kg q48h	6mg /kg q72h	
Tigecycline, R	100 mg loading dose then 50 mg q12h	No adjustment required					
Trimethoprim	100-200 mg q12h		>30:100-200mg q12h 10-30: 100-200mg q18h	100-200 mg q24h	100-200 mg q18h	100-200 mg q24h	
Vancomycin	See AHH-S Vancomycin dosing and monitoring guidelines						

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Antibacterial Agents:	Adult dose	Estimated creatinine clearance (ml/min)			CRRT	IHD	PD
		50- > 90	10-50	<10			
Aminoglycosides							
Amikacin, R	See AHH-S aminoglycoside dosing and monitoring guidelines						
Gentamycin	See AHH-S aminoglycoside dosing and monitoring guidelines						
Streptomycin, R	15 mg/kg q24h (max: 1g). IM		15 m/kg q24-72h (max: 1g)	15 mg/kg q72-96h (max: 1g)	15 mg/kg per dose two or three times per week		
Tobramycin, R	See AHH-S aminoglycoside dosing and monitoring guidelines						
Anti-tuberculous agents							
Cycloserine, R	250mg q12 for 14 days then 500- 1000mg/day in 2 divided doses		500-1000mg q24h	250mg q24h	250 mg once daily, or 500 mg/dose three times per week		
Ethambutol, R	15-25mg/kg q24h		15-25mg/kg q24-36h	15-25mg/kg q48h	15-25mg/kg q24-36h	15-25mg/kg q48h	
Isoniazid, R	5 mg/kg/day max:300 mg	No adjustment required					
Pyrazinamide, R	25 mg/kg q24h (max: 2.5g)			25 mg /kg /dose 3tw			
Rifampicin, R	10 mg/kg od (max:600 mg)	No adjustment required					
Anti-fungal agents							
Amphotericin B, R	0.25-1mg/kg q24h			0.25-1mg/kg q24-36h	0.25-1mg/kg q24h		
Amphotericin B liposomal, R	3-5 mg/kg q24h			3-5 mg/kg q24- 36h	3-5 mg/kg q24h		
Caspofungin, R	70 mg x1 day then 50 mg q24h		No adjustment required				
Fluconazole PO & IV(R)	6-12 mg/kg q24h		3-6mg/kg q24h		6-12 mg/kg q24h	6-12mg/kg 3times/ week. AD	3-6mg/kg q24h
Flucytosine	37.5 mg/kg q6h	37.5 mg/kg q12h	37.5 mg/kg q12-24h	37.5 mg/kg 24-48h	37.5 mg/kg q12-24h	37.5 mg/kg 24-48h. AD	500-1000mg q24h
Itraconazole PO	100-200 mg q12-8h		No adjustment required				
Itraconazole IV	200 mg q12h		Do not use due to accumulation of cyclodextrin				
Nystatin	400,000-600,000unit q6h		No adjustment required				
Posaconazole, R	800 mg/day divided dose q6-12h		No adjustment required				
Terbinafine	250-500 mg q12h		500mg q24h	Not recommended			
Voriconazole, R (use IBW)	IV: 6mg/kg q12h for 1 day then 4 mg/kg q12h. PO: 200-300 mg q12h		Accumulation of cyclodextrin, Switch to oral				

AD: After dialysis, **CRRT:** Continuous renal replacement therapy, **I:** Induction dose, **IHD:** Intermittent hemodialysis, **LD:** Loading dose, **MD:** Maintenance dose, **NR:** Not recommended, PD: Peritoneal dialysis, **3tw:** 3 times weekly, **R:** restricted.

Antibacterial Agents:	Adult dose	Estimated creatinine clearance (ml/min)			CRRT	IHD	PD
		50- >90	10-50	< 10			
Anti-parasitic agents							
Hydroxyl chloroquine	800 mg then 400 mg in 6 to 8 hr			50% of normal dose prolonged treatment is necessary, the dosage should be further reduced to 50 to 100 mg/day	800 mg then 400 mg in 6 to 8 hr	50% of normal dose prolonged treatment is necessary, the dosage should be further reduced to 50 to 100 mg/day	
Mefloquine, R	1250 mg as a single dose		No adjustment required				
Primaquine, R	15-30 mg od	No data					
Quinine	650 mg q8h		650mg q8-12h	650mg q24h	650mg q8-12h	650mg q24h. AD	
Tinidazole	2g/day	No adjustment required			No data	An additional dose equal to 1/2 the usual dose, should be administered at the end of hemodialysis if tinidazole is administered on a day hemodialysis occurs.	No adjustment required
Albendazole	400-800 mg /day if patient < 60 kg : 15 mg/kg/day in 2 divided dose	No data					
Praziquantel	25 mg/kg 3 times over 1 day (at 4 to 6 hr intervals)	No adjustment required					

AD: After dialysis, **CRRT:** Continuous renal replacement therapy, **I:** Induction dose, **IHD:** Intermittent hemodialysis, **LD:** Loading dose, **MD:** Maintenance dose, **NR:** Not recommended, PD: Peritoneal dialysis, **3tw:** 3 times weekly, **R:** restricted.

Antibacterial Agents:	Adult dose	Estimated creatinine clearance (ml/min)			CRRT	IHD	PD
		50- >90	10-50	< 10			
Antiviral agents							
Abacavir, R	300 mg q12h OR 600 mg daily	No adjustment required					
Acyclovir IV, R (use IBW)	5-12 mg/kg q8h	5-12 mg/kg q8h	5-12 mg/kg q12-24	2.5-6mg /kg q24	5-10mg/kg q12-24	2.5-5mg/kg q24h AD	2.5-6mg /kg q24
Acyclovir PO	Genital herpes treatment: 400 mg q8h Genital herpes prophylaxsis: 400 mg q12h Herpes zoster treatment: 800 mg 5 times/day			200 mg q12h Herpes zoster: 800 mg q12h	No data	AD	No data
Adefovir, R	10 mg q 24h po	10 mg od	10 mg q48-72h	10 mg q72h	No data	10 mg every 7 days following dialysis.	No data
Foscarnet, R	Induction: 60 mg/kg q8h Maintenance: 90-120 mg/kg/day	Discuss with Pharmacist					
Gancyclovir, R	I: 5mg/kg q12h IV	I: 5 mg/kg q12h	I:1.25-2.5mg/kg q24h	I: 1.25mg/kg 3 times/wk	I: 2.5 mg/kg q12-24h	I: 1.25mg/kg q48-72h AD	I: 1.25mg/kg 3 times/wk
	M:5mg/kg q24 IV	M: 2.5-5mg/kg q24h	M: 0.6-1.25mg/kg q24	M: 0.625mg/kg 3 times/wk	M: 1.25-2.5mg /kg q24h	M: 0.625mg/ kg q48-72h AD	0.625mg/kg 3 times/wk
Lamivudine, R	HIV:300 mg q24h po OR 150mg q12h HBV: 100 mg od		HIV:50-150mg q24h HBV: 30-49ml/min:100 mg first dose then 50 mg od 15-29ml/min: 100 mg first dose then 25mg od. < 14 ml/min: 35 mg first dose then 15 mg od	HIV: 25-50 mg q24h. HBV: 35 mg first dose then 15 mg od	HIV: 100 mg first day then 50 mg q24h HBV: follow hepatology protocol	HIV: 50 mg first dose then 25-50 mg q24h AD HBV: follow hepatology protocol	HIV: 25-50 mg q24h. HBV: follow hepatology protocol
Oseltamivir, R	75 mg po q12h Up to 150mg q12h		30-60: 30 mg q12h < 30: 30 mg q24h	No data	75 mg q12h	30 mg in non- dialysis days	30 mg once / wk
Raltegravir, R	400 mg q12h	No adjustment required					
Ribavirin, R	As per hepatology protocol						
Valaciclovir	1g q8h	1g q8h	1g q12-24h	500 mg q24h	1g q12-24h	500 mg q24h AD	500 mg q24h
Valgancyclovir, R	900 mg q12h po	900 mg q12h	450 mg q24 to every other day	NR	NR	NR	NR

AD: After dialysis, **CRRT:** Continuous renal replacement therapy, **I:** Induction dose, **IHD:** Intermittent hemodialysis, **LD:** Loading dose, **MD:** Maintenance dose, **NR:** Not recommended, PD: Peritoneal dialysis, **3tw:** 3 times weekly, **R:** restricted.

ABDOMINAL INFECTIONS

	1st Line	Alternative	Notes
Biliary sepsis	**Community acquired:** **Cefuroxime** 750-1500mg iv q8h **Plus Metronidazole** 500mg iv or po q8h **Hospital acquired or prior biliary procedure:** **Tazocin** 4.5g iv q8h	**Community acquired:** **Moxifloxacin** 400mg po or iv q24h **Plus Metronidazole** 500mg iv q8h **Hospital acquired or prior biliary procedure:** **Add Amikacin** iv (as per aminoglycoside dosing guidelines)	▪ **5-7 days** unless persistent source, e.g., undrained obstruction
Liver abscess	**Cefuroxime** 750-1500mg iv q8h **Plus Metronidazole** 500mg po or iv q8h **OR** **Augmentin** 1.2g iv q8h or 1g po q12h	**Vancomycin** iv (as per Vancomycin dosing guidelines) **Plus, Gentamicin** iv (see aminoglycoside dosingGL) **Plus, Metronidazole** 500mg iv or po q8h	▪ Duration will depend on clinical progress and whether abscess is fully drained. ▪ Consider amoebic liver abscess and hydatid disease if appropriate. ▪ Discuss with ID Team.
Perforated viscus (secondary peritonitis) **Intra-abdominal abscess** **Diverticulitis**	**Mild to moderate:** **Cefuroxime** 750-1500mg iv q8h **Plus Metronidazole** 500mg iv or po q8h **Severely ill or immune compromised:** **Tazocin** 4.5g iv q8h	**Mild to moderate:** **Moxifloxacin** 400mg po or iv q24h **Plus, Metronidazole** 500mg iv q8h **Severely ill or immune compromised:** **Vancomycin** iv (as per Vancomycin dosing guidelines) **Plus, Moxifloxacin** 400mg iv q24h **Plus, Metronidazole** 500mg iv q8h	▪ **7 days** unless persistent source, e.g., persistent intra-abdominal collection ▪ Discuss with ID Team if previous multi-resistant organisms ▪ Add **Fluconazole** 400mg po or iv q24h if persistent upper GI leak or esophageal perforation
Primary peritonitis (spontaneous bacterial peritonitis) **-Therapy**	**Ceftriaxone** 1g iv q12h or **Augmentin** 1.2 g iv q8h (Switch to Augmentin 1g po q12h as soon as clinically appropriate)	**Ciprofloxacin** 400mg iv q12h (Switch to 750mg po q12h as soon as clinically appropriate)	▪ **5-7 days** ▪ Discuss with ID Team if previous multi-resistant organism or long-term prophylaxis ▪ A diagnostic paracentesis should be performed whenever possible
Spontaneous bacterial peritonitis - Prophylaxis	**Norfloxacin** 400mg po q24h	**Co-trimoxazole** 960mg po q24h	▪ Consider for cirrhotic patients with one or more previous episodes of SBP

Peritoneal dialysis-related peritonitis	**Mild to moderate:** **Cefazolin** 15mg/kg (minimum 1g) in one bag q24h **Plus:** **Gentamicin** 0.6mg/kg in one bag q24h **Severe:** **Vancomycin** iv (as per Vancomycin dosing guidelines) **Plus : Tazocin** 2.25g iv q8h	▪ **10-14 days** ▪ Send peritoneal fluid for cell count, gram stain and culture ▪ Review previous microbiology results and antimicrobial therapy history. ▪ Consider removing peritoneal catheter if recurrent infection or failing to respond to therapy.

	1st Line	Alternative	Notes
Pancreatitis	**Tazocin** 4.5g iv q8h **If ≥30% necrosis on CT:** **Imipenem** 500mg- 1g q6h IV	**Moxifloxacin** 400mg po or iv q24h **Plus Metronidazole** 500mg iv q8h **Plus Amikacin** iv (as per aminoglycoside dosing guidelines)	▪ **Antibiotics are only indicated if there is clinical evidence of sepsis** ▪ **7 days** unless uncontrolled infection or persistent source, e.g., pancreatic abscess
***C difficile* infection**	**Mild to moderate:** **Metronidazole** 500mg po q8h for **10 – 14 days** **Severe:** **Vancomycin** 125mg po q6h for **10-14 days** **Life threatening:** **Metronidazole** 500mg po or iv q8h **plus Vancomycin** 500mg po q6h for **10-14 days**		▪ Do not treat asymptomatic patients with positive CDT ▪ Always stop/review all unnecessary antibiotics ▪ All patients must have a daily stool chart ▪ Check FBC, CRP, U&Es, at baseline ▪ Review patient's progress daily ▪ Refer to ID all severe cases, failing respond to therapy or multiple recurrences
Gastroenteritis (infectious diarrhea)	Routine antibiotic therapy is not recommended. Antimicrobial therapy may be considered in the following: ▪ Bloody diarrhea, ▪ Fever (Temperature >38°C on two or more occasions), ▪ Patient systemically unwell, or ▪ Symptoms for more than 7 days		▪ Send stool for microscopy, culture and ova and parasites ▪ Take detailed travel history ▪ Discuss with ID Team if needed ▪ Do not use anti-motility agents unless infection has been excluded

***Helicobacter pylori* eradication therapy** **First eradication course** **Failed first course**	**Amoxicillin** 1g po q12h **Plus** **Clarithromycin** 500mg po q12h **10-14** **Plus** **Pantoprazole** 40mg po q12h	**Clarithromycin** 500mg po q12h **Plus** **Metronidazole** 500mg po q12h **10-14** **Plus** **Pantoprazole** 40mg po q12h	▪ Do not use clarithromycin or metronidazole if used in the past year for **ANY** type of infection ▪ Send stool for *H pylori* fecal antigen if symptoms persist despite therapy ▪ Discuss patients who fail multiple therapy courses with ID Team or Gastroenterology

	1st Line	Alternative	Notes
Bleeding oesophageal varices	**Ceftriaxone** 1g iv q12h or **Augmentin** 1.2 g iv q8h (Switch to Augmentin 1g po q12h assoon as clinically appropriate)	**Ciprofloxacin** 400mg iv q12h (Switch to 750mg po q12h as soon as clinically appropriate)	▪ **For 7 days**
PEG insertion prophylaxisIf **MRSA positive, use**	**Augmentin** 1.2 g iv 30-60 min prior to procedure **Vancomycin** 15mg/kg over 60 minutes (start infusion 30-60 minutesbefore procedure)	**Vancomycin** 15mg/kg over 30-60 minutes (start infusion 60-90 minutes before procedure)	▪ Review previous microbiology results

ERCP prophylaxis	**Routine prophylaxis for ERCP is no longer considered appropriate.See comments column for more details** **Cefuroxime 750mg** iv within ≈30 minutes prior to procedure	**Ciprofloxacin** 750mg po within ≈60 minutes prior to procedure **or** **Gentamicin** 3 mg/kg iv within ≈30-60 minutes prior to procedure	**Antibiotic prophylaxis should be given in:** ▪ patients with biliary disorders in whom it can be anticipated that complete biliary drainage will be difficult or impossible to achieve during one procedure, ▪ patients with a history of liver transplantation, ▪ patients with pancreatic pseudocyst, ▪ patients with severe neutropenia, or ▪ patients with advanced hematological malignancy

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7. European Society of Clinical Microbiology & Infectious Diseases (ESCMID): treatment guidance document for *Clostridium difficile* infection (CDI). Clin Microbiol Infect Dis 2009; 15:1067-79
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BLOOD STREAM INFECTIONS AND SEVERE SEPSIS OF UNKNOWN ETIOLOGY

Refer to RH Sepsis Code CPG

<table>
<tr><th></th><th>1st Line</th><th>Alternative</th><th>Notes</th></tr>
<tr><td rowspan="3">Severe sepsis of unknown source including neutropenic sepsis

Previous multi-resistant gram-negative microorganisms (eg, ESBL-producing coliforms)

If patient previously MRSA Positive, use</td><td>Tazocin 4.5g iv q6h
<u>Plus</u>
Amikacin 15mg/kg iv (see aminoglycoside dosing GL)</td><td>Vancomycin iv (see vancomycin dosing GL)
<u>Plus</u>
Amikacin 15mg/kg iv (see aminoglycoside dosing GL)</td><td rowspan="3">▪ 7 days are usually adequate, unless WCC fails to recover, or patient remains unwell
▪ Assess carefully for source of sepsis
▪ Remove or control source if possible
▪ Review previous microbiology results
▪ Discuss with ID Team if required</td></tr>
<tr><td>Imipenem 500mg to 1g iv q6h
<u>Plus</u>
Amikacin 15mg/kg iv (see aminoglycoside dosing GL)</td><td>Clindamycin 900mg iv q8h
<u>Plus</u>
Colistin iv (as per colistin dosing GL)</td></tr>
<tr><td>Tazocin 4.5g iv q6h
<u>Plus</u>
Vancomycin iv (see Vancomycin dosing GL)</td><td>Vancomycin iv (as per Vancomycin dosing guidelines)
<u>Plus</u>
Amikacin 15mg/kg iv (see aminoglycoside dosing GL)</td></tr>
<tr><td>Vascular line associated infection</td><td colspan="2">Take blood cultures from a peripheral vein and via the vascular line at the same time.
The following are considered strong indications for removing the affected vascular line:
1) Presence of pus or purulent discharge at the line’s exit site
2) Line infections caused by fungi, gram-negative bacteria or rapidly growing mycobacterial.
Vancomycin iv (see Vancomycin dosing GL)
If gram negative organisms on film or previous gram-negative sepsis add Amikacin iv (see aminoglycoside dosing GL)</td><td>▪ Review previous microbiology results
▪ Send any pus or purulent discharge from exit site for gram film and culture
▪ Treat for a total of 7 days unless secondary complications or certainmicroorganisms.
▪ Discuss with ID Team.</td></tr>
<tr><td>Candidemia
(Candida species in blood culture)</td><td>Fluconazole 800mg iv stat followed by 400mg iv q24h

<u>If recent azole therapy or prophylaxis:</u>
Caspofungin 70mg loading dose followed by 50mg iv q24h (continue 70mg iv 24 hourly if body weight over 80kg)</td><td>Caspofungin 70mg loading dose followed by 50mg iv q24h (continue 70mg iv 24 hourly if body weight over 80kg)</td><td>▪ 14 days from the first <u>negative</u> blood culture, longer if secondary complications(e.g., endocarditis)
▪ All patients with candidemia should have a fundoscopic examination to exclude retinal Candida lesions.
▪ Review antifungal therapy with ID Team once Candida species known</td></tr>
</table>

	Remove or replace all existing vascular lines and take blood cultures every 48 hours until microbiological response is confirmed		

	1st Line	Alternative	Notes
***Staph aureus* bacteraemia** (Methicillin sensitive)	**Flucloxacillin** 1g iv q4h or **Cefazolin** 1-2g iv q8h	**Vancomycin** iv (see Vancomycin dosing GL)	▪ **≥14 days** unless deep focus of infection (eg, endocarditis, osteomyelitis, deep abscess) ▪ Always look for source of sepsis and ensure adequate source control ▪ Take follow up blood cultures after 48 hours of therapy to confirm microbiological response ▪ ID consult recommended ▪ 50% of patients will have infective endocarditis. Assess carefully and consider echocardiography, if appropriate
Methicillin-resistant *Staph aureus* **(MRSA)** bacteraemia	**Vancomycin** iv (see Vancomycin dosing GL)	**Co-trimoxazole** (Septrin, Bactrim) 5-10mg/kg of trimethoprim in 2-4 divided doses iv	

References:

1. Dellinger RP et al. Surviving Sepsis Campaign: international guidelines for management of severe sepsis and septic shock: 2008. Crit Care Med. 2008 Jan;36(1):296-327.
2. Freifeld AG et al. Clinical Practice Guideline for the Use of Antimicrobial Agents in Neutropenic Patients with Cancer: 2010 Update by the Infectious Diseases Society of America. CID 2011; 52(4): e56-e93.
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6. Garau J et al. Management of methicillin-resistant Staphylococcus aureus infections. Clin Microbiol Infect 2009 Feb;15(2):125-36
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8.

Management of Patients with Sepsis:

Refer to RH Sepsis Code CPG

- Suspected or documented infection.
- An acute increase of >= 2 SOFA (organ failure, oxygenation, platelet count. Bilirubin, blood pressure, renal function and mental status.
- A "quick" SOFA score, at least 2 of:
  - Respiratory rate of >= 22/min
  - Altered mental status
  - Systolic blood pressure <= 100 mmHg

Infection Type	First Line Therapy	Alternative Therapy
Source is unclear	▪ Ertapenem 1 g IV every 24 hours (if history of ESBL) + Vancomycin 1gm IV q 12h. ▪ Meropenem 1 gm IV q8h + Vancomycin 1gm IV q 12h. ▪ Imipenem 0.5 gm IV q6h + Vancomycin 1gm IV q 12h.	If low prevalence of ESBL or carbapenemase aerobic gram- negative bacilli: ❖ Piperacillin-Tazobactam4.5 gm IV q6h + Vancomycin 1gm IV q 12h. ❖ If high prevalence of ESBL or carbapenemase aerobic gram- negative bacilli: ▪ Colistin IV +Meropenem 1 gm IV q8h + Vancomycin 1gm IV q 12h.
Suspect biliary source	Piperacillin-Tazobactam 4.5 gm IV q6h	
Suspect community acquired pneumonia source	Piperacillin-Tazobactam 4.5 gm IV q6h + Vancomycin 1gm IV q 12h.	
Suspect illicit IV drug use source	Meropenem 1 gm IV q8h + Vancomycin 1gm IV q 12h.	
Suspect petechial rash source	Ceftriaxone 2gm IV q12h.	

BONE & JOINT INFECTIONS

	1st Line	Alternative	Notes
Septic arthritis (native joint) Acute Pyogenic	**Flucloxacillin** 1-2g iv q4h **OR** **Cefazolin** 1-2g iv q8h (Discuss oral switch options with ID Team as soon as clinically appropriate)	**Clindamycin 600mg** iv q8h or q6h (Discuss oral switch options with ID Team as soon as clinically appropriate)	▪ **≥4-6 weeks in total** (including oral treatment phase) ▪ Take two sets of blood cultures before commencing antibiotic therapy ▪ Always aim to send joint aspirate/bone tissuefor urgent gram film and culture ▪ Review treatment if failing to respond to therapy ▪ ID consult is strongly recommended ▪ Always consider risk factors for **gram-negative infections** (e.g., Sickle cell disease), **TB** and **Brucella**.
MRSA positive	**Vancomycin** iv (see Vancomycin dosing GL) (Discuss oral switch options with ID Team when clinically appropriate)	Review MRSA sensitivity profile and choose therapy, accordingly, refer to ID	
Septic arthritis (prosthetic joint)	**Vancomycin** iv (see Vancomycin dosing GL) (Discuss oral switch options with ID Team as soon as clinically appropriate)	**Clindamycin 600mg** iv q8h or q6h **OR** **Co-trimoxazole** (Septrin, Bactrim) 5-10mg/kg of Trimethoprim per day in 2-4 divided doses iv (Discuss oral switch options with ID Team as soon as clinically appropriate)	▪ **≥6-8 weeks in total** (including oral treatment phase) ▪ Always aim to send joint aspirate/bone tissuefor urgent gram film and culture BEFORE starting antimicrobial therapy. ▪ Review treatment if failing to respond to therapy ▪ May need two-stage joint replacement. ▪ ID consult is strongly recommended ▪ Always consider risk factors for **gram-negative infections** (eg, Sickle cell disease), **TB** and **Brucella**.
Osteomyelitis, Acute	**Flucloxacillin** 1-2g iv q4h **OR** **Cefazolin** 1-2g iv q8h (Discuss oral switch options with ID Team as soon as clinically appropriate)	**Clindamycin 600mg** iv q8h or q6h (Discuss oral switch options with ID Team as soon as clinically appropriate)	▪ **≥4-6 weeks in total** (including oral treatment phase) ▪ Take two sets of blood cultures before commencing antibiotic therapy ▪ Always aim to send joint aspirate/bone tissue for urgent gram film and culture ▪ Send samples from any associated open wounds for culture ▪ Review treatment if failing to respond to therapy ▪ ID consult is strongly recommended
MRSA positive	**Vancomycin** iv (see Vancomycin dosing GL) (Discuss oral switch options with ID Team when clinically appropriate) Discuss with Consultant ID Team	Review MRSA sensitivity profile and choose therapy, accordingly, refer to ID	

			▪ Always consider risk factors for **gram-negative infections** (e.g., Sickle cell disease), **TB** and **Brucella**.

	1st Line	Alternative	Notes
Osteomyelitis, Chronic	Plan treatment based on known microbiology results, prior antibiotic therapy history and discussion with ID.		▪ Review all previous microbiology results, especially from bone/joint fluid cultures and cultures of swabs from associated wounds ▪ Review prior antibiotic therapy history ▪ **ALWAYS** obtain bone biopsy for gram stain, AFB, and culture unless impossible ▪ ID consult is strongly recommended ▪ Always consider risk factors for **gram-negative infections** (e.g., Sickle cell disease), **TB** and **Brucella**.
Disciitis Paraspinal **abscessPsoas** **abscess** MRSA positive	**Flucloxacillin** 1-2g iv q4h **OR** **Cefazolin** 1-2g iv q8h (Discuss oral switch options with ID Team as soon as clinically appropriate)	**Clindamycin 600mg** iv q8h or q6h (Discuss oral switch options with ID Team as soon as clinically appropriate)	▪ **≥6-8 weeks in total** (including oral treatment phase) ▪ Always aim to send joint aspirate/bone tissue/joint aspirate for urgent gram film andculture ▪ Take two sets of blood cultures before commencing antibiotic therapy ▪ ALWAYS aim for a confirmed microbiological diagnosis unless the patient is systemically unwell or at risk of neurological complications ▪ Review any previous antimicrobial therapy ▪ Review previous microbiology results ▪ Review treatment if failing to respond to therapy ▪ ID consult is strongly recommended ▪ Always consider risk factors for **gram-negative infections** (e.g., Sickle cell disease), **TB** and **Brucella**. ▪ Review antimicrobial therapy as soon as further results are available
	Vancomycin iv (see Vancomycin dosing GL) (Discuss oral switch options with ID Team as soon as clinically appropriate)	**Co-trimoxazole** (Septrin, Bactrim) 5-10mg/kg of trimethoprim per day in 2-4 divided doses iv (Discuss oral switch options with ID Team as soon as clinically appropriate)	

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10. Garau J et al. Management of methicillin-resistant Staphylococcus aureus infections. Clinical Microbiology & Infection 2009; 15:125-36

CARDIOVASCULAR SYSTEM (CVS) INFECTIONS

	1st Line	Alternative	Duration and Comments
Vascular graft associated infection	▪ Take ≥3 sets of blood cultures under strict aseptic technique, 30 minutes apart with ≥10 ml of blood per bottle. ▪ Blood cultures are usually positive. Antibiotic therapy should be directed accordingly. ▪ Consider early radio-labelled imaging. ▪ Refer to vascular surgery. ▪ Empiric therapy will depend on multiple factors. Refer to ID.		
Infective endocarditis prophylaxis	▪ There have been major changes in the recommendations for IE prophylaxis. ▪ **<u>Antibiotic prophylaxis in ONLY indicated if both of the following conditions are fulfilled:</u>** i. The patient has one or more of the following predisposing conditions: a) Prosthetic cardiac valve or prosthetic material used for cardiac valve repair b) Previous IE c) One of the following congenital heart diseases d) Unrepaired cyanotic CHD e) Repaired CHD with prosthetic material or device (only for first 6 months after procedure) f) Repaired CHD with residual defect at site or adjacent to site of a prosthetic patch or device g) Cardiac transplantation recipients who develop valvulopathy ii. The patient is about to undergo a high-risk dental procedure (i.e.; those that involve manipulation of gingival tissue or the periapical region of teeth orperforation of the oral mucosa) ▪ Antibiotic prophylaxis is **NOT** indicated for any other cardiac conditions or procedures.		
If antibiotic prophylaxis for IE is indicated:	**Amoxicillin** 2g po single dose 30-60 minutes before procedure **<u>OR</u>** **Cefazolin** 1g iv or im single dose 30-60 minutes before procedure	**Clindamycin** 600mg po or iv single dose 30-60 minutes before procedure **<u>OR</u>** **Azithromycin** 500mg po single dose 30-60 minutes before procedure	

<table>
<tr><th></th><th>1st Line</th><th>Alternative</th><th>Duration and Comments</th></tr>
<tr><td>Infective endocarditis (IE)</td><td colspan="3">

As soon as IE is suspected, arrange the following:

Take baseline CBC, clotting, U&Es, LFT and CRP
Blood cultures: Take ≥3 sets using strict aseptic technique, 30 minutes apart with ≥10 ml of blood per bottle. Do not wait for fever. Write on thePathology Request Form that IE is suspected.
Refer to Cardiology and request urgent trans-thoracic echocardiography (TTE)
Refer to ID
If patient is unwell or acute IE is suspected, start empiric antibiotic therapy as per recommendations below. DO NOT give any antibiotics prior totaking at least 2 sets of blood cultures.

Review diagnosis once blood cultures and TTE results available. Apply Modified Duke’s Criteria to make the diagnosis (see below).
If blood cultures are positive, review empiric antibiotic therapy as per recommendations below.
If culture negative IE is suspected, take blood samples for serology (Brucella, Coxiella, Mycoplasma, Legionella and Bartonella) and ask Microbiology to extend blood culture incubation for Brucella.

</td></tr>
<tr><td rowspan="3">Empiric therapy

Native Valve
Early Prosthetic Valve (<12 months from surgery)</td><td colspan="2">See notes above, take BC before giving any antibiotics</td><td rowspan="3">Modified Duke’s Criteria for diagnosing IE:Definite IE:
2 major, or
1 major + 3 minor, or
5 minor
Possible:
1 major + 1 minor, or
3minor

Major criteria:
1. Blood culture with typical IE organism (or C. burnetii phase I IgG antibody titre > 1:800)
2. Echocardiogram evidence of IE</td></tr>
<tr><td>Augmentin 3g iv q6h
<u>Plus</u>
Gentamicin 1mg/kg iv q8h</td><td>Vancomycin iv (see Vancomycin dosing GL)
<u>Plus</u>
Gentamicin 1mg/kg iv q8h
<u>Plus</u>
Ciprofloxacin 400mg iv q12h</td></tr>
<tr><td>Vancomycin iv (see Vancomycin dosing GL)
<u>Plus</u>
Gentamicin 1mg/kg iv q8h
<u>Plus</u>
Rifampicin 450mg po q12h</td><td>Vancomycin iv (see Vancomycin dosing GL)
<u>Plus</u>
Gentamicin 1mg/kg iv q8h
<u>Plus</u>
Rifampicin 450mg po q12h</td></tr>
<tr><td>Late Prosthetic Valve
(≥12 months from surgery)</td><td></td><td></td><td></td></tr>
</table>

	Augmentin 3g iv q8h **Plus** **Gentamicin** 1mg/kg iv q8h	**Vancomycin** iv (see Vancomycin dosing GL) **Plus** **Gentamicin** 1mg/kg iv q8h **Plus** **Ciprofloxacin** 400mg iv q12h	**Minor criteria:** 1. Predisposition 2. Temperature >38°C 3. Immunological phenomena 4. Vascular phenomena 5. Microbiological evidence of non-typical IE organism

	1st Line	Alternative	Duration and Comments
Targeted Antimicrobial Therapy for Infective Endocarditis			
Streptococcus Viridans Group ***Strepotococcus bovis*** Fully susceptible strains; Penicillin MIC <0.12 mg/L	**Penicillin G** 2-3 mU iv q4h *(4 weeks)* **Or** **Ceftriaxone** 2g iv q24h *(4 weeks)*	**Vancomycin** iv (see Vancomycin dosing GL) *(4 weeks)*	▪ Treatment duration: **4 weeks** ▪ Repeat BC every 24-48 hours until negative
Relatively resistant strains: Penicillin MIC >0.5 mg/L	**Penicillin G** 4 mU iv q4h *(4 weeks)* **Plus** **Gentamicin** iv 3mg/kg q24h *(2 weeks)*	**Vancomycin** iv (see Vancomycin dosing GL) *(4 weeks)*	
B-hemolytic streptococci (Groups A, B, C & G)	**Penicillin G** 2-3 mU iv q4h *(4 weeks)* **Or** **Ceftriaxone** 2g iv q24h *(4 weeks)*	**Vancomycin** iv (see Vancomycin dosing GL) *(4 weeks)*	▪ Treatment duration: **4 weeks** ▪ Repeat BC every 24-48 hours until negative
Nutritionally variant Streptococci (*Abiotrophia defectiva*)	**Penicillin G** 3-4 mU iv q4h *(6 weeks)* **Plus** **Gentamicin** iv 3mg/kg q24h *(2 weeks)* **OR** **Ceftriaxone** 2g iv q24h *(6 weeks)* **Plus** **Gentamicin** iv 3mg/kg q24h *(2 weeks)*	**Vancomycin** iv (see Vancomycin dosing GL) *(6 weeks)* **Plus** **Gentamicin** iv 3mg/kg q24h *(2 weeks)*	▪ Treatment duration: **6 weeks** ▪ Repeat BC every 24-48 hours until negative
Streptococcus pneumonia Fully susceptible strains; Penicillin MIC ≤0.1 mg/L	**Penicillin G** 2-3 mU iv q4h *(4 weeks)* **OR** **Ceftriaxone** 2g iv q24h *(4 weeks)*	**Vancomycin** iv (see Vancomycin dosing GL) *(4 weeks)*	▪ **Do NOT** use Penicillin G if there is associated meningitis (use Ceftriaxone and/or Vancomycin) ▪ Treatment duration: **4 weeks** ▪ Repeat BC every 24-48 hours until negative
Relatively resistant strains: Penicillin MIC >1.0 mg/L	**Ceftriaxone** 2g iv q24h *(4 weeks)*	**Vancomycin** iv (see Vancomycin dosing GL) *(4 weeks)*	
Enterococcus species Ampicillin susceptible, no high-level Gentamicin resistance strains	**Ampicillin** 2g iv q4h *(4-6 weeks)* **Plus** **Gentamicin** 1mg/kg iv q8h *(4-6 weeks)*	**Vancomycin** iv (see Vancomycin dosing GL) *(6 weeks)* **Plus** **Gentamicin** 1mg/kg iv q8h *(6 weeks)*	▪ Repeat BC every 24-48 hours until negative ▪ PVE requires early evaluation for valve replacement

Ampicillin resistant, no high-level Gentamicin resistance strains	**Vancomycin** iv (see Vancomycin dosing GL) *(6 weeks)* **Plus** **Gentamicin** 1mg/kg iv q8h *(6 weeks)*	Discuss with ID	▪ Patients on long term Linezolid therapy require carefulmonitoring for thrombocytopenia and peripheral neuropathy
Ampicillin resistant, high level Gentamicin resistance strains	**Vancomycin** iv (see Vancomycin dosing GL) *(6 weeks)*		
Vancomycin resistant strains	**Linezolid** 600mg iv or po q12h *(≥8 weeks)*		

	1st Line	Alternative	Duration and Comments
Targeted Antimicrobial Therapy for Infective Endocarditis			
Staphylococcus aureus **(Methicillin sensitive - MSSA)** Native valve(s) Prosthetic valve(s)	**Flucloxacillin** 2g iv q4h *(6 weeks)* **Flucloxacillin** 2g iv q4h *(≥ 6 weeks)* **Plus** **Rifampicin** 450mg po or iv q12h *(≥ 6 weeks)* **Plus** **Gentamicin** 1mg/kg iv q8h *(2 weeks)*	**Vancomycin** iv (see Vancomycin dosing GL) *(6 weeks)* **Vancomycin** iv (see Vancomycin dosing GL) *(≥6 weeks)* **Plus** **Rifampicin** 450mg po or iv q12h *(≥ 6 weeks)* **Plus** **Gentamicin** 1mg/kg iv q8h *(2 weeks)*	▪ Treatment duration: **6 weeks** ▪ Repeat BC every 24-48 hours until negative ▪ PVE requires early evaluation for valve replacement
Staphylococcus aureus **(Methicillin resistant - MRSA)** Native valve(s) Prosthetic valve(s)	**Vancomycin** iv (see Vancomycin dosing GL) *(6 weeks)* **Vancomycin** iv (see Vancomycin dosing GL) *(≥6 weeks)* **Plus** **Rifampicin** 450mg po or iv q12h *(≥ 6 weeks)* **Plus** **Gentamicin** 1mg/kg iv q8h *(2 weeks)*	Discuss with ID Discuss with ID	
All other organisms (eg, Gram-negative bacilli, Brucella, fungi ...etc)	Refer to ID		▪ Repeat BC every 24-48 hours until negative ▪ Early evaluation for valve replacement is strongly recommended

References:

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3. Gould FK et al. Guidelines for the diagnosis and antibiotic treatment of endocarditis in adults: a report of the Working Party of the British Society for Antimicrobial Chemotherapy. JAC 2012;67: 269-89
4. Nishimura RA et al. American of College of Cardiology/American Heart Association 2008 Guideline Update on valvular heart disease: focused update on infective endocarditis. Circulation 2008;118: 887-96
5. National Institute for Health and Clinical Excellence (2008). Prophylaxis against infective endocarditis. CG64. London: National Institute for Health and Clinical Excellence (NICE).
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7. Liu C et al. Clinical Practice Guidelines by the Infectious Diseases Society of America for the Treatment of Methicillin-Resistant Staphylococcus aureus Infections in Adults and Children. ClinicalInfectious Diseases 2011: 52;1-38
8. Gemmell CG et al. Guidelines for the prophylaxis and treatment of methicillin-resistant Staphylococcus aureus (MRSA) infections in the UK. Journal of Antimicrobial Chemotherapy 2006; 57: 589-608
9. Garau J et al. Management of methicillin-resistant Staphylococcus aureus infections. Clinical Microbiology & Infection 2009; 15:125-36

10. **Microbiology:**

- Three to five blood cultures of at least 10 mL each should be drawn during the first 24–48 hours.

Native Valve	
Patient Group	**Therapy (dosing interval in hours) (weeks)**
Empiric therapy	▪ Vancomycin IV 15 mg/kg q12hr (2wks) **PLUS** ▪ Ceftriaxone IV/IM 2g q24h (2wks) **OR** ▪ Vancomycin IV 15 mg/kg q12hr (2wks) **PLUS** ▪ Gentamicin 3 mg/kg IV q24h (2wks) (If patient is not acutely ill and not in heart failure, the preference is to wait for blood culture results)
Streptococcus viridans (Penicillin MIC ≤ 0.12)	▪ Penicillin G IV 2-3 million Unit q4h (4wks) **OR** ▪ Penicillin G IV 2-3 million Unit q4h **PLUS** ▪ Gentamicin 3 mg/kg IV q24h (2wks) **In patients with non-immediate and non-severe penicillin allergy:** ▪ Ceftriaxone IV/IM 2g q24 hr (4wks) **OR** ▪ Ceftriaxone IV 2 g q24hr **PLUS** ▪ Gentamicin 3 mg/kg IV q8h (2wks) **In patients with immediate or severe penicillin allergy:** ▪ Vancomycin 15mg/kg q12h (4wks)
Streptococcus viridans (Penicillin MIC: 0.12 - <0.5)	▪ Penicillin G: IV 4 million Unit q4h (4wks) **PLUS** ▪ Gentamicin 3mg/kg q24h IV/IM (2wks) **In patients with non-immediate and non-severe penicillin allergy:** ▪ Ceftriaxone IV 2 g q24h (2wks) **PLUS** ▪ Gentamicin 3 mg/kg q24h IV/IM (2wks) **In patients with immediate or severe penicillin allergy:** ❖ Vancomycin 15mg/kg q12h (4wks)
Streptococcus viridans (Penicillin MIC > 0.12)	**If ceftriaxone-susceptible:** ❖ Ceftriaxone IV 2 g q24h (4wks)

	PLUS ❖ Gentamicin 3 mg/kg q24h IV/IM (4wks) **If ceftriaxone-resistant:** ❖ Vancomycin 15mg/kg q12h (4wks)
Staphylococcus Methicillin Sensitive	▪ Cloxacillin IV 2 g q4hr (6wks) **OR** ▪ Flucloxacillin IV 2g q4hr (6wks) **In patients with non-immediate and non-severe penicillin allergy:** ❖ Cefazolin IV 2 g q8hr (6wks) **In patients with immediate or severe penicillin allergy:** ❖ Vancomycin 15mg/kg q12h (6wks)
Staphylococcus Methicillin Resistant	▪ Vancomycin IV 15mg/kg q12hr (6wks)
Enterococcus— Penicillin Sensitive	▪ Ampicillin IV 2g q4h (4-6 wks) **PLUS** ▪ Gentamicin 1 mg/kg q8hr IV/IM (4-6 wks) **OR** ▪ Penicillin G IV 3-5 million Unit q4h (4-6wks) **PLUS** ▪ Gentamicin 1mg/kg q8hr IV/IM (4-6wks) **If CrCl<50mL/min:** ❖ Ampicillin IV 2g q4h (6wks) **PLUS** ❖ Ceftriaxone 2g q12hr IV (6wks)
Enterococcus— Penicillin Resistant Or Penicillin Allergy	▪ Vancomycin IV15mg/kg q12hr **PLUS** ▪ Gentamicin 1 mg/kg q8hr IV (6wks)
Gentamicin resistance (MIC > 500 µg/mL): (Penicillin sensitive)	▪ Ampicillin IV 2g q4h (6wks) **PLUS** ▪ Ceftriaxone 2g q12hr IV (6wks) **If Streptomycin-susceptible :** ❖ Ampicillin IV 2g q4hr **PLUS** ❖ Streptomycin 15 mg/kg IV q12hr (6wks)

	OR ❖ Penicillin-G IV 3-5 million-unit q4h (4-6 weeks) **PLUS** ❖ Streptomycin IV/IM 15 mg/kg q12hr (6 weeks)
Enterococcus penicillin, aminoglycoside, and vancomycin resistant	▪ Daptomycin 10-12mg/kg q24hr (>6wks) **OR** ▪ Linezolid IV 600 mg q12hr (>6wks)
HACEK Group	▪ Ceftriaxone IV 2g q24 h (4wks) **OR** ▪ Ampicillin IV 2g q4h (4wks) **OR** ▪ Ciprofloxacin IV 400 mg q12h (4wks) **OR** ▪ Ciprofloxacin PO 500mg q12h (4wks)

Prosthetic Valve	
Patient Group	**Therapy (dosing interval in hours) (weeks)**
Empiric therapy	▪ Vancomycin IV 15 mg/kg q12hr (6wks) **PLUS** ▪ Gentamicin IV 3 mg/kg q24hr (6wks) **PLUS** ▪ Rifampin 300 mg PO/IV q8h (6wk)
Streptococcus viridans (Penicillin MIC < 0.5)	▪ Penicillin G IV 4 million Unit q4 h (6wk) **PLUS** ▪ Gentamicin IV 3mg/kg q24hr (6wk) **In patients with non-immediate and non-severe penicillin allergy:** ▪ Ceftriaxone 2 g q24 h IV (6wk) **PLUS** ▪ Gentamicin IV 3mg/kg q24hr (6wk) **In patients with immediate or severe penicillin allergy:** ▪ Vancomycin 15mg/kg q12h (6wks)
Streptococcus viridans (Penicillin MIC: >0.5)	**If ceftriaxone-susceptible:** ▪ Ceftriaxone IV 2 g q24h (6wks) **PLUS** ▪ Gentamicin 3 mg/kg q24h IV/IM (6wks) **If ceftriaxone-resistant:** ▪ Vancomycin 15mg/kg q12h (6wks)
Staphylococcus Methicillin Sensitive	▪ Cloxacillin IV 2g q4hr (≥6wks) **PLUS** ▪ Gentamicin IV 1mg/kg q8h (2wks) **PLUS** ▪ Rifampin IV/PO 300mg q8h (≥6wks) **OR** ▪ Flucloxacillin IV 2g q4hr (≥6wks) **PLUS** ▪ Gentamicin IV 1mg/kg q8h (2wks) **PLUS** ▪ Rifampin IV/PO 300mg q8hr (≥6wks) **In patients with non-immediate or non-severe penicillin allergy:** ❖ Cefazolin IV 2g q8hr (≥6wks) **PLUS** ❖ Gentamicin 1mg/kg q8hr IV (2wks)

	PLUS ❖ Rifampin IV/PO 300mg q8hr (≥6wks) **In patients with immediate or severe penicillin allergy:** ❖ Vancomycin 15mg/kg q12h (≥6wks) **PLUS** ❖ Gentamicin 1mg/kg q8hr IV (2wks) **PLUS** ❖ Rifampin IV/PO 300mg q8hr (≥6wks)
Staphylococcus Methicillin Resistant	▪ Vancomycin 15mg/kg q12h (≥6wks) **PLUS** ▪ Gentamicin 1mg/kg q8hr IV (2wks) **PLUS** ▪ Rifampin IV/PO 300mg q8hr (≥6wks)
Enterococcus—Penicillin Sensitive	▪ Ampicillin IV 2g q4h (4-6 wks) **PLUS** ▪ Gentamicin 1 mg/kg q8hr IV (4-6 wks) **OR** ▪ Penicillin G: IV 3-5 million Unit q4h (4-6wks) **PLUS** ❖ Gentamicin 1mg/kg q8hr IV (4-6wks) **If CrCl<50mL/min:** ❖ Ampicillin IV 2g q4h (6wks) **PLUS** ❖ Ceftriaxone 2g q12hr IV (6wks)
Enterococcus—Penicillin Resistant Or Penicillin Allergy	▪ Vancomycin IV15mg/kg q12hr + Gentamicin 1mg/kg q8hr IV (6wks)
Gentamicin resistance (MIC > 500 µg/mL): (Penicillin sensitive)	▪ Ampicillin IV 2g q4h (6wks) **PLUS** ▪ Ceftriaxone 2g q12hr IV (6wks) **If Streptomycin-susceptible :** ❖ Ampicillin IV 2g q4hr **PLUS** ❖ Streptomycin 15 mg/kg IV q12hr (6wks) **OR** ❖ Penicillin-G IV 3-5 million-unit q4h (4-6 weeks)

	PLUS ❖ Streptomycin IV 15 mg/kg q12hr (6 weeks)
Enterococcus penicillin, aminoglycoside, and vancomycin resistant	▪ Daptomycin 10-12mg/kg q24hr (>6wks) **OR** ▪ Linezolid IV 600 mg q12hr (>6wks)
HACEK Group	▪ Ceftriaxone IV/IM 2g q24 h (6wks) ▪ Ampicillin IV 2g q4h (6wks) ▪ Ciprofloxacin IV 400 mg q12h (6wks) **OR** ▪ Ciprofloxacin PO 500mg q12h (6wks)
Endocarditis Prevention	**I.E prophylaxis** is indicated only for high-risk cardiac conditions such as: ▪ Prosthetic material used for cardiac valve repair ▪ A prior history of IE ▪ Unrepaired cyanotic congenital heart disease, including palliative shunts and conduits ▪ Completely repaired congenital heart defects with prosthetic material or device during the first six months after the procedure (whether placed by surgery or by catheter intervention). ▪ Repaired congenital heart disease with residual defects at the site or adjacent to site of the prosthetic device ▪ Cardiac "valvulopathy" in a transplanted heart. Valvulopathy is defined as documentation of substantial leaflet pathology and regurgitation. Routine dental cleaning or routine anaesthetic injections through non-infected tissue does not require antibiotic prophylaxis. **The risk of IE is highest for the following dental procedures hence prophylaxis is indicated:** ▪ Those involving manipulation of gingival tissue or The peri-apical region of the teeth **OR** ▪ Perforation of the oral mucosa, such as tooth extractions **OR** ▪ Drainage of a dental abscess **Prosthetic heart valves, including bioprosthetic and homograft valves** ▪ Amoxicillin 2 g PO one hour before procedure **OR** ▪ Ampicillin 2 g IM/IV 30 min before procedure **Penicillin allergy:**

	▪ Cefazolin 1g IV/IM 30 min before procedure

Table 1. Treatment Options for the Management of Endocarditis

Treatment Regimen	Indication	Line of therapy	Level of Evidence/Grade of Recommendation	Referenc
NATIVE VALVE				
Vancomycin + ceftriaxone	Empiric therapy	1st	-	KSA (2018
Vancomycin + gentamicin	Empiric therapy	1st	-	KSA (2018
Penicillin G	*Streptococcus viridans* (MIC ≤ 0.12)	1st	Class IIa Level of evidence B	KSA (2018 AHA (2015
Penicillin G + gentamicin	*Streptococcus viridans*	1st	Class IIa Level of evidence B	KSA (2018) AHA (2015)
	Relatively Penicillin-Resistant VGS and *S gallolyticus*	1st	Class IIa Level of evidence B	AHA (2015)
	Penicillin-sensitive enterococcus	1st	Class IIa Level of evidence B	KSA (2018) AHA (2015)
Ceftriaxone	Penicillin-sensitive *Streptococcus viridans* (MIC ≤ 0.12)	1st	Class IIa Level of evidence B	AHA (2015)
	Relatively Penicillin-Resistant VGS and *S gallolyticus*	2nd	Class IIa Level of evidence C	AHA (2015)
	HACEK group	1st	Class IIA Level of evidence B	KSA (2018) AHA (2015)
Ceftriaxone + gentamicin	*Streptococcus viridans* (MIC > 0.12) Ceftriaxone-sensitive	1st	Class IIa Level of evidence B	KSA (2018) AHA (2015)
Vancomycin	*Streptococcus viridans* (MIC > 0.12) Ceftriaxone-resistant	1st	Class IIa Level of evidence C	KSA (2018) AHA (2015)
	Methicillin-resistant *Staphylococcus aureus*	1st	Class I Level of evidence C	KSA (2018) AHA (2015)
	Methicillin-sensitive	2nd	Class IIa Level of evidence B	KSA (2018) AHA (2015)

	Staphylococcus aureus	(in case of allergy)		
	Relatively Penicillin-Resistant *S. gallolyticus*	2nd	Class IIa Level of evidence C	AHA (2015)
Vancomycin + gentamicin	Penicillin-sensitive enterococcus	2nd (in case of allergy)	Class IIa Level of evidence B	KSA (2018) AHA (2015)
	Penicillin-resistant enterococcus	1st	Class IIb Level of evidence C	KSA (2018) AHA (2015)
Cloxacillin	Methicillin-sensitive *Staphylococcus aureus*	1st	-	KSA (2018)
Flucloxacillin	Methicillin-sensitive *Staphylococcus aureus*	1st	-	KSA (2018)
Cefazolin	Methicillin-sensitive *Staphylococcus aureus*	1st 2nd	Class I Level of evidence B	AHA (2015) KSA (2018)
Ampicillin	Penicillin-sensitive *Streptococcus viridans* (MIC ≤ 0.12)	1st	Class IIa Level of evidence B	AHA (2015)
	HACEK group	1st	Class IIa Level of evidence B	KSA (2018) AHA (2015)
Ampicillin + gentamicin	Penicillin-sensitive enterococcus	1st	Class IIa Level of evidence B	KSA (2018) AHA (2015)
	Streptococcus viridans (MIC ≥ 0.5)	1st	Class IIa Level of evidence C	AHA (2015)
Ampicillin + ceftriaxone	Penicillin-resistant enterococcus	1st	Class IIa Level of evidence B	KSA (2018) AHA (2015)
	Penicillin-sensitive enterococcus	2nd	Class IIa Level of evidence B	KSA (2018) AHA (2015)
Daptomycin	Oxacillin-resistant staphylococcus	1st	Class IIb Level of evidence B	AHA (2015)
	Penicillin/ aminoglycoside/ vancomycin resistant enterococcus	1st	Class IIB Level of evidence C	KSA (2018) AHA (2015)
Linezolid	Penicillin/ aminoglycoside/ vancomycin resistant enterococcus	1st	Class IIB Level of evidence C	KSA (2018) AHA (2015)
Ciprofloxacin	HACEK group	1st	Class IIb Level of evidence C	KSA (2018) AHA (2015)
Amphotericin B	Fungal IE	1st	Class IIb Level of evidence C	AHA (2015)
Caspofungin	Fungal IE	Alternative agent	No level of evidence	ESC (2023)
Micafungin	Fungal IE	Alternative agent	No level of evidence	ESC (2023)
Anidulafungin	Fungal IE	Alternative agent	No level of evidence	ESC (2023)
PROSTHETIC VALVE				
Vancomycin + gentamicin + rifampin	Empiric therapy	1st	-	KSA (2018)
	Methicillin resistant staphylococcus (MRSA)	1st	Class I Level of evidence B	KSA (2018) AHA (2015)
Penicillin G + gentamicin	*Streptococcus viridans*	1st	Class IIa Level of evidence B	KSA (2018) AHA (2015)

	(MIC < 0.5)			
	Penicillin sensitive enterococcus	1st	-	KSA (2018)
Ceftriaxone + gentamicin	*Streptococcus viridans* (MIC < 0.5)	1st 2nd	Class IIa Level of evidence B	KSA (2018) AHA (2015)
	Streptococcus viridans (MIC > 0.5)	1st	-	KSA (2018)
Vancomycin	*Streptococcus viridans* (MIC < 0.5)	2nd	Class IIa Level of evidence C	KSA (2018) AHA (2015)
	Streptococcus viridans (MIC > 0.5)	1st	Class IIa Level of evidence C	KSA (2018) AHA (2015)
Cloxacillin + gentamicin + rifampin	Methicillin sensitive staphylococcus	1st	-	KSA (2018)
Flucloxacillin + gentamicin + rifampin	Methicillin sensitive staphylococcus	1st	-	KSA (2018)
Cefazolin + gentamicin + rifampin	Methicillin sensitive staphylococcus	2nd	-	KSA (2018)
Ampicillin + gentamicin	Penicillin sensitive enterococcus	1st	-	KSA (2018)
Ampicillin + ceftriaxone	Penicillin sensitive enterococcus	1st 2nd	Class IIa Level of evidence B	AHA (2015) KSA (2018)
Vancomycin + gentamicin	Penicillin resistant enterococcus	1st	Class IIb Level of evidence C	KSA (2018) AHA (2015)
	Penicillin sensitive enterococcus	2nd	Class IIa Level of evidence B	KSA (2018) AHA (2015)
Daptomycin	Penicillin/ aminoglycoside/ vancomycin resistant enterococcus	1st	Class IIb Level of evidence C	KSA (2018) AHA (2015)
Linezolid	Penicillin/ aminoglycoside/ vancomycin resistant enterococcus	1st	Class IIb Level of evidence C	KSA (2018) AHA (2015)
Penicillin	Penicillin susceptible *Streptococcus pneumonia*	1st	Class IIa Level of evidence C	AHA (2015)
	Streptococcus pyogenes	1st	Class IIa Level of evidence C	AHA (2015)
Cefazolin	Penicillin susceptible *Streptococcus pneumonia*	1st	Class IIa Level of evidence C	AHA (2015)
Ceftriaxone	Penicillin susceptible *Streptococcus pneumonia*	1st	Class IIa Level of evidence C	AHA (2015)
	Streptococcus pyogenes	1st	Class IIa Level of evidence C	AHA (2015)
	HACEK group	1st	Class IIa Level of evidence B	KSA (2018) AHA (2015)
Ampicillin	HACEK group	1st	Class IIa Level of evidence B	KSA (2018) AHA (2015)
Ciprofloxacin	HACEK group	1st	Class IIa Level of evidence C	KSA (2018) AHA (2015)
Amphotericin B	Fungal IE	1st	Class IIb Level of evidence C	AHA (2015)
Caspofungin	Fungal IE	Alternative agent	No level of evidence	ESC (2023)
Micafungin	Fungal IE	Alternative agent	No level of evidence	ESC (2023)
Anidulafungin	Fungal IE	Alternative agent	No level of evidence	ESC (2023)

Table 4. Recommended Therapy for Adults with Infective Endocarditis (Adapted from the 2015 American Heart Association Guidelines)

Causative Microorganism	Regimen	Duration (weeks)	Strength of Recommendation	Comment
NATIVE VALVE				
Highly Penicillin-Susceptible viridans group streptococci (VGS) and *Streptococcus gallolyticus* (*bovis*) (*S gallolyticus*) (MIC ≤0.12 µg/mL)	Aqueous crystalline penicillin G sodium 12–18 million U/24 h IV, continuously or in 4 or 6 equally divided doses	4	*Class IIa; Level of Evidence B*	Preferred in patients >65 y or patients with impairment of eighth cranial nerve function or renal function.
	OR			
	Ampicillin 2 g IV every 4 h is a reasonable alternative to penicillin if a penicillin shortage exists.			
	Ceftriaxone sodium 2 g/24 h IV/IM in 1 dose	4	*Class IIa; Level of Evidence B*	
	Aqueous crystalline penicillin G sodium 12–18 million U/24 h IV either continuously or in 6 equally divided doses	2	*Class IIa; Level of Evidence B*	A 2-week antibiotic regimen is not suitable for patients with confirmed cardiac or extracardiac abscesses or those with specific conditions such as severely reduced kidney function (CrCl <20 mL/min), impaired eighth cranial nerve function, or infections caused by *Abiotrophia*,
	OR			
	Ceftriaxone sodium 2 g/24 h IV or IM in 1 dose	2		
	PLUS			
	Gentamicin sulfate 3 mg/kg per 24 h IV or IM in 1 dose	2		

				Granulicatella, or *Gemella spp.* When administering gentamicin 3 times/day, it's important to adjust the dosage to achieve a peak serum concentration of 3–4 µg/mL and a trough serum concentration < 1 µg/mL. For single daily dosing, there are no established optimal drug concentration levels.
	Vancomycin hydrochloride 30 mg/kg per 24 h IV in 2 equally divided doses	4	*Class IIa; Level of Evidence B*	Vancomycin is reasonable only for patients who cannot tolerate penicillin or ceftriaxone. When using vancomycin, it's essential to tailor the dosage to achieve a trough concentration within the range of 10–15 µg/mL (*Class I; Level of Evidence C*).
Relatively Penicillin-Resistant VGS and *S gallolyticus* (*bovis*) (MIC >0.12–<0.5 µg/mL)	Aqueous crystalline penicillin G sodium 24 million U/24 h IV either continuously or in 4–6 equally divided doses PLUS	4	*Class IIa; Level of Evidence B*	It is reasonable to treat patients with IE caused penicillin-resistant (MIC ≥0.5 µg/mL) VGS strains with a combination of ampicillin or penicillin plus gentamicin as
	Gentamicin sulfate 3 mg/kg per 24 h IV or IM in 1 dose	2		done for enterococcal IE with infectious diseases consultation (*Class IIa; Level of Evidence C*). Ampicillin 2 g IV every 4 h is a reasonable alternative to penicillin if a penicillin shortage exists.
	Ceftriaxone sodium 2 g/24 h IV/IM in 1 dose	4	*Class IIb; Level of Evidence C*	Ceftriaxone is a reasonable alternative treatment option for VGS isolates susceptible to ceftriaxone.
	Vancomycin hydrochloride 30 mg/kg per 24 h IV in 2 equally divided doses	4	*Class IIa; Level of Evidence C*	Vancomycin therapy is reasonable only for patients who cannot tolerate penicillin or ceftriaxone.
***Abiotrophia defectiva* (*A. defectiva*) and *Granulicatella* Species and VGS With a Penicillin MIC ≥ 0.5 µg/mL**	Ampicillin 12 g/d in divided doses OR Penicillin 18–30 million U/D in divided doses or by continuous infusion PLUS Gentamicin 3 mg/kg/d in 2–3 divided doses	Consult ID	*Class IIa; Level of Evidence C*	Vancomycin is used for patients who cannot tolerate ampicillin or penicillin, (Class III; Level of Evidence C). Ceftriaxone plus gentamicin might be considered a reasonable alternative when VGS are susceptible to ceftriaxone (Class IIb; Level of Evidence C).
Staphylococci Oxacillin-susceptible	Nafcillin or oxacillin 12 g/24 h IV in 4–6 equally divided doses	6	*Class I; Level of Evidence C*	At least 6 weeks therapy for complicated IE (*Class I; Level of Evidence C*)

				For penicillin-allergic patients (not anaphylactoid): consider skin testing for oxacillin-susceptible staphylococci, and questionable history of immediate hypersensitivity to penicillin.
	Cefazolin 6 g/24 h IV in 3 equally divided doses	6	*Class I; Level of Evidence B*	Avoid cephalosporins in patients with anaphylactoid-hypersensitivity to β-lactams; use vancomycin in these cases.
Staphylococci Oxacillin-resistant	Vancomycin 30 mg/kg per 24 h IV in 2 equally divided doses	6	*Class I; Level of Evidence C*	Dose of vancomycin should be adjusted to achieve trough concentration of 10–20 µg/mL.
	Daptomycin ≥ 8 mg/kg/dose	6	*Class IIb; Level of Evidence B*	ID should be consulted for daptomycin dosing (*Class I; Level of Evidence C*).
Enterococci Susceptible to Penicillin and Gentamicin in Patients Who Can Tolerate β-Lactam Therapy	Ampicillin sodium 2 g IV every 4 h	4-6	*Class IIa; Level of Evidence B*	**If symptoms <3 months:** A 4-weeks course of therapy is recommended. **If symptoms >3 months:** A 6-weeks course of therapy is recommended. Recommended for patients with CrCl >50 mL/min.
	OR			
	Aqueous penicillin G sodium 18–30 million U/24 h IV either continuously or in 6 equally divided doses	4-6		
	PLUS			
	Gentamicin sulfate 3 mg/kg ideal body weight in 2–3 equally divided doses	4-6		Dose of gentamicin should be adjusted to achieve a peak serum concentration of 3 to 4 µg/mL and a trough concentration of <1 µg/mL.
	OR			
	Double β-lactam Ampicillin 2 g IV every 4 h	6		Recommended for patients with initial CrCl <50 mL/min or who develop CrCl <50 mL/min during therapy with gentamicin.
	PLUS			
	Ceftriaxone 2 g IV every 12 h	6		
Enterococci Susceptible to Penicillin and Resistant to Aminoglycosides or Streptomycin-Susceptible Gentamicin-Resistant in Patients Able to Tolerate β-Lactam Therapy	Double β-lactam Ampicillin 2 g IV every 4 h	6	*Class IIa; Level of Evidence B*	Double β-lactam therapy is reasonable for patients with normal or impaired renal function, abnormal cranial nerve VIII function, or if the laboratory is unable to provide rapid results of streptomycin serum concentration. For patients with symptoms of infection < 3 months, a 4-weeks course of therapy with the streptomycin-containing regimen is reasonable. If symptoms >3 months, or
	PLUS			
	Ceftriaxone 2 g IV every 12 h			
				lactam: regimen require a minimum of 6 weeks.
	Alternative for streptomycin susceptible/gentamicin resistant			
	Ampicillin sodium 2 g IV every 4h	4-6	*Class IIa; Level of Evidence B*	Only for patients with access to fast streptomycin serum concentrations. Patient with CrCl <50 mL/min or who develop CrCl <50 mL/min during treatment should be given a double-β-lactam regimen. A double- β -lactam regimen should also be used to treat patients with abnormal cranial nerve VIII function.
	OR			
	Aqueous penicillin G sodium 18–30 million U/24 h IV either continuously or in 6 equally divided doses			
	PLUS			
	Streptomycin sulfate 15 mg/kg ideal body weight per 24h IV or IM in 2 equally divided doses			
Enterococci Vancomycin- and Aminoglycoside-Susceptible Penicillin-Resistant	**Patients Unable to tolerate β-lactams**			
	Vancomycin 30 mg/kg per 24 h IV in 2 equally divided doses	6	*Class IIa; Level of Evidence B*	Dose of vancomycin should be adjusted to obtain a serum trough concentration of 10 to 20 µg/mL. Dose of gentamicin should be adjusted to obtain serum peak and trough concentrations of 3 to 4 and <1 µg/mL, respectively.
	PLUS			
	Gentamicin 3 mg/kg per 24 h IV or IM in 3 equally divided doses	6		
	Penicillin resistance; intrinsic or β-lactamase producer			

	Vancomycin 30 mg/kg per 24 h IV in 2 equally divided doses	6	*Class IIb; Level of Evidence C*	For β-lactamase–producing strain, and patients able to tolerate a β-lactam antibiotic, ampicillin-sulbactam (3 g/6 hour IV) plus aminoglycoside may be used.
	PLUS			
	Gentamicin 3 mg/kg per 24 h IV or IM in 3 equally divided doses	6		
Enterococci Resistant to Penicillin, Aminoglycosides, and Vancomycin	Linezolid 600 mg IV or orally every 12 h	>6	*Class IIb; Level of Evidence C*	Linezolid use can cause bone marrow suppression, neuropathy, and drug interactions. Patients with IE caused by these strains should be treated by a multidisciplinary team of specialists. Cardiac valve replacement may be necessary for cure.
	OR			
	Daptomycin 10–12 mg/kg per dose			
HACEK Microorganisms: *Haemophilus* species, *Aggregatibacter* species, *Cardiobacterium hominis*, *Eikenella corrodens*, and *Kingella* species	Ceftriaxone sodium 2 g/24 h IV or IM in 1 dose	4	*Class IIa; Level of Evidence B*	Preferred therapy: Cefotaxime or another 3rd or 4th generation cephalosporin may be used. Inform patients that IM injection of ceftriaxone is painful.
	OR			
	Ampicillin sodium 2 g IV every 4 h		*Class IIa; Level of Evidence B*	If the isolate's growth is sufficient to allow in vitro susceptibility results, ampicillin sodium may be considered an option.
	OR			
	Ciprofloxacin 1000 mg/24 h orally or 800 mg/24 h IV in 2 equally divided doses		*Class IIb; Level of Evidence C*	Fluoroquinolone therapy may be explored for patients who are unable to take cephalosporin and ampicillin therapy; levofloxacin or moxifloxacin may be replaced; fluoroquinolones are not generally indicated for patients < 18 years.
Non-HACEK Gram-Negative Bacilli				Cardiac surgery combined with prolonged courses of combined antibiotic therapy is reasonable for most patients with IE caused by non-HACEK Gram-negative aerobic bacilli, mainly *Pseudomonas aeruginosa* (*Class IIb; Level of Evidence B*). Combination antibiotic therapy for 6 weeks with a β-lactam (penicillins, cephalosporins, or carbapenems) and either an aminoglycoside or fluoroquinolone is effective
				(*Class IIa; Level of Evidence C*). Consult with an ID specialist (*Class I; Level of Evidence C*)
PROSTHETIC VALVE OR VALVULAR PROSTHETIC MATERIAL				
VGS and *Streptococcus gallolyticus* (*bovis*) Penicillin-susceptible (≤0.12 µg/mL)	Aqueous crystalline penicillin G sodium 24 million U/24 h IV either continuously or in 4–6 equally divided doses	6	*Class IIa; Level of Evidence B*	Penicillin or ceftriaxone combined with gentamicin has not showed higher cure rates compared to penicillin or ceftriaxone alone. Gentamicin should not be given to patients with CrCl <30 mL/min. Ampicillin 2 g IV every 4 h is a reasonable alternative to penicillin in case of penicillin shortage exists.
	OR			
	Ceftriaxone 2 g/24 h IV or IM in 1 dose	6		
	WITH or WITHOUT			
	Gentamicin sulfate 3 mg/kg per 24 h IV or IM in 1 dose	2		
	Vancomycin hydrochloride 30 mg/kg per 24 h IV in 2 equally divided doses	6	*Class IIa; Level of Evidence B*	Vancomycin is reasonable only for patients who cannot tolerate penicillin or ceftriaxone.
VGS and Streptococcus gallolyticus (bovis) Penicillin relatively or fully resistant strain (MIC >0.12 µg/mL)	Aqueous crystalline penicillin sodium 24 million U/24 h IV either continuously or in 4–6 equally divided doses	6	*Class IIa; Level of Evidence B*	Ampicillin 2 g IV every 4 h is a reasonable alternative to penicillin if a penicillin shortage exists.
	OR			
	Ceftriaxone 2 g/24 h IV/IM in 1 dose	6		

	PLUS			
	Gentamicin sulfate 3 mg/kg per 24 h IV/IM in 1 dose	6		
	Vancomycin hydrochloride 30 mg/kg per 24 h IV in 2 equally divided doses	6	*Class IIa; Level of Evidence B*	Vancomycin is reasonable only for patients who cannot tolerate penicillin or ceftriaxone.
***Streptococcus pneumoniae* (*S pneumoniae*) highly penicillin susceptible (uncommon)**	Penicillin	4	*Class IIa; Level of Evidence C*	6 weeks of therapy is reasonable for *S pneumoniae* PVE (*Class IIa; Level of Evidence C*). Vancomycin is reasonable only for patients who cannot tolerate β-lactam therapy. For the treatment of pneumococcal IE, consult an ID specialist.
	Cefazolin	4	*Class IIa; Level of Evidence C*	
	Ceftriaxone	4	*Class IIa; Level of Evidence C*	
***Streptococcus pneumoniae* with intermediate penicillin resistance (MIC >0.1–1.0 µg/mL) or high penicillin resistance (MIC ≥2.0 µg/mL) (uncommon)**				**In Penicillin-resistant IE without meningitis:** High-dose penicillin or a 3rd-generation cephalosporin is reasonable (*Class IIa; Level of Evidence C*). **In patients with IE and meningitis:** High doses of cefotaxime or ceftriaxone are reasonable (*Class IIa; Level of Evidence C*).

				If the isolate is resistant (MIC ≥2 µg/mL) to cefotaxime, then the addition of vancomycin and rifampin may be considered (*Class IIb; Level of Evidence C*). For the treatment of pneumococcal IE, consult an ID specialist (*Class I; Level of Evidence C*).
***Streptococcus pyogenes* (uncommon)**	Penicillin G	4-6	*Class IIa; Level of Evidence C*	Vancomycin is reasonable only for patients who are unable to tolerate a β-lactam antibiotic.
	Ceftriaxone	4-6	*Class IIa; Level of Evidence C*	
Group B, C, F and G Streptococcus (uncommon)	Penicillin G	4-6	*Class IIb; Level of Evidence C*	Consult an ID specialist to guide treatment (Class I; Level of Evidence C).
	OR			
	Ceftriaxone	4-6		
	PLUS			
	Gentamicin	2		
Staphylococci Oxacillin-susceptible	Nafcillin or oxacillin 12 g/24 h IV in 6 equally divided doses	≥6	*Class I; Level of Evidence B*	Vancomycin should be used in patients with immediate hypersensitivity reactions to β-lactam; cefazolin may be substituted for nafcillin or oxacillin in patients with non–immediate
	PLUS			
	Rifampin 900 mg per 24 h IV or orally in 3 equally divided doses	≥6		
	PLUS			
	Gentamicin 3 mg/kg per 24 h IV or IM in 2 or 3 equally divided doses	2		hypersensitivity reactions to penicillin.
Staphylococci Oxacillin-resistant strains	Vancomycin 30 mg/kg 24 h in 2 equally divided doses	≥6	*Class I; Level of Evidence B*	Vancomycin dose should be adjusted to a trough concentration of 10–20 µg/mL. If *Coagulase-Negative Staphylococci* (CoNS) are resistant to gentamicin, consider another aminoglycoside to which they are susceptible (*Class IIb, Level of Evidence C*). If CoNS are resistant to all aminoglycosides, consider a fluoroquinolone if the isolate is susceptible (*Class IIb, Level of Evidence C*). Carefully retest antibiotic susceptibility of organisms recovered from surgical specimens or blood of patients who have had a bacteriological (*Class I, Level of Evidence C*).
	PLUS			
	Rifampin 900 mg/24 h IV/PO in 3 equally divided doses	≥6		
	PLUS			
	Gentamicin 3 mg/kg per 24 h IV/IM in 2 or 3 equally divided doses	2		
Enterococci Susceptible to Penicillin and	Ampicillin sodium 2 g IV every 4 h	6	*Class IIa; Level of Evidence B*	
	OR			

Gentamicin in Patients Who Can Tolerate β-Lactam Therapy	Aqueous penicillin G sodium 18–30 million U/24 h IV either continuously or in 6 equally divided doses	6		
	PLUS			
	Gentamicin sulfate 3 mg/kg ideal body weight in 2–3 equally divided doses	6		
	OR			
	Double β-lactam Ampicillin 2 g IV every 4 h	6		Recommended for patients with initial CrCl <50 mL/min or who develop CrCl <50 mL/min during therapy with gentamicin.
	PLUS			
	Ceftriaxone 2 g IV every 12 h	6		
Enterococci Susceptible to Penicillin and Resistant to Aminoglycosides or Streptomycin-Susceptible Gentamicin-Resistant in Patients Able to Tolerate β-Lactam Therapy	Double β-lactam Ampicillin 2 g IV every 4 h	6	*Class IIa; Level of Evidence B*	Double β-lactam therapy is reasonable for patients with normal or impaired renal function, abnormal cranial nerve VIII function, or if the laboratory is unable to provide rapid results of streptomycin serum concentration.
	PLUS			
	Ceftriaxone 2 g IV every 12 h			
	Alternative for streptomycin susceptible/gentamicin resistant			
	Ampicillin sodium 2 g IV every 4h	4-6	*Class IIa; Level of Evidence B*	Only for patients with access to fast streptomycin serum concentrations.
	OR			
	Aqueous penicillin G sodium 18–30 million U/24 h IV either continuously or in 6 equally divided doses			Patient with CrCl <50 mL/min or who develop CrCl <50 mL/min during treatment should be given a double-β-lactam regimen. A double- β -lactam regimen should also be used to treat patients with abnormal cranial nerve VIII function.
	PLUS			
	Streptomycin sulfate 15 mg/kg ideal body weight per 24h IV or IM in 2 equally divided doses			
	Double β-lactam Ampicillin 2 g IV every 4 h			
Enterococci Vancomycin- and Aminoglycoside-Susceptible Penicillin-Resistant	**Unable to tolerate β-lactams**			
	Vancomycin 30 mg/kg per 24 h IV in 2 equally divided doses	6	*Class IIa; Level of Evidence B*	Dose of vancomycin should be adjusted to obtain a serum trough concentration of 10 to 20 µg/mL. Dose of gentamicin should be adjusted to obtain serum peak and trough concentrations of 3 to 4 and <1 µg/mL, respectively.
	PLUS			
	Gentamicin 3 mg/kg per 24 h IV or IM in 3 equally divided doses	6		
	Penicillin resistance; intrinsic or β-lactamase producer			
	Vancomycin 30 mg/kg per 24 h IV in 2 equally divided doses	6	*Class IIb; Level of Evidence C*	For β-lactamase–producing strain, and patients able to tolerate a β-lactam antibiotic, ampicillin-
	Aqueous penicillin G sodium 18–30 million U/24 h IV either continuously or in 6 equally divided doses			Patient with CrCl <50 mL/min or who develop CrCl <50 mL/min during treatment should be given a double-β-lactam regimen. A double- β -lactam regimen should also be used to treat patients with abnormal cranial nerve VIII function.
	PLUS			
	Streptomycin sulfate 15 mg/kg ideal body weight per 24h IV or IM in 2 equally divided doses			
	Double β-lactam Ampicillin 2 g IV every 4 h			
Enterococci Vancomycin- and Aminoglycoside-Susceptible Penicillin-Resistant	**Unable to tolerate β-lactams**			
	Vancomycin 30 mg/kg per 24 h IV in 2 equally divided doses	6	*Class IIa; Level of Evidence B*	Dose of vancomycin should be adjusted to obtain a serum trough concentration of 10 to 20 µg/mL. Dose of gentamicin should be adjusted to obtain serum peak and trough concentrations of 3 to 4 and <1 µg/mL, respectively.
	PLUS			
	Gentamicin 3 mg/kg per 24 h IV or IM in 3 equally divided doses	6		
	Penicillin resistance; intrinsic or β-lactamase producer			
	Vancomycin 30 mg/kg per 24 h IV in 2 equally divided doses	6	*Class IIb; Level of Evidence C*	For β-lactamase–producing strain, and patients able to tolerate a β-lactam antibiotic, ampicillin-
	PLUS			

				cephalosporin and ampicillin therapy; levofloxacin or moxifloxacin may be replaced; fluoroquinolones are not generally indicated for patients < 18 years.
Non-HACEK Gram-Negative Bacilli				Cardiac surgery combined with prolonged courses of combined antibiotic therapy is reasonable for most patients with IE caused by non-HACEK Gram-negative aerobic bacilli, mainly *Pseudomonas aeruginosa* (*Class IIb; Level of Evidence B*). Combination antibiotic therapy for 6 weeks with a β-lactam (penicillins, cephalosporins, or carbapenems) and either an aminoglycoside or fluoroquinolone is effective (*Class IIa; Level of Evidence C*). Consult with an ID specialist (*Class I; Level of Evidence C)*

Table 9. Recommendations for Antimicrobial Regimen for Pediatric Infective Endocarditis (Adapted from the 2015 American Heart Association Guidelines)

Streptococcal IE on Native Cardiac Valves	
A 4-week regimen of IV aqueous crystalline penicillin G (or ampicillin if penicillin G not available) has proven highly effective in cases of highly penicillin-susceptible streptococci IE. This approach is especially beneficial for pediatric patients who have impaired renal function, are concurrently taking nephrotoxic medications, or suffer from eighth cranial nerve impairment, avoiding the need for aminoglycoside-containing regimens.	*Class I; Level of Evidence B*
While the option of home-based treatment is becoming more frequent, it is a reasonable choice that requires careful selection of suitable candidates, considering family circumstances and the availability of home healthcare providers.	*Class IIa; Level of Evidence B*
IE cases attributed to *Abiotrophia, Granulicatella* species, or streptococci with a penicillin MIC > 0.5 μg per milliliter should be managed with the antibiotic regimen designated for enterococci. For children who cannot tolerate β-lactam antibiotics, vancomycin is an effective alternative. Current practice involves supplementing this with gentamicin for a 4-week treatment course.	*Class I; Level of Evidence C*
Considering the potential nephrotoxicity associated with multiple nephrotoxic antibiotics, it may be reasonable to monitor blood concentrations of vancomycin and gentamicin, as well as renal function, on a weekly basis.	*Class IIb; Level of Evidence C*
Streptococcal IE on Prosthetic Cardiac Valves or Other Prosthetic Material	
In the case of prosthetic penicillin-susceptible streptococcal IE, the treatment regimen extends for 6 weeks. This treatment includes penicillin, ampicillin, or ceftriaxone in combination with gentamicin during the initial 2 weeks of therapy. For infections caused by a strain with a penicillin MIC > 0.1 μg per milliliter or by *Abiotrophia* or *Granulicatella* species, it is recommended to use a combination therapy of penicillin, ampicillin, or ceftriaxone with gentamicin for 6 weeks.	*Class I; Level of Evidence C*
Enterococcal IE on Native Cardiac Valves or Prosthetic Material	
In cases of NVE caused by susceptible enterococcus strains, the recommended treatment involves a combination therapy of penicillin G or ampicillin with gentamicin, administered over 4 to 6	*Class I; Level of Evidence A [in adults]*

weeks. Extended treatment duration is recommended when prosthetic material is involved.	
The consensus among the experts in the writing group is that, as a standard of care, the management of patients with enterococcal IE should involve infectious disease specialists' consultation.	*Class I; Level of Evidence C*
Staphylococcal IE on Native Valves	
For methicillin-susceptible *S. aureus* IE involving a native valve or other native cardiac tissue, it is recommended to follow the current standard of care including an IV semisynthetic β-lactamase-resistant penicillin, such as nafcillin or oxacillin, for a minimum of 4 to 6 weeks, assuming an appropriate clinical and microbiological response to therapy.	*Class I; Level of Evidence A*
The addition of gentamicin during the initial 3 to 5 days of treatment for methicillin-susceptible S. aureus IE may be considered (based on extrapolation from experimental models). It is important to be aware that adding gentamicin increases the risk of potential renal and otic toxicity.	*Class IIb; Level of Evidence C*
It is recommended to treat methicillin-resistant staphylococcal IE with vancomycin for a minimum of 6 weeks except in cases where the organism is resistant to vancomycin. The use of gentamicin for the initial 3 to 5 days may also be useful.	*Class I; Level of Evidence B*
Patients with *S. aureus* IE should receive care in a medical facility equipped with cardiothoracic surgery capabilities and have access to infectious diseases consultation.	*Class I; Level of Evidence C*
As with other cases of IE, the possibility of outpatient therapy may be considered. This decision is individualized based on clinical progress, cardiovascular stability, the family's ability to adhere to prescribed treatment, and the availability of suitable infrastructure for outpatient monitoring.	*Class IIb; Level of Evidence C*
Staphylococcal IE on Prosthetic Material	
In cases of *S. aureus* PVE, valve replacement surgery may be considered for most, if not all, patients.	*Class IIb; Level of Evidence C*
Gram-Negative IE (Including HACEK Species)	
Therapy should be a 4-week course of ceftriaxone or another third-generation cephalosporin alone, or alternatively, ampicillin plus gentamicin.	*Class I; Level of Evidence C*

Table 12. Treatment of Fungal Endocarditis

	Initial therapy	Step-down
Candida Native valve endocarditis	A lipid formulation of amphotericin B (3 to 5 mg/kg IV daily) with or without flucytosine (25 mg/kg orally four times daily); OR High-dose echinocandin (caspofungin 150 mg IV daily, micafungin 150 mg IV daily, or anidulafungin 200 mg IV daily).	For patients who are clinically stable, have isolates that are susceptible to fluconazole, and have negative repeat blood cultures following initiation of a lipid formulation of amphotericin B or high-dose echinocandin therapy, transition to oral fluconazole 400 to 800 mg (6 to 12 mg/kg) daily is appropriate. Oral voriconazole 200 to 300 mg (3 to 4 mg/kg) twice daily or delayed-release posaconazole tablets 300 mg daily can be used for step-down therapy in clinically stable patients who have isolates susceptible to these agents but not susceptible to fluconazole.
Candida Prosthetic valve endocarditis	A lipid formulation of amphotericin B (3 to 5 mg/kg IV daily) with or without flucytosine (25 mg/kg orally four times daily); OR High-dose echinocandin (caspofungin 150 mg IV daily, micafungin 150 mg IV daily, or anidulafungin 200 mg IV daily).	For patients who are clinically stable, have isolates that are susceptible to fluconazole, and have negative repeat blood cultures following initiation of a lipid formulation of amphotericin B or high-dose echinocandin therapy, transition to oral fluconazole 400 to 800 mg (6 to 12 mg/kg) daily is appropriate. Oral voriconazole 200 to 300 mg (3 to 4 mg/kg) twice daily or delayed-release posaconazole tablets 300 mg daily can be used for step-down therapy in clinically stable patients who have isolates susceptible to

Table 16. Recommendations for Antibiotic Therapy of IE Due to Oral Streptococci and *Streptococcus gallolyticus* Group (Adapted from the 2023 European Society of Cardiology Guidelines)

Recommendations		Strength of Recommendation
Penicillin-susceptible oral streptococci and *Streptococcus gallolyticus* group		
Standard treatment: 4-week duration in NVE or 6-week duration in PVE		
• **In patients with IE due to oral streptococci and *S. gallolyticus* group, penicillin G, amoxicillin, or ceftriaxone are recommended for 4 (in NVE) or 6 weeks (in PVE), using the following doses:**		*Class I; Level of Evidence B*
Adult antibiotic dosage and route		
Penicillin G	12–18 million U/day IV either in 4–6 doses or continuously	
Amoxicillin	100–200 mg/kg/day IV in 4–6 doses	
Ceftriaxone	2 g/day IV in 1 dose	
Pediatric antibiotic dosage and route		
Penicillin G	200 000 U/kg/day IV in 4–6 divided doses	
Amoxicillin	100–200c mg/kg/day IV in 4–6 doses	
Ceftriaxone	100 mg/kg/day IV in 1 dose	
Standard treatment: 2-week duration (not applicable to PVE)		
• **2-week treatment with penicillin G, amoxicillin, ceftriaxone combined with gentamicin is recommended only for the treatment of non-complicated NVE due to oral streptococci and *S. gallolyticus* in patients with normal renal function using the following doses:**		*Class I; Level of Evidence B*
Adult antibiotic dosage and route		
Penicillin	G 12–18 million U/day IV either in 4–6 doses or continuously	
Amoxicillin	100–200 mg/kg/day IV in 4–6 doses	
Ceftriaxone	2 g/day IV in 1 dose	
Gentamicin	3 mg/kg/day IV or IM in 1 dose	
Pediatric antibiotic dosage and route		
Penicillin G	12–18 million U/day IV either in 4–6 doses or continuously	
Amoxicillin	100–200 mg/kg/day IV in 4–6 doses	
Ceftriaxone	100 mg/kg IV in 1 dose	
Gentamicin	3 mg/kg/day IV or IM in 1 dose or 3 equally divided doses	
Allergy to beta-lactams		
• **In patients allergic to beta-lactams and with IE due to oral streptococci and S. gallolyticus, vancomycin for 4 weeks in NVE or for 6 weeks in PVE is recommended using the following doses:**		*Class I; Level of Evidence B*
Adult antibiotic dosage and route		
Vancomycin	30 mg/kg/day IV in 2 doses	
Pediatric antibiotic dosage and route		
Vancomycin	30 mg/kg/day IV in 2 or 3 equally divided doses	
Oral streptococci and *Streptococcus gallolyticus* group susceptible, increased exposure or resistant to penicillin		
• **In patients with NVE due to oral streptococci and *S. gallolyticus*, penicillin G, amoxicillin, or ceftriaxone for 4 weeks in combination with gentamicin for 2 weeks is recommended using the following doses:**		*Class I; Level of Evidence B*
Adult antibiotic dosage and route		
Penicillin G	24 million U/day IV either in 4–6 doses or continuously	
Amoxicillin	2 g/day IV in 6 doses	

Ceftriaxone	2 g/day IV in 1 dose	
Gentamicin	3 mg/kg/day IV or IM in 1 dose	
• **In patients with PVE due to oral streptococci and *S. gallolyticus*, penicillin G, amoxicillin, or ceftriaxone for 6 weeks combined with gentamicin for 2 weeks is recommended using the following doses:**		*Class I; Level of Evidence B*
Adult antibiotic dosage and route		
Penicillin G	24 million U/day IV either in 4–6 doses or continuously	
Amoxicillin	2 g/day IV in 6 doses	
Ceftriaxone	2 g/day IV in 1 dose	
Gentamicin	3 mg/kg/day IV or IM in 1 dosed	
Allergy to beta-lactams		
• **In patients with NVE due to oral streptococci and *S. gallolyticus* and who are allergic to beta-lactams, vancomycin for 4 weeks is recommended using the following doses:**		*Class I; Level of Evidence C*
Adult antibiotic dosage and route		
Vancomycin	30 mg/kg/day IV in 2 doses	
Pediatric antibiotic dosage and route		
Vancomycin	30 mg/kg/day IV in 2 doses	
• **In patients with PVE due to oral streptococci and *S. gallolyticus* and who are allergic to beta-lactams, vancomycin for 6 weeks combined with gentamicin for 2 weeks is recommended using the following doses:**		*Class I; Level of Evidence C*
Adult antibiotic dosage and route		
Vancomycin	30 mg/kg/day IV in 2 doses	
Gentamicin	3 mg/kg/day IV or IM in 1 dose	

Table 17. Recommendations for Antibiotic Therapy of IE Due to *Staphylococcus spp.* (Adapted from the 2023 European Society of Cardiology Guidelines)

Recommendations		Strength of Recommendation
IE caused by methicillin-susceptible staphylococci		
• **In patients with NVE due to methicillin-susceptible staphylococci, (flu)cloxacillin or cefazolin is recommended for 4–6 weeks using the following doses**		*Class I; Level of Evidence B*
Adult antibiotic dosage and route		
(Flu)cloxacillin	12 g/day IV in 4–6 doses	
Cefazolin	6 g/day IV in 3 doses	
Pediatric antibiotic dosage and route		
(Flu)cloxacillin	200–300 mg/kg/day IV in 4–6 equally divided doses	
Cefazolin	6 g/day IV in 3 doses	
• **In patients with PVE due to methicillin-susceptible staphylococci, (flu)cloxacillin or cefazolin with rifampin for at least 6 weeks and gentamicin for 2 weeks is recommended using the following doses**		*Class I; Level of Evidence B*
Adult antibiotic dosage and route		

(Flu)cloxacillin	12 g/day IV in 4–6 doses	
Cefazolin	6 g/day IV in 3 doses	
Rifampin	900 mg/day IV or orally in 3 equally divided doses	
Gentamicin	3 mg/kg/day IV or IM in 1 (preferred) or 2 doses	
Pediatric antibiotic dosage and route		
(Flu)cloxacillin	200–300 mg/kg/day IV in 4–6 equally divided doses	
Cefazolin	6 g/day IV in 3 doses	
Rifampin	20 mg/kg/day IV or orally in 3 equally divided doses	
Gentamicin	3 mg/kg/day IV or IM in 1 (preferred) or 2 doses	
Allergy to beta-lactams		
• **In patients with NVE due to methicillin-susceptible staphylococci who are allergic to penicillin, cefazolin for 4–6 weeks is recommended using the following doses**		*Class I; Level of Evidence B*
Adult antibiotic dosage and route		
Cefazolin	6 g/day IV in 3 doses	
Pediatric antibiotic dosage and route		
Cefazolin	6 g/day IV in 3 doses	
• **In patients with PVE due to methicillin-susceptible staphylococci who are allergic to penicillin, cefazolin combined with rifampin for at least 6 weeks and gentamicin for 2 weeks is recommended using the following doses**		*Class I; Level of Evidence B*
Adult antibiotic dosage and route		
Cefazolin	6 g/day IV in 3 doses	
Rifampin	900 mg/day IV or orally in 3 equally divided doses	
Gentamicin	3 mg/kg/day IV or IM in 1 (preferred) or 2 doses	
Pediatric antibiotic dosage and route		

Cefazolin	6 g/day IV in 3 doses	
Rifampin	20 mg/kg/day IV or orally in 3 equally divided doses	
Gentamicin	3 mg/kg/day IV or IM in 1 (preferred) or 2 doses	
• **In patients with NVE due to methicillin-susceptible staphylococci who are allergic to penicillin, daptomycin combined with ceftaroline or fosfomycin may be considered.**		*Class IIb; Level of Evidence C*
Adult antibiotic dosage and route		
Daptomycin	10 mg/kg/day IV in 1 dose	
Ceftaroline OR Fosfomycin	1800 mg/day IV in 3 doses OR 8–12 g/day IV in 4 doses	
• **In patients with PVE due to methicillin-susceptible staphylococci who are allergic to penicillin, daptomycin combined with ceftaroline or fosfomycin or gentamicin with rifampin for at least 6 weeks and gentamicin for 2 weeks may be considered using the following doses:**		*Class IIb; Level of Evidence C*
Adult antibiotic dosage and route		
Daptomycin	10 mg/kg/day IV in 1 dose	
Ceftaroline OR Fosfomycin	1800 mg/day IV in 3 doses OR 8–12 g/day IV in 4 doses	
Rifampin	900 mg/day IV or orally in 3 equally divided doses	
Gentamicin	3 mg/kg/day IV or IM in 1 (preferred) or 2 doses	
IE caused by methicillin-resistant staphylococci		
• **In patients with NVE due to methicillin-resistant staphylococci, vancomycin is recommended for 4–6 weeks using the following doses**		*Class I; Level of Evidence B*
Adult antibiotic dosage and route		
Vancomycin	30–60 mg/kg/day IV in 2–3 doses	

• **In patients with PVE due to methicillin-resistant staphylococci, vancomycin with rifampin for at least 6 weeks and gentamicin for 2 weeks is recommended using the following doses:**		*Class I; Level of Evidence B*
Adult antibiotic dosage and route		
Vancomycin	30–60 mg/kg/day IV in 2–3 doses	
Rifampin	900–1200 mg/day IV or orally in 2 or 3 divided doses	
Gentamicin	3 mg/kg/day IV or IM in 1 (preferred) or 2 doses	
Pediatric antibiotic dosage and route		
Vancomycin	30 mg/kg/day IV in 2–3 equally divided doses	
Rifampin	20 mg/kg/day IV or orally in 2 or 3 divided doses	
Gentamicin	3 mg/kg/day IV or IM in 1 (preferred) or 2 doses	
• **In patients with NVE due to methicillin-resistant staphylococci, daptomycin combined with cloxacillin, ceftaroline or fosfomycin may be considered using the following doses:**		*Class IIb; Level of Evidence C*
Adult antibiotic dosage and route		
Daptomycin	10 mg/kg/day IV in 1 dose	
Cloxacillin OR Ceftaroline OR Fosfomycin	12 g/day IV in 6 doses OR 1800 mg/day IV in 3 doses OR 8–12 g/day IV in 4 doses	

Table 18. Recommendations for Antibiotic Therapy of IE due to Enterococcus spp. (Adapted from the 2023 European Society of Cardiology Guidelines)

Recommendations		Strength of Recommendation
Beta-lactam and gentamicin-susceptible strains		
• **In patients with NVE due to non- High-level aminoglycoside resistance (HLAR) *Enterococcus spp.*, the combination of ampicillin or amoxicillin with ceftriaxone for 6 weeks or with gentamicin for 2 weeks is recommended.**		*Class I; Level of Evidence B*
Adult antibiotic dosage and route		
Amoxicillin	200 mg/kg/day IV in 4–6 doses	
Ampicillin	12 g/day IV in 4–6 doses	
Ceftriaxone	4 g/day IV in 2 doses	
Gentamicin	3 mg/kg/day IV or IM in 1 dose	
Pediatric antibiotic dosage and route		
Ampicillin	300 mg/kg/day IV in 4–6 equally divided doses	
Ceftriaxone	100 mg/kg IV in 2 doses	
Gentamicin	3 mg/kg/day IV or IM in 3 equally divided doses	
• **In patients with PVE and patients with complicated NVE or >3 months of symptoms due to non-HLAR Enterococcus spp., the combination of ampicillin or amoxicillin with ceftriaxone for 6 weeks or with gentamicin for 2 weeks is recommended.**		*Class I; Level of Evidence B*

Adult antibiotic dosage and route		
Amoxicillin	200 mg/kg/day IV in 4–6 doses	
Ampicillin	12 g/day IV in 4–6 doses	
Ceftriaxone	4 g/day IV in 2 doses	
Gentamicin	3 mg/kg/day IV or IM in 1 dose	
Pediatric antibiotic dosage and route		
Ampicillin	300 mg/kg/day IV in 4–6 equally divided doses	
Amoxicillin	100–200 mg/kg/day IV in 4–6 doses	
Ceftriaxone	100 mg/kg/day IV in 2 doses	
Gentamicin	3 mg/kg/day IV or IM in 3 equally divided doses	
High-level aminoglycoside resistance		
• **In patients with NVE or PVE due to HLAR *Enterococcus spp.*, the combination of ampicillin or amoxicillin and ceftriaxone for 6 weeks is recommended.**		
Adult antibiotic dosage and route		
Ampicillin	12 g/day IV in 4–6 doses	
Amoxicillin	200 mg/kg/day IV in 4–6 doses	*Class I; Level of Evidence B*
Ceftriaxone	4 g/day IV or IM in 2 doses	
Pediatric antibiotic dosage and route		
Ampicillin	300 mg/kg/day IV in 4–6 equally divided doses	
Amoxicillin	100–200 mg/kg/day IV in 4–6 doses	
Ceftriaxone	100 mg/kg IV or IM in 2 doses	
Beta-lactam resistant *Enterococcus spp.* (*E. faecium*)		

• **In patients with IE due to beta-lactam resistant *Enterococcus spp.* (*E. faecium*), vancomycin for 6 weeks combined with gentamicin for 2 weeks is recommended.**		
Adult antibiotic dosage and route		
Vancomycin	30 mg/kg/day IV in 2 doses	*Class I; Level of Evidence C*
Gentamicin	3 mg/kg/day IV or IM in 1 dose	
Pediatric antibiotic dosage and route		
Vancomycin	30 mg/kg/day IV in 2–3 equally divided doses	
Gentamicin	3 mg/kg/day IV or IM in 1 dose	
Vancomycin-resistant *Enterococcus spp.*		
• **In patients with IE due to vancomycin-resistant Enterococcus spp., daptomycin combined with beta-lactams (ampicillin, ertapenem, or ceftaroline) or fosfomycin is recommended.**		
Adult antibiotic dosage and route		
Daptomycin	10–12 mg/kg/day IV in 1 dose	
Ampicillin	300 mg/kg/day IV in 4–6 equally divided doses	
Fosfomycin	12 g/day IV in 4 doses	
Ceftaroline	1800 mg/day IV in 3 doses	
Ertapenem	2 g/day IV or IM in 1 dose	*Class I; Level of Evidence C*
Pediatric antibiotic dosage and route		
Daptomycin	10–12 mg/kg/day IV in 1 dose (age-adjusted)	
Ampicillin	300 mg/kg/day IV in 4–6 equally divided doses	
Fosfomycin	2–3 g/day IV in 1 dose	
Ceftaroline	24–36 mg/kg/day in 3 doses	
Ertapenem	1 g/day IV or IM in 1 dose [if younger than 12 years, 15 mg/kg/dose (to a maximum of 500 mg) twice daily]	

Table 19. Initial Empirical Treatment of IE Before Pathogen Identification (Adapted from the 2023 European Society of Cardiology Guidelines)

Recommendations		Strength of Recommendation
In patients with community acquired NVE or late PVE (≥12 months post-surgery), ampicillin in combination with ceftriaxone or with (flu)cloxacillin and gentamicin should be considered using the following doses		*Class IIa; Level of Evidence C*
Adult antibiotic dosage and route		
Ampicillin	12 g/day IV in 4–6 doses	
Ceftriaxone	4 g/day IV or IM in 2 doses	
(Flu)cloxacillin	12 g/day IV in 4–6 doses	
Gentamicin	3 mg/kg/day IV or IM in 1 dose	
Pediatric antibiotic dosage and route		
Ampicillin	300 mg/kg/day IV in 4–6 equally divided doses	
Ceftriaxone	100 mg/kg IV or IM in 1 dose	
(Flu)cloxacillin	200–300 mg/kg/day IV in 4–6	
Gentamicin	3 mg/kg/day IV or IM in 3 equally divided doses	
In patients with early PVE (<12 months post-surgery) or nosocomial and non-nosocomial healthcare-associated IE, vancomycin or daptomycin combined with gentamicin and rifampin may be considered using the following doses:		*Class IIb; Level of Evidence C*
Adult antibiotic dosage and route		
Vancomycin	30 mg/kg/day IV in 2 doses	
Daptomycin	10 mg/kg/day IV in 1 dose	
Gentamicin	3 mg/kg/day IV or IM in 1 dose	
Rifampin	900–1200 mg IV or orally in 2 or 3 doses	

Pediatric antibiotic dosage and route		
Vancomycin	40 mg/kg/day IV in 2–3 equally divided doses	
Gentamicin	3 mg/kg/day IV or IM in 3 equally	
Rifampin	20 mg/kg/day IV or orally in 3 equally divided doses	
Allergy to beta-lactams		
In patients with community acquired NVE or late PVE (≥12 months post-surgery) who are allergic to penicillin, cefazolin, or vancomycin in combination with gentamicin may be considered using the following doses:		*Class IIb; Level of Evidence C*
Adult antibiotic dosage and route		
Cefazolin	6 g/day IV in 3 doses	
Vancomycin	30 mg/kg/day IV in 2 doses	
Gentamicin	3 mg/kg/day IV or IM in 1 dose	
Pediatric antibiotic dosage and route		
Cefazolin	6 g/day IV in 3 doses	
Vancomycin	40 mg/kg/day IV in 2–3 equally divided doses	
Gentamicin	3 mg/kg/day IV or IM in 3 equally divided doses	

Table 28. Recommendations of Antibiotic Prophylaxis for High-Risk Patients of Infective Endocarditis and Level of Evidence

Antibiotic prophylaxis	Situation	Class of recommendation	Level of evidence
Antibiotic prophylaxis is strongly recommended	• Dental and oral surgery: All invasive dental procedures causing bleeding and bacteremia (oral surgery such as tooth extraction, periodontal surgery, dental implant surgery, dental scaling, infected root canal treatment etc.) • Otolaryngologic field: Tonsillectomy and adenoidectomy • Cardiovascular field: Implantation of pacemaker and implantable cardioverter defibrillator	I	B
Antibiotic prophylaxis is preferable	• Invasive procedures for local infection foci: Abscess drainage and endoscopic examination and treatment for infection foci (including biliary obstruction) • Cardiovascular field: Implantation of prosthetic valve and other cardiovascular prostheses • Transurethral prostatectomy: Especially patients with prosthetic valve	IIa	C
Antibiotic prophylaxis can be performed. However, antibiotic prophylaxis is recommended for the patients with a history of IE	• Gastrointestinal field: Sclerotherapy for esophageal varices, dilatation of esophageal stenosis, mucosal biopsy or polypectomy by colonoscopy and proctoscopy, and biliary tract surgery • Urogenital/reproductive field: Urethral dilatation, vaginal delivery/vaginal hysterectomy, intrauterine curettage, therapeutic abortion/induced abortion, and insertion and removal of intrauterine devices • Cardiovascular field: Cardiac catheterization/percutaneous intravascular catheter intervention • Skin incision associated with surgery (especially in the patients with atopic dermatitis)	IIb	C
Antibiotic prophylaxis is not recommended	• Dental and oral surgery: Local anesthesia from uninfected site, orthodontic procedures, dental pulpectomy • Respiratory field: Bronchoscopy/ laryngoscopy, endotracheal intubation (transnasal/oral) • Otolaryngologic field: Tube insertion for tympanic perforation • Gastrointestinal field: Transesophageal echocardiography, gastrointestinal endoscopy (including biopsy) • Urogenital field: urethral catheterization and transurethral endoscopy (cystourethroscopy and pyeloureteroscopy) • Cardiovascular field: Central venous catheterization	III	B

IE, infective endocarditis.

CENTRAL NERVOUS SYSTEM (CNS) INFECTIONS

<table>
<tr><th></th><th>1st Line</th><th>Alternative*</th><th>Notes</th></tr>
<tr><td>Bacterial meningitis</td><td colspan="3">▪ Give Dexamethasone 0.15 mg/kg iv <u>10-20 minutes before commencing antibiotics</u> for suspected acute bacterial meningitis.
▪ Continue Dexamethasone 0.15 mg/kg iv q6h for 4 days <u>if any evidence to suggest Strep pneumoniae</u> (eg; CSF gram stain, CSF culture, CSF PCR, blood cultures, ..etc)
▪ <u>DO NOT</u> start Dexamethasone to patients who <u>have already received antibiotics.</u></td></tr>
<tr><td rowspan="4">Immune competent patients, aged <50 years

Immune competent patients, aged >50 years

Immune compromised patients

Post-neurosurgery and post-traumatic meningitis

CSF shunt infection</td><td>Ceftriaxone 2g iv q12h
<u>Plus</u>
Vancomycin iv (see Vancomycin dosing GL)</td><td>Chloramphenicol* 12.5-25mg/kg iv q6h
<u>Plus</u>
Vancomycin iv (see Vancomycin dosing GL)</td><td rowspan="4">▪ Start antimicrobial therapy as soon as the possibilityof bacterial becomes evident.

▪ Start with the appropriate empiric therapy and thenadjust choice and duration once microbiological cause is identified.

▪ All cases of CNS infection should be referred for ID consultation.

▪ *Only if history of <u>penicillin anaphylaxis</u> and <u>after discussion with ID Team</u></td></tr>
<tr><td>Ceftriaxone 2g iv q12h
<u>Plus</u>
Vancomycin iv (see Vancomycin dosing GL)
<u>Plus</u>
Ampicillin 2g iv q4h</td><td>Chloramphenicol* 12.5-25mg/kg iv q6h
<u>Plus</u>
Vancomycin iv (see Vancomycin dosing GL)
<u>Plus</u>
Co-trimoxazole (Septrin, Bactrim) 5mg/kg of trimethoprim iv q6h</td></tr>
<tr><td>Ceftriaxone 2g iv q12h
<u>Plus</u>
Vancomycin iv (see Vancomycin dosing GL)
<u>Plus</u>
Ampicillin 2g iv q4h</td><td>Vancomycin iv (see Vancomycin dosing GL)
<u>Plus</u>
Co-trimoxazole (Septrin, Bactrim) 5mg/kg of trimethoprim iv q6h
<u>Plus</u>
Ciprofloxacin 400mg iv q8h</td></tr>
<tr><td>Ceftazidime 2g iv q8h
<u>Plus</u>
Vancomycin iv (see Vancomycin dosing GL)</td><td>Vancomycin iv (see Vancomycin dosing GL)
<u>Plus</u>
Ciprofloxacin 400mg iv q8h</td></tr>
<tr><td colspan="2">▪ Check previous microbiology results including from other hospitals
▪ Empiric antimicrobial regimen should be discussed with ID Team
▪ Some patients might benefit from intra-thecal or intra-ventricular antimicrobial therapy; discuss with ID</td></tr>
</table>

Viral meningitis	Viral meningitis is usually a self-limiting illness and antiviral therapy is **not required** in the absence of clinical evidence of encephalitis (ie; confusion, reduced level of consciousness and/or focal signs)	▪ Consider LP unless contra-indicated ▪ Send throat swab and CSF for viral PCR

	1st Line	Alternative*	Notes
HSV encephalitis	**Acyclovir** 10mg/kg iv q8h (Calculate dose according to patient's ideal body weight)		▪ **14-21 days** ▪ Always consider brain imaging, EEG and LP (unless contra-indicated) ▪ Discuss as early as possible with ID Team
Encephalitis	▪ Acyclovir should be initiated in all patients with suspected encephalitis, pending results of diagnostic studies. ▪ Other empirical antimicrobial agents should be initiated on the basis of specific epidemiologic or clinical factors, including appropriate therapy for presumedbacterial meningitis, if clinically indicated. ▪ A detailed **travel history** and assessment of **risk factors for immune deficiency** are **mandatory**. ▪ ID and Neurology consultations are strongly recommended ▪ Infective causes of encephalitis include: ➢ Viruses (HSV, VZV, HIV, rabies, endemic flaviviruses such as West Nile & Al-Khumra, Influenza, Measles, CMV, JC virus. etc) ➢ Bacteria (eg; spirochetes, *Bartonella spp*, *Listeria monocytogenes*, Rickettsia, *Coxiella burnetii*, *Mycoplasma pneuomniae*, *Tropheryma whipplei* ...etc) ➢ Protozoa (eg; Malaria, *Toxoplasma gondii*, *Acanthamoeba spp*, ...etc) ➢ Parasites (eg; Cysticercosis) ➢ Fungi (eg; *Cryptococcus neoformans*)		
Brain abscess	**Vancomycin** iv (see Vancomycin dosing GL) **Plus** **Ceftriaxone** 2g iv q12h **Plus** **Metronidazole** 500mg iv q8h	**Vancomycin** iv (see Vancomycin dosing GL) **Plus** ***Ciprofloxacin** 400mg iv q8h **Plus** **Metronidazole** 500mg iv q8h	▪ Take detailed history including immune deficiency, surgical procedures, ENT infections, Intravenous drug use and travel history ▪ Assess risk for HIV and TB ▪ Take multiple blood cultures ▪ ID and Neurology consultations are strongly recommended ▪ *Only if history of penicillin anaphylaxis and after discussion with ID Team

References:

1. Tunkel AR et al. IDSA Practice Guidelines for the Management of Bacterial Meningitis. CID 2004; 39:1267-84.
2. National Institute for Health and Clinical Excellence (2010). The management of bacterial meningitis and meningococcal septicaemia in children and young people younger than 16 years inprimary and secondary care - CG102. London: National Institute for Health and Clinical Excellence (NICE).
3. Chaudhuri A et al. Bacterial Meningitis: European Federation of Neurological Societies (EFNS) Guideline on The Management of Community-Acquired Bacterial Meningitis: Report of an EFNSTask Force on Acute Bacterial Meningitis in Older Children and Adults: European Journal of Neurology 2008; 15:649-659
4. Heyderman RS et al. Early management of suspected bacterial meningitis and meningococcal septicaemia in adults. Journal of Infection 2001; 46:75-77
5. de Gans J et al. Dexamethasone in Adults with Bacterial Meningitis. New England Journal of Medicine 2002; 347:1549-1556
6. Tunkel AR et al. The Management of Encephalitis: Clinical Practice Guidelines by the Infectious Diseases Society of America. CID 2008; 47(3):303-327.
7. Steiner I et al. Viral encephalitis: a review of diagnostic methods and guidelines for management. European Journal of Neurology 2005; 12: 331-343
8. Madani TA. Alkhumra virus infection, a new viral hemorrhagic fever in Saudi Arabia. J Infect. 2005 Aug;51(2):91-7.

ORO-PHARYNX AND ENT INFECTIONS

	1st Line	Alternative	Notes
Oro-pharyngeal Thrush	**Nystatin** liquid 400,000 – 600,000 Units po q6h	**Fluconazole** 100-200mg po q24h	▪ **14 days** ▪ Always look for precipitating causes (eg; recent antibiotics, inhaled steroids, immune deficiency)
Recurrent or refractory oro-pharyngeal thrush	Discuss with ID Team		
Oesophageal candidiasis	**Fluconazole** 200-400mg po q24h	**Caspofungin** 70mg loading dose followed by 50mg iv q24h (continue 70mg iv 24 hourly if body weight >80kg)	
Acute bacterial tonsillo-pharyngitis	**Penicillin G** 2-3 million units iv q6h **OR** **Penicillin** V 500mg po q12h	**Clarithromycin** 500mg po or iv q12h	▪ **7-10 days** in total ▪ Send throat swab for culture ▪ Treat Streptococcus group A infection for ≥ 10 days ▪ Peritonsillar abscesses require drainage
Lemierre's Syndrome (*Fusobacterium necrophorum*) Suspected or confirmed	**Penicillin G** 2-3 million units iv q4h **Plus** **Metronidazole** 500mg iv q8h (Switch to oral therapy once clinically appropriate) **OR** **Augmentin** 1.2g iv q8 (Switch to oral therapy once clinically appropriate)	**Clindamycin** 600-900 mg iv q6h (Switch to oral therapy as once clinically appropriate)	▪ Treat for **2-6 weeks** in total ▪ **Urgent ENT and ID consultation** ▪ Start aggressive antibiotic therapy as soon as diagnosis issuspected ▪ Look for complications such empyema, mediastinitis, metastatic abscesses. etc
Acute sinusitis	**Cefuroxime** po 250-500mg po q12h **OR** **Augmentin** 1g po q12h	**Doxycycline** 100mg po q12h **OR** **Moxifloxacin** 400mg po q24h	**7 days**
Dental abscess	**Metronidazole** 500mg po q8h **Or** **Augmentin** 1g po q12h	**Clindamycin** 300mg po q6h or 450mg po q8h	**7 days**

Acute otitis media (adults)	**Amoxicillin** 500mg po q8h **OR** **Augmentin** 1g po q12h	**Clarithromycin** 500mg po q12h **OR** **Co-trimoxazole** 960mg po q12h	**7 days**
Otitis media with effusion	Antibiotics are not usually required		

	1st Line	Alternative	Notes
Otitis externa **Acute OE** **Chronic OE**	Topical acidifying agents/corticosteroids/antibiotics as per ENT advice Options: Chloramphenicol, Gentamicin topical, Otosporin		▪ **7-14 days** ▪ Ear cleaning (aural toilet) is the single most important aspectof treatment ▪ Topical antimicrobial therapy is highly effective for otitis externa
Malignant OE	**Tazocin** 4.5g iv q6h (Switch to oral alternative as soonas clinically appropriate)	**Ciprofloxacin** 500mg po q12h or 400mg iv q12h	▪ **10-14 days** ▪ MOE requires **urgent ENT referral** ▪ Review previous microbiology results and adjust initial antibiotic therapy if required (eg; add MRSA cover, antifungal ...etc) ▪ **ID consult** is strongly recommended

References:

1. Respiratory tract infections - Prescribing of antibiotics for self-limiting respiratory tract infections in adults and children in primary care (CG69). National Institute for Health and Clinical Excellence (NICE). July 2008
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3. Bisno AL et al. IDSA Practice Guidelines for the Diagnosis and Management of Group A Streptococcal Pharyngitis. Clinical Infectious Diseases 2002; 35:113–2
4. Clinical Practice Guidelines for the Management of Candidiasis: 2009 Update by the Infectious Diseases Society of America. Clinical Infectious Diseases 2009; 48:503–535
5. ESCMID diagnostic & management guideline for Candida diseases 2011. ECCMID, May 2011, Milan
6. Karkos PD et al. Lemierre's syndrome: A systematic review. Laryngoscope. 2009; 119:1552-9.
7. Hagelskjaer KL et al. Human necrobacillosis, with emphasis on Lemierre's syndrome. Clinical Infectious Diseases 2000; 31(2):524-32.
8. Hollis S, Evans K. Management of malignant (necrotising) otitis externa. Journal Laryngology and Otology. 2011; 125(12):1212-7.

<table>
<tr><th colspan="4">**Malaria** (therapy)</th></tr>
<tr><td>*Plasmodium falciparum*
Uncomplicated</td><td>Artescope
Day 1: Artesunate (50mg) 2-tab plus
Sulfadoxine-pyrimethamine (500mg/25mg) 1 tab
Day 2: Artesunate (50mg) 2-tab po
Day 3: Artesunate (50mg) 2-tab po</td><td>Quinine 600mg po q8h (5-7 days)
<u>Plus</u>
Doxycycline 200mg po q24h (7 days)
Or
Clindamycin 450mg po q8h (7 days)

<u>OR</u>
Malarone (Proguanil 100mg - Atovaquone 250mg) 4 tablets po q24h (3 days)</td><td rowspan="5">▪ Urgent malaria blood film / rapid diagnostic tests
▪ CBC, clotting screen, U&Es, LFT, glucose and CRP
▪ Blood cultures (≥2 sets, one hour apart)
▪ Refer all patients with confirmed malaria to ID
▪ Malaria in pregnancy is associated with a significant risk both the mother and the fetus.
▪ Artusunate, Artescope and Coartem are all contraindicated in the 1st trimester of pregnancy.
▪ Doxycycline is contraindicated throughoutpregnancy.</td></tr>
<tr><td>Complicated</td><td>Artesunate 2.4 mg/kg iv at 0h & 12h, followed by q24h for a total of 7 days (change to po alternative assoon as appropriate to do so)</td><td>Quinine 20mg/kg (max. 1.4g) iv loading dose over 4h, followed 8h later by 10mg/kg (max. 700mg) over 4h q8h for 7 days (change to po alternative as soon asappropriate to do so)
<u>Plus</u>
Doxycycline 200mg po q24h (7 days)
Or
Clindamycin 600mg iv or 450mg po q8h (7 days)</td></tr>
<tr><td>Pregnancy
(1st trimister)</td><td colspan="2">Quinine iv or po (as per dosing recommended above)
<u>Plus</u>
Clindamycin 450mg po or 600mg iv q8h (7 days)

Follow recommendations above for non-pregnant patients (apart from Doxycycline)</td></tr>
<tr><td>Pregnancy
(2nd & 3rd trimister)</td><td colspan="2"></td></tr>
<tr><td>Non- Plasmodium falciparum malaria</td><td colspan="2">Chloroquine as per the following schedule (each tablet contains 155mg chloroquine base):
0h: 4 tablets
6-8h: 2 tablets
24h: 2 tablets</td><td>▪ Screen all patients for glucose-6-phosphatedehydrogenase (G6PD) deficiency</td></tr>
</table>

	48h: 2 tablets **<u>For *P vivax*, followed by:</u>** **Primaquine** 30mg po q24h (14 days) For G6PD deficient patients, give Primaquine 0.75mg/kg (rounded down to the nearest 15mg) once weekly for 8 weeks **<u>For *P ovale*, followed by:</u>** **Primaquine** 15mg po q24h (14 days) For G6PD deficient patients, give Primaquine 0.75mg/kg (rounded down to the nearest 15mg) once weekly for 8 weeks	
Malaria prophylaxis	▪ Several options are recommended depending on age, destination, duration of travel, existing medical conditions, and long-term medications. ▪ Discuss with ID team for further advice	

	Recommended Therapy	Notes
Schistosomiasis	**Praziquantel** 20mg/kg po two doses within 4-6 hours of one another	▪ Schistosoma serology is not very helpful in patients from endemic areas ▪ Stool/urine microscopy provides definitive diagnosis ▪ Repeated courses of therapy are not usually required
Pinworms *(Entrobius vermicularis)*	**Mebendazole** 100mg single dose (repeat in 2 weeks)	▪ Strict handwashing is required after contact with patient, patient clothing for bedding . ▪ All bedding and clothing should be cleaned. ▪ The entire household should be treated simultaneously.
Roundworms *(Ascaris lumbricoides)*	**Mebendazole** 100mg po q12h (3 days)	▪ Treatment should normally be initiated based on positive microscopy results. ▪ Multiple stool samples (≥ 3 samples) may be required to make a positive diagnosis.
Tapeworms *(Tenia saginata and T solium)*	**Praziquantel** 5-10 mg/kg (single dose)	
Hookworms *(Ankylostoma duodenale & Necator americans)*	**Mebendazole** 100mg po q12h (3 days) **Or** **Albendazole** 400mg po q24h (single dose)	
Strongyloides stercoralis	**Albendazole** 400mg po q12h for 3 days	▪ Repeat treatment 3 weeks later if needed
Entamoeba histolytica		

(Amebiasis) **Colitis/dysentery** **Liver abscess**	**Metronidazole** 500-750mg po q8h (7-10 days) **Followed by:** **Diloxanide** 500mg po q8h (10 days) **Metronidazole** 500-750 mg iv q8h (10 days) **Followed by:** **Diloxanide** 500mg po q8h (10 days) **Or** **Tinidazole** 2g po q24h (5 days)	▪ Send a minimum of three stool samples for microscopic examination (ova& cysts) ▪ Serology is not helpful for patients from endemic areas ▪ Aspiration of amebic liver abscess is only required if: a) Large size and risk of rupture. b) Clinical deterioration or lack or response despite antimicrobial therapy.
Giardia lamblia (Giardiasis)	**Metronidazole** 500mg po q8h (5 days) **Or** **Tinidazole** 2g po (single dose)	▪ Treatment should normally be initiated based on positive microscopy results (stool, duodenal aspirate). ▪ Multiple stool samples (≥ 3 samples) may be required to make a positive diagnosis.

	Recommended Therapy	Notes
Hydatid disease (Human Echinococcosis)	▪ The diagnosis of HD is made based on a combination of clinical, radiological and serological evidence. ▪ Medical therapy is in the form of albendazole with or without praziquantel. ▪ Some patients may require percutaneous aspiration of the cysts, injection, or surgical removal. ▪ Refer all patients with suspected or confirmed Hydatid disease to both ID and Gastroenterology services. ▪ The treatment duration will depend on clinical response and whether additional intervention, e.g., surgery or aspiration, has taken place.	
Scabies	**Permethrin** 5% cream applied to the entire skin from chin down to toes, leave on for 8-14h and wash off. Repeat treatment again in 2-4 weeks	▪ Treat all household contacts simultaneously
Lice (head/pubic)	**Permethrin** 1% lotion applied for 10 minutes to all hair. Repeat treatment in 9-10 days **Or** **Malathion** 0.5% lotion applied for 8-12 hours. Repeat treatment in 7-10 days	▪ Consider treating all household contacts if more than one person in the family is affected.
Imported Fever	▪ Take detailed history included countries visited, dates, onset of symptoms, immunization history, malaria prophylaxis, sexual contacts and past medical history ▪ Urgent malaria blood film, blood cultures (at least two sets taken one hour apart), stool cultures and urine cultures ▪ CBC, clotting screen, U&Es, LFT, glucose, CRP, Chest x-ray	

	▪ **Discuss with ID Team**

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PELVIC AND GENITAL INFECTIONS

	1st Line	Alternative	Notes
Pelvic inflammatory disease (PID)			
Mild to moderate PID	**Ceftriaxone** 250-500 mg IM (single dose) **PLUS** **Doxycycline** 100mg po q12h **PLUS** **Metronidazole** 500mg po q12h	**Moxifloxacin** 400mg po q24h **PLUS** **Metronidazole** 500mg po q12h	▪ Total duration of **14 days including both iv and po phases of therapy** ▪ Always test for other sexually acquired infections including HIV ▪ Always screen and treat sexual partners
Severe PID	**Ceftriaxone** 1g iv q24h (until >24h of improvement) **PLUS** **Doxycycline** 100mg po q12h **PLUS** **Metronidazole** 500mg iv q8h (Switch to oral therapy once clinically appropriate)	**Moxifloxacin** 400mg iv q24h **PLUS** **Metronidazole** 500mg iv q8h for 14 days (Switch to oral therapy once clinically appropriate)	
Bacterial vaginosis	**Metronidazole** 500mg po q12h for 7 days **OR** **Metronidazole** 2g po single dose	**Clindamycin** 300mg po q12h for 7 days **OR** **Clindamycin** cream 2%, one full applicator (5 g) intravaginally at bedtime for 7 days	▪ Antibiotic therapy is usually only indicated for symptomatic women or those undergoing some surgical procedure
Trichomonas vaginalis	**Metronidazole** 500mg po q12h for 5-7 days **OR** **Metronidazole** 2g po (single dose)	**Tinidazole** 2g po (single dose)	▪ Always screen and treat sexual partners ▪ Always test for other sexually acquired infections including HIV
Bartholine abscess	Pain relief and drainage are most important Antibiotics are only indicated for women with evidence of systemic infection (eg; fever) or at risk of sexually acquired infection		
Vulvovaginal candidiasis	**Clotrimazole pessary** 500mg (single dose)	**Fluconazole** 150mg po (single dose)	▪ Seek further advice for patients with recurrent or refractory infections

Genital chlamydia trachomatis	**Doxycycline** 100mg po q12h for 7 days **or** **Azithromycin** 1g po (single dose)	**Moxifloxacin** 400mg po q24h for 7 days	▪ Always screen and treat sexual partners ▪ Always test for other sexually acquired infections including HIV screen
Gonorrhea (genital)	**Ceftriaxone** 250-500mg IM (single dose) **Plus** **Azithromycin** 1g po (single dose)	**Ciprofloxacin** 500mg po (single dose) **Plus** **Azithromycin** 1g po (single dose)	▪ Always screen and treat sexual partners ▪ Always test for other sexually acquired infections including HIV

	1st Line	Alternative	Notes
Disseminated gonococcal infection	**Ceftriaxone** 1g iv q24h (Switch to oral therapy once clinically appropriate) **Plus** **Azithromycin** 1g po single dose	**Ciprofloxacin** 400mg iv q12h or 500mg po q12h **Plus** **Azithromycin** 1g po (single dose)	▪ **≥7 days** ▪ Always screen and treat sexual partners ▪ Always test for other sexually acquired infections including HIV
Gonococcal conjunctivitis or pharyngitis	**Ceftriaxone** 1g iv q24h (Switch to oral therapy once clinically appropriate) **Plus** **Azithromycin** 1g po (single dose)	**Ciprofloxacin** 400mg iv q12h or 500mg po q12h **Plus** **Azithromycin** 1g po (single dose)	▪ **≥3 days** ▪ Always screen and treat sexual partners ▪ Always test for other sexually acquired infections including HIV
Genital herpes simplex **Primary infection**	**Valaciclovir** 500mg po q12h **OR** **Acyclovir** 400mg po q8h		▪ **5-7 days** ▪ Oral antiviral drugs are indicated within 5 days of the start of the episode and while new lesions are still forming. ▪ Always screen and treat sexual partners ▪ Always test for other sexually acquired infections including HIV
Recurrent infection	Recurrences are self-limiting and generally cause minor symptoms.Treatment strategies include: a) Supportive therapy only b) Episodic antiviral treatments (eg; Acyclovir 400mg po q8h or Valaciclovir 500mg po q12h for 3-5 days) c) Suppressive antiviral therapy (limited to patients with ≥6 episodes per year, requires O&G or ID approval, prolonged courses of Acyclovir 400mg po q12h or Valaciclovir 500mg po q24h)		

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8. British Association for Sexual Health & HIV (BASHH) National Guideline for the Management of Genital Herpes (2007). http://www.bashh.org/guidelines

RESPIRATORY TRACT INFECTIONS

	1st Line	Alternative	Notes
Influenza			
Therapy for active disease	**Oseltamivir** (Tamiflu) 75 mg po q12h (5 days) **OR** **Zanamivir** (Relenza) 10mg via inhalation q12h (5 days) ▪ Send samples for respiratory pathogens panel ▪ Antiviral therapy is normally only indicated if Influenza is circulating in the community and the patient belongs to one of the risk groups ▪ It is not certain if patients presenting ≥48 hours of onset of symptoms are likely to benefit from anti-viral therapy. Such patients should be considered on a case-by-case basis. ▪ Add antibacterial therapy if there is evidence of secondary pneumonia or if the patient is severely ill. ▪ The following are associated with an increased risk of severe or complicated influenza: a) chronic lung diseases, b) significant cardiac disease, c) immune suppression, d) sickle cell anemia or other haemoglobinopathy, e) chronic renal failure, f) cancer, g) diabetes mellitus, h) neuromuscular disorders, seizure disorders, or cognitive dysfunction that may compromise the handling of respiratory secretions, i) age >65 years, j) residence in long-term care, and k) pregnancy (up to 2 weeks post-partum)		

Influenza prophylaxis (Timely Influenzaimmunization is by far themost effective Influenza prevention strategy)	**Oseltamivir** (Tamiflu) 75mg po q24h **OR** **Zanamivir** (Relenza) 10mg via inhalation q24h ▪ Influenza prophylaxis is indicated for the following: a) During sustained influenza circulation in the community, prophylaxis should be offered to individuals at high risk of complications who are not adequatelyprotected by vaccination. b) All household contacts if one or more person in the family develops influenza and any other family member is at increased risk of complications. All familymembers should receive Influenza vaccination as soon as possible. c) All residents of long-term care facilities when an influenza outbreak is detected or strongly suspected ▪ Prophylaxis should continue until 2 weeks after the administration of influenza vaccination ▪ Individuals for whom influenza vaccination is contra-indicated or who are severely immune compromised should continue prophylaxis until Influenza is no longercirculating in the community

	1st Line	Alternative	Notes
Non – consolidated LRTI including COPD exacerbations (No consolidation on CXR)	**Doxycycline** 200mg po (loading dose) followed by 100mg po q24h **OR** **Augmentin** 1g po q12h	**Azithromycin** 500mg po q24h	▪ **5 – 7 days** ▪ Always review previous microbiology results ▪ Discuss with ID Team if previous Pseudomonas or multi-resistant micro-organisms
Previous MRSA	**Doxycycline** 200mg po (loading dose) followed by 100mg po q24h	**Co-trimoxazole** (Septrin, Bactrim) 960mg po q12h	

<table>
<tr><td>Community acquired pneumonia
(Must have radiological or clinical evidence of consolidation)</td><td colspan="3">Always check and record CURB 65 score: one point each for:
a) Recent onset Confusion,
b) Urea>7,
c) Respiratory Rate > 30,
d) BP: systolic<90 or diastolic<60,
e) Age>65 years</td></tr>
<tr><td>Mild (CURB 65 ≤ 1)</td><td>Augmentin 1g po q12h</td><td>Doxycycline 100mg po 12 hourly</td><td rowspan="3">▪ Treat for a total of 5-7 days
▪ For severe pneumonia, send blood and sputum forculture, urine for Legionella antigen and blood forbaseline serology
▪ Discuss with ID Team if immune compromised, recent travel or previous multi-resistant micro-organisms
▪ Quinolones should be avoided unless TB is considered very unlikely</td></tr>
<tr><td>Moderate (CURB 65 = 2)</td><td>Augmentin 1.2g iv q8h or 1g po q12h
<u>PLUS</u>
Azithromycin 500mg iv or po q24h</td><td>Doxycycline 100mg po 12 hourly
<u>OR</u>
Azithromycin 500mg iv or po q24h</td></tr>
<tr><td>Severe (CURB ≥3)</td><td>Ceftriaxone 1-2g iv q24h
<u>PLUS</u>
Azithromycin 500mg iv or po q24h</td><td>Vancomycin (see vancomycin dosing GL)
<u>PLUS</u>
Azithromycin 500mg iv or po q24h</td></tr>
<tr><td>Healthcare associated pneumonia
(Residence in long-term care, recent broad-spectrum antibiotics, neutropenia)</td><td>Tazocin 4.5g iv q6h
<u>PLUS</u>
Azithromycin 500mg iv or po q24h</td><td>Moxifloxacin 400mg iv q24h
<u>PLUS</u>
Azithromycin 500mg iv or po q24h</td><td>▪ Treat for a total of 7-14 days
▪ Quinolones should be avoided unless TB is considered very unlikely</td></tr>
<tr><td>Hospital acquired pneumonia
(HAP)
Low risk</td><td>Ceftriaxone 1-2g iv q24h
or
Augmentin 1g po q12h or 1.2g iv q8h</td><td>Moxifloxacin 400mg po or iv q24h</td><td rowspan="2">▪ Treat for a total of 7-10 days
▪ Always review previous microbiology results
▪ Discuss with ID Team if known MRSA, Pseudomonas, or other multi-resistant micro-organisms.
▪ Quinolones should be avoided unless TB is considered very unlikely</td></tr>
<tr><td>High risk
(Recent antibiotics, > 5 days in hospital,long-term steroids, immune compromise)</td><td>Tazocin 4.5g iv q6h</td><td>Vancomycin (see vancomycin dosing GL)
<u>PLUS</u>
Moxifloxacin 400mg po or iv q24h</td></tr>
</table>

	1st Line	Alternative	Notes
Ventilator-associated pneumonia (VAP)	**Vancomycin** (see vancomycin dosing GL) **PLUS** **Tazocin** 4.5g iv q6h (Review therapy once culture resultsare available)	**Vancomycin** (see vancomycin dosing GL) **PLUS** **Amikacin** (see aminoglycoside dosing GL) (Review therapy once culture results areavailable)	▪ Treat for a total of **7-8 days** ▪ Obtain deep respiratory samples for culture prior tocommencing antibiotic therapy ▪ Always review previous microbiology results ▪ Discuss with ID Team if known MRSA, Pseudomonas, or other multi-resistant micro-organisms. ▪ Quinolones should be avoided unless TB is considered very unlikely
Aspiration pneumonia Mild to moderate	**Augmentin** 1.2g iv 8 hourly (Switch to oral therapy once clinically appropriate)	**Clindamycin** 600-900mg iv q8h (Switch to oral therapy once clinically appropriate)	▪ **7 days** ▪ Most early pulmonary changes are secondary tochemical pneumonitis ▪ Antibiotics are only indicated if there is clinical evidence of sepsis (fever, tachycardia, high WCC ...etc)
Severe	**Tazocin** 4.5g iv q6h (Switch to oral therapy once clinically appropriate)	**Clindamycin** 600-900mg iv q8h **PLUS** **Amikacin** (see aminoglycoside dosing GL)	

<table>
<tr><td>Empyema

Acute (post-pneumonia or primary empyema)

Chronic empyema

Post-thoracic surgery empyema</td><td>Augmentin 1.2g iv q8h or 1g po q12h
<u>OR</u>
Cefazolin 1-2g iv q8h
(Switch to oral therapy once clinically appropriate)</td><td>Clindamycin 600mg po or iv q8h
(Switch to oral therapy once clinically appropriate)

<u>OR</u>

Vancomycin iv (see vancomycin dosing GL)
<u>PLUS</u>
Metronidazole 500mg iv or po q8h
(Discuss oral switch options with ID Team as soon as clinically appropriate)</td><td>▪ 2-6 weeks
▪ All patients with a pleural effusion in association with sepsis or pneumonia require diagnostic pleural fluid sampling.
▪ Patients with frankly purulent or turbid/cloudy pleural fluid should have a chest drain inserted.
▪ Early Pulmonology consult is essential.
▪ ID consult is recommended if MRSA, Pseudomonas, or multi-resistant organisms.
▪ Where possible, antibiotics should be guided bybacterial culture results.
▪ Surgery should be considered if persistentempyema despite drainage and antibiotics.
▪ Always consider TB and take pleural biopsy for histology and mycobacterial cultures, if appropriate.</td></tr>
<tr><td></td><td colspan="3">▪ Early Pulmonology consult is essential.
▪ ID consult is recommended if MRSA, Pseudomonas, or multi-resistant organisms.
▪ Treatment should be guided by pleural fluid culture results, clinical history, and previous antibiotic therapy
▪ Surgery should be considered if persistent empyema despite drainage and antibiotics.
▪ Always consider TB and take pleural biopsy for histology and mycobacterial cultures, if appropriate.</td></tr>
</table>

References:

1. Antiviral Agents for the Treatment and Chemoprophylaxis of Influenza - Recommendations of the Advisory Committee on Immunization Practices (ACIP). MMWR Recommendations and Reports 2011:60(RR01);1-24
2. Harper et al. Seasonal Influenza in Adults and Children—Diagnosis, Treatment, Chemoprophylaxis, and Institutional Outbreak Management: Clinical Practice Guidelines of the Infectious Diseases Society of America. Clinical Infectious Diseases 2009; 48:1003–32
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SKIN AND SOFT TISSUE INFECTIONS

	1st Line	Alternative	Notes
Cellulitis Mild / moderate	**Flucloxacillin** 1g iv or po q6h **OR** **Cefazolin** 1-2g iv q8h	**Doxycycline** 100mg po q12h **OR** **Clindamycin** 300-450mg po q6h	▪ **Usually, 7-14 days** of antibiotic therapy ▪ Always review previous microbiology results ▪ Discuss with ID if known MRSA, Pseudomonas, or multi-resistant gram organisms or if the patient is failing to respondto therapy ▪ Patients with soft-tissue infection accompanied by signs andsymptoms of systemic toxicity (e.g., fever or hypothermia, tachycardia, hypotension) should have blood cultures taken ▪ **Necrotizing infections** require **urgent surgical debridement/decompression** ▪ Send tissue/aspirate/exudate for urgent gram film and culture ▪ Clues for potentially severe deep soft-tissue infection include: a) pain disproportionate to the physical findings, b) violaceous bullae, c) coetaneous hemorrhage, d) skin sloughing, e) skin anesthesia, f) rapid progression, and gas in the tissue
Mild / moderate and known MRSA colonization/infection	**Doxycycline** 100mg po q12h **OR** **Vancomycin** iv (see vancomycin dosing GL) (Switch to oral therapy as soon asclinically appropriate)	**Co-trimoxazole** 960mg po q12h or 5-10mg/kg TMP per day iv in 2-4 divided doses	
Severe	**Flucloxacillin** 1-2g iv 4 hourly **OR** **Cefazolin** 1-2g iv q8h (Switch to oral therapy as soon as clinically appropriate)	**Clindamycin** 600-900mg iv q8h **OR** **Vancomycin** iv (see vancomycin dosing GL) (switch to oral therapy as soon as clinically appropriate)	
Severe and known MRSA colonization/infection	**Vancomycin** iv (see vancomycin dosing GL) (Switch to oral therapy as soon asclinically appropriate)	**Co-trimoxazole** (Septrin, Bactrim) 5-10mg/kg of trimethoprim per day iv in 2-4 divided doses (Switch to oral therapy as soon as clinically appropriate)	
Necrotizing fasciitis	**Imipenem** 500mg-1g iv q8h or q6h **PLUS** **Clindamycin** 600-900mg iv q8h	**Linezolid** 600mg iv q12h **PLUS** **Metronidazole** 500mg iv q8h	

		PLUS **Amikacin** (see aminoglycoside dosing GL)	
Infected chronic ulcers	**Augmentin** 1g po q12h **OR** **Clindamycin** 300-450mg po q6h	**Doxycycline** 100mg po q12h **PLUS** **Metronidazole** 500mg po q8h	**Usually, 7-14 days** Always review previous microbiology results and modify treatment if required Discuss with ID if known MRSA, Pseudomonas, or multi-resistant gram organisms.

	1st Line	Alternative	Notes
Superficial skin abscess Known MRSA colonization/infection	**Flucloxacillin** 1g po or iv q6h **OR** **Cefazolin** 1-2g iv q8h	**Doxycycline** 100mg po q12h **OR** **Clindamycin** 300mg po q6h or 600mg iv q8h **OR** **Vancomycin** iv (see vancomycin dosing GL) (Switch to oral therapy as soon as clinically appropriate)	▪ **Usually, 5-7 days** ▪ Incision and drainage are if possible ▪ Antibiotics may not be required if adequately drained ▪ Send pus for microscopy and culture
	Doxycycline 100mg po q12h **OR** **Vancomycin** iv (see vancomycin dosing GL) (Switch to oral therapy as soon as clinically appropriate)	**Co-trimoxazole** 960mg po q12h or 5-10mg/kg TMP per day iv in 2-4 divided doses	

Perineal abscess Known MRSA colonization/infection	**Augmentin** 1g po q12h or 1.2g iv q8h **OR** **Cefazolin** 1-2g iv q8h **PLUS** **Metronidazole** 500mg po or iv q8h	**Doxycycline** 100mg po q12h **PLUS** **Metronidazole** 500mg po or iv q8h **OR** **Vancomycin** iv (see vancomycin dosing GL) **PLUS** **Metronidazole** 500mg po or iv q8h (switch to oral therapy as soon as clinically appropriate)	
	Doxycycline 100mg po q12h **PLUS** **Metronidazole** 500mg po or iv q8h	**Vancomycin** iv (see vancomycin dosing GL) **PLUS** **Metronidazole** 500mg po or iv q8h (Switch to oral therapy as soon as clinically appropriate)	
Surgical wound infection **Abdominal wound** **Other wounds:** No prosthesis in-situ	**Augmentin** 1g po q12h or 1.2g iv q8h **OR** **Cefazolin** 1-2g iv q8h **PLUS** **Metronidazole** 500mg po or iv q8h	**Clindamycin** 300mg po q6h or 600-900mg iv q8h **PLUS** **Ciprofloxacin** 500mg po q12h or 400mg iv q12h **OR** **Doxycycline** 100mg po q12h **PLUS** **Metronidazole** 500mg po or iv q8h	▪ **Usually, 7 days** ▪ Always review previous microbiology results ▪ Discuss with ID if known MRSA, Pseudomonas, or multi-resistant gram organisms.
	Flucloxacillin 1g po or iv q6h **OR** **Cefazolin** 1-2g iv q8h	**Doxycycline** 100mg po or iv q12h **OR** **Clindamycin** 300mg po q6h or 600-900mg iv q8h	

Known MRSA colonization/infection	**Vancomycin** iv (see vancomycin dosing GL) **OR** **Doxycycline** 100mg po q12hy (Switch to oral therapy as soon as clinically appropriate)	**Co-trimoxazole** 960mg po q12h or 5-10mg/kg TMP per day iv in 2-4 divided doses	

	1st Line	Alternative	Notes
Infected human or animal bite	**Augmentin** 1.2g iv q8h or 1g po q12h **OR** **Cefuroxime** 750mg to 1.5g iv q8h **PLUS** **Metronidazole** 500mg po or iv q8h (Switch to oral therapy as soon asclinically appropriate)	**Doxycycline** 100mg po q12h **PLUS** **Metronidazole** 500mg po or iv q8h	▪ Usually, **5-7 days** ▪ Discuss with ID if severe infection or failing to respond to therapy
Diabetic foot infection			▪ Usually, 7-14 days ▪ Always review previous microbiology results ▪ Discuss with ID if known Pseudomonas or multi-resistant organisms ▪ Diabetes consults strongly recommended ▪ Refer to ID if severe or limb-threatening infection
Mild to moderate	**Augmentin** 1.2g iv q8h or 1g po q12h **OR** **Cefazolin** 1-2g q8h **PLUS** **Metronidazole** 500mg po or iv q8h (Switch to oral therapy as soon asclinically appropriate)	**Doxycycline** 100mg po q12h **PLUS** **Metronidazole** 500mg po or iv q8h	
Known MRSA colonization/infection	**Doxycycline** 100mg po q12h **PLUS** **Metronidazole** 500mg po or iv q8h	**Vancomycin** iv (see vancomycin dosing GL) **PLUS** **Metronidazole** 500mg po or iv q8h (Switch to oral therapy as soon as clinically appropriate)	

Severe or limb threatening infection	**Tazocin** 4.5g iv q8h **PLUS** **Vancomycin** iv (see vancomycin dosing GL) (Switch to oral therapy as soon asclinically appropriate)	**Clindamycin** 600-900mg iv q8h **PLUS** **Metronidazole** 500mg iv q8h **PLUS** **Amikacin** (see aminoglycoside dosing GL) (Switch to oral therapy as soon as clinically appropriate)	

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1. Steven DL et al. IDSA Practice Guidelines for the Diagnosis and Management of Skin and Soft-Tissue Infection. Clinical Infectious Diseases 2005; 41:1373–406
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4. Gemmell CG et al. Guidelines for the prophylaxis and treatment of methicillin-resistant Staphylococcus aureus (MRSA) infections in the UK. Journal of Antimicrobial Chemotherapy 2006; 57(4): 589-608
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URINARY TRACT INFECTIONS

	1st Line	Alternative	Notes
Uncomplicated UTI	**Trimethoprim** 200mg po q12h **(5 days)** **OR** **Co-trimoxazole** 960mg po q12h **(3 days)** **OR** **Nitrofurantoin** 100mg po q6h **(5 days)**	**Cefuroxime** po 250-500mg po q12h **(7 days)** **OR** **Norfloxacin** 400mg po q12h **(3 days)**	▪ Always review previous microbiology results and modify treatment accordingly if needed. ▪ Discuss with ID if known Pseudomonas or multi-resistant organisms. ▪ Always take mid-stream urine sample for microscopy andculture prior to commencing antibiotic therapy. ▪ Review therapy once urine culture and sensitivity results areavailable.
Complicated UTI including pyelonephritis (e.g. upper UTI, systemic symptoms, abnormal urinarytract, diabetes etc)	**Augmentin** 1.2g iv 8 hourly or 1g po q12h **(10-14 days)** **OR** **Cefuroxime** 750mg iv q8h **(10-14 days)** **OR** **Ceftriaxone** 1-2g iv q24h **(10-14 days)** (Switch to oral therapy as soon as clinically appropriate)	**Ciprofloxacin** 500mg po q12h or 400mg iv q12h **(7 days)** **OR** **Co-trimoxazole** 960mg po q12h or 5-10mg/kg TMP per day iv in 2-4 divided doses **(14 days)**	
	Consider giving a single dose if Amikacin 15 mg/kg iv to severely ill patients, pending further microbiology results		
Catheter-related UTI Signs and symptoms compatible with CA-UTI include: ▪ fever, ▪ rigors, ▪ altered mental status, ▪ malaise, ▪ flank pain, ▪ costovertebral angletenderness, ▪ pelvic discomfort, and ▪ suprapubic pain or tenderness	**Cefuroxime** po 250-500mg po q12h **(7-10 days)** **OR** **Co-trimoxazole** 960mg po q12h **(7-10 days)**	**Ciprofloxacin** 500mg po q12h or 400mg iv q12h **(7 days)**	▪ In catheterized patients, pyuria is not diagnostic of UTI ▪ Do not treat unless there is clinical evidence of infection ▪ Always review previous microbiology results and modify treatment accordingly if needed. ▪ Discuss with ID if known Pseudomonas or multi-resistant organisms. ▪ Always take urine sample for microscopy and culture prior tocommencing antibiotic therapy. ▪ Indwelling catheters should be placed only when they areindicated and removed as soon as no longer needed. ▪ Indwelling urinary catheters should not be normally used forthe management of urinary incontinence. ▪ Catheter removal or exchange hastens resolution of symptoms ▪ Review therapy once urine culture and sensitivity results areavailable.
	Consider giving a single dose if Amikacin 15 mg/kg iv to severely ill patients, pending further microbiology results		

Recurrent UTI (prophylaxis)	Review old results, use monthly cycles of 2 or 3 antibiotics to which the predominanturinary isolates are sensitive **Trimethoprim** 100mg po q24h at night **Nitrofurantoin** 50-100mg po q24h at night **Co-trimoxazole** 480mg every other night	▪ Decision to put patient on long term antibiotic prophylaxis should only be made by experienced physicians/urologists orafter discussion with ID.

	1st Line	Alternative	Notes
Candida Asymptomatic candiduria	Treatment is only indicated if neutropenic or about to undergo an invasive urologic procedure **Fluconazole** 200mg po q24h for **7 days**		▪ Take blood cultures and treat as Candidemia if patient is unwell or immune deficient (see above) ▪ Remove or change urinary catheter, if possible
Symptomatic cystitis	**Fluconazole** 200mg po q24h for **14 days**	**Caspofungin** 70mg loading dose followed by 50mg iv q24h (continue 70mg iv 24 hourly if body weight over 80kg)	
Pyelonephritis	**Fluconazole** 200mg po or iv q24h for **14 days**	**Caspofungin** 70mg loading dose followed by 50mg iv q24h (continue 70mg iv 24 hourly if body weight over 80kg)	
Acute prostatitis	**Co-trimoxazole** 960mg po q12h or 5-10mg/kg TMP per day iv in 2-4 divided doses **OR** **Ceftriaxone** 1-2g iv q24h **PLUS** **Amikacin** (see aminoglycoside dosing GL) (Switch to oral therapy as soonas clinically appropriate)	**Ciprolfoxacin** 500mg po q12h or 400mg iv q12h	▪ **Total 28 days** ▪ Send MSU and blood cultures ▪ Prostate massage not recommended ▪ Early empiric treatment is highly recommended

Chronic prostatitis	**Trimethoprim** 200mg po q12h **OR** **Co-trimoxazole** 960mg po q12h **OR** **Doxycycline** 100mg po q12h	**Norfloxacin** 400mg po q12h **OR** **Ciprofloxacin** 500mg po q12h	▪ **Total 28 days** ▪ Send MSU and blood cultures ▪ Seek Urology advice as early as possible ▪ Review therapy as per culture results
Acute epididymo-orchitis	**Cefuroxime** po 250-500mg po q12h or 750mg iv q8h **OR** **Augmentin** 1.2g iv 8 hourly or 1g po q12h **If at risk of sexually acquired infections:** **Ceftriaxone** 1g iv q24h **PLUS** **Azithromycin** 1g po (single dose) TAKE 2 SETS OF BLOOD CULTURES AND BLOODFOR BRUCELLA SEROLOGY **PRIOR TO** ANY ANTIBIOTICS	**Ciprofloxacin** 500mg po q12h or 400mg iv q12h **(7 days)** **OR** **Co-trimoxazole** 960mg po q12h or 5-10mg/kg TMP per day iv in 2-4 divided doses TAKE 2 SETS OF BLOOD CULTURES AND BLOODFOR BRUCELLA SEROLOGY **PRIOR TO** ANY ANTIBIOTICS	▪ 10-14 days of antibiotic therapy ▪ Always consider **Brucellosis** and **TB** ▪ If at risk of brucella, take blood cultures and brucella serology **PRIOR** to any antibiotic therapy ▪ Look for any risk factors for sexually acquired infections and arrange appropriate tests if required

	1st Line	Alternative	Notes
Fournier's gangrene	**Imipenem** 500mg-1g iv q8h or q6h **PLUS** **Clindamycin** 600-900mg iv q8h (Switch to oral therapy as soonas clinically appropriate)	**Linezolid** 600mg iv q12h **PLUS** **Metronidazole** 500mg iv q8h **PLUS** **Amikacin** (see aminoglycoside dosing GL) (Switch to oral therapy as soon as clinically appropriate)	▪ **≥14 days** ▪ Early surgical drainage and debridement is usually essential ▪ Send tissue/aspirate/exudate for urgent gram film andculture ▪ ID consult strongly recommended
Scrotal cellulitis	**Augmentin** 1.2g iv q8h **OR** **Tazocin** 4.5g iv q8h (Switch to oral therapy as soonas clinically appropriate)	**Clindamycin** 300-450mg po q6h or 600-900mg iv q6h **PLUS** **Ciprofloxacin** 500mg po q12h or 400mg iv q8h	▪ Usually, **7-14 days** ▪ Always review previous microbiology results ▪ Discuss with ID if known Pseudomonas or multi-resistant organisms or if the patient is failing to respond to therapy
Known MRSA colonization/infection	**Vancomycin** iv (see vancomycin dosing GL) **PLUS** **Metronidazole** 500mg po or iv q8h **OR** **Doxycycline** 100mg po q12h **PLUS** **Metronidazole** 500mg po or iv q8h (switch to oral therapy as soonas clinically appropriate)	**Co-trimoxazole** 960mg po q12h or 5-10mg/kg TMP per day iv in 2-4 divided doses	

References:

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Miscellaneous:

	1st Line	Alternative	Notes
Brucellosis	**Outpatient Therapy:** **Streptomycin** 15mg/kg (max. 1 gram) IM q24h (14 days) **Plus** **Doxycycline** 100mg po q12h (6 weeks) **Inpatient Therapy:** **Gentamicin** iv (see aminoglycoside dosing GL) (14 days) **Plus** **Doxycycline** 100mg po q12h (6 weeks)	Discuss with ID Discuss with ID	▪ Refer all patients with suspected or confirmed brucellosisto ID ▪ Whenever Brucella infection is considered, take of 3 setsof blood cultures and brucella serology ▪ Do not give antibiotics **PRIOR** to blood cultures. ▪ Arrange imaging/biopsy investigations as appropriate forthe suspected anatomical site of infection. ▪ Always state on the Pathology Request Form if Brucella is suspected.
Tuberculosis	▪ Refer all patients with suspected or confirmed pulmonary TB to Pulmonologists. ▪ Refer all patients with suspected or confirmed extra-pulmonary TB to ID. ▪ Whenever pulmonary TB is considered, arrange isolation in a single negative-pressure room and send 3 sputum samples for ZN smear (sputum samples to be taken8 hours apart from one another). ▪ Empiric anti-TB therapy is indicated only in exceptional circumstances. Always refer to specialist for further advice. ▪ Adjuvant corticosteroid therapy is indicated only when there is evidence or high suspicion of CNS, pericardial or ureteral involvement. If indicated, corticosteroidsshould be started before the first dose of anti-TB therapy. ▪ Avoid antibiotic agents with activity against Mycobacteria (eg; quinolones, streptomycin, amikacin. etc) unless TB is considered unlikely. ▪ Arrange imaging/biopsy investigations as appropriate for the suspected anatomical site of infection. ▪ Always state on the Pathology Request Form if TB is suspected.		

References:

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3. Solís García del Pozo J & Solera J. Systematic review and meta-analysis of randomized clinical trials in the treatment of human brucellosis. PLoS One. 2012;7(2): e32090.
4. National Institute for Clinical Excellence and Health (2011). Clinical diagnosis and management of tuberculosis, and measures for its prevention and control Clinical guidelines, CG117. NICE, March 2011
5. Centers for Disease Control and Prevention. Treatment of Tuberculosis, American Thoracic Society, CDC, and Infectious Diseases Society of America. MMWR 2003;52(No. RR-11):1-80.
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VARICELLA-ZOSTER VIRUS (VZV) INFECTIONS

	Recommended Therapy	Notes
Chickenpox (Varicella) Uncomplicated, immunecompetent Immune compromised or complicated chickenpox (e.g. pneumonitis, hepatitis, encephalitis. etc)	Valacyclovir 1g q8h po for 7 days Or Acyclovir 800mg 5 times per day po for 5 days Acyclovir 10 mg/kg q8h iv for 7-10 days (May switch to oral valacyclovir 1g q8h to complete the course, once clinical improvement is noted and thecondition is stable)	▪ Refer all adult patients with suspected or confirmed chickenpox to ID ▪ Whenever varicella infection is considered, send skin scrapings from the base of the vesicle for VZV PCR or immune fluorescence (rub dry swab firmly against the base of the lesion and send to the laboratory in viral transport medium). ▪ The swab and viral transport medium should be requested from the Microbiology Department if oneis not available in the clinical area where the patient is being assessed. ▪ Early anti-viral therapy in immune competent adults with uncomplicated chickenpox may shortenduration of illness. ▪ Antiviral therapy should be started as soon as possible if chickenpox is suspected or confirmed in animmune compromised patient. ▪ Antiviral therapy should be started in all patients with complicated chickenpox (e.g., pneumonitis,encephalitis, varicella hepatitis ...etc)

Chickenpox in pregnancy Uncomplicated Complicated (e.g., pneumonitis,hepatitis.etc)	Acyclovir 800mg 5 times per day po for 5 days Or Valacyclovir 1g q8h po for 7 days Acyclovir 10 mg/kg q8h iv for 7-10 days	▪ Primary VZV infection (chickenpox) in pregnancy is associated with an increased risk of complications (e.g., pneumonitis, hepatitis ...etc) in the mother. ▪ The risk of congenital varicella syndrome is highest if maternal infection occurs during weeks 8-20 of pregnancy. ▪ Maternal chickenpox within 7 days before or after delivery can result in neonatal varicella, a condition with very high morbidity and mortality; neonatologists should be informed as soon as possible. ▪ Acyclovir safety in pregnancy has never been assessed in a randomized clinical study. However, data from animal studies and observational human studies do not suggest that acyclovir or valacyclovir use in pregnancy is associated with teratogenicity. ▪ Women should be informed of the potential risk and benefits of treatment with acyclovir for chickenpox in pregnancy. The discussion must be clearly document in the patient's clinical notes.
Exposure to VZV in pregnancy	▪ Pregnant women who report a history of significant exposure to a VZV need careful evaluation to assess their susceptibility to primary VZV infection. ▪ A positive history of prior chickenpox is accepted as evidence of VZV immunity. ▪ Pregnant women who cannot give a positive history of prior VZV infection must have their immunological status confirmed. A serum sample should be sentto the Microbiology Department for urgent testing for VZV IgG. A positive VZV IgG result confirms immunity. Patients with negative VZV IgG should be considered susceptible. ▪ Pregnant women who are confirmed susceptible to VZV and who present within 10 days of significant exposure to VZV should receive Varicella-zoster immunoglobulin as soon as possible. This should be arranged through Department of Obstetrics & Gynecology or ID.	

	Recommended Therapy	**Notes**
Shingles (Zoster) Immune competent patients'Immune compromised patients	Valacyclovir 1g q8h po for 7 days Valacyclovir 1g q8h po for 7-14 days Or Acyclovir 10 mg/kg q8h iv for 7-14 days	▪ Early antiviral treatment reduces the duration of the illness and may decrease the risk of post-herpeticneuralgia ▪ Immune compromised patient is at significant risk of severe zoster complications, includingsecondary dissemination and visceral involvement.

halmic shingles erOphthalmicus)	Acyclovir 10 mg/kg q8h iv for 7-14 days (may be switched to Valacyclovir 1g q8h po, once clinical improved is observed, to complete the treatment course)	▪ Ophthalmic involvement is a serious complication of shingles and re attention. ▪ Urgent referral to Ophthalmology is essential.

References:

1. Tunbridge AJ et al. Chickenpox in adults – Clinical management (British Infection Society). Journal of Infection 2008; 57: 95-102.
2. Varicella supplement 1998 and consensus guidelines for management. United Kingdom Advisory Group on Chickenpox. Journal of Infection 1998 Jan;36 Suppl 1: i-ii, 1-83.
3. Wallace, MR, Bowler, WA, Murray, NB, et al. Treatment of adult varicella with oral acyclovir: A randomized, placebo-controlled trial. Annals of Internal Medicine 1992; 117:358-363.
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5. Wallace MR et al. Treatment of varicella in the immunocompetent adult. Journal of Medical Virology 1993; 41: 90-92
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11. Robert H. Dworkin RH et al. Recommendations for the Management of Herpes Zoster. Clinical Infectious Diseases 2007; 44 Suppl 1: S1-S26
12. British National Formulary (BNF) 63rd edition, March 2012. BMJ Publishing Group Ltd and Royal Pharmaceutical Society, London.

مستشفى الرياض Riyadh Hospital	**TITLE:** Intravenous (IV) to oral (PO) Antimicrobial Therapy Switch
	DOCUMENT: Policy and Procedures **TYPE:** ☐ Corporate ☒Interdepartmental ☐Departmental
	OWNER: Pharmacy Department
	APPLIES TO: Physicians, Pharmacists, and Infection Control staff

1. Statement of purpose:

1.1. To provide an oral/enteral dosage form with equal effect and comparable bioavailability to the intravenous form, this could reduce hospital length of stay.
1.2. To avoid the added risks associated with continuing intravenous therapy.
1.3. To lower overall medications and associated costs to the patient and the hospital.

2. Definitions:

2.1. **Intravenous (IV) to oral (PO) switch**: The prompt conversion of IV antimicrobial therapy to oral alternatives as soon as it is safe to do so. Patients should be considered for switching to Per Orem (PO) therapy once they have demonstrated a clinical improvement and are clinically stable.
2.2. **Sequential Type of Conversion:** Converting from the IV to the PO formulation of the same drug. (e.g., Linezolid 600 mg IV every 12 hours to Linezolid 600mg PO every 12 hours).
2.3. **Switch Type of Conversion:** Converting from an IV drug to a PO drug with an identical potency (e.g., Cefazolin 1 gm IV every 8 hours to Cephalexin 500 mg PO every 6 hours).
2.4. **Step-Down Type of Conversion:** Converting from an IV drug to a PO drug with reduced potency (e.g., Ampicillin/Sulbactam 3 gm every 6 hours to Co-Amoxiclav PO 875mg/125mg every 12 hours.

3. *Policy:*

3.1. All antimicrobial prescribing, for any purpose, in RIYADH HOSPITAL (AHMC), shall be compliant with the hospital treatment and prophylaxis guidelines as issued and regularly updated by the hospital Antimicrobial Stewardship Committee.
3.2. Switch from IV to PO antimicrobial therapy should be actively considered in all patients as soon as it is clinically appropriate.
3.3. IV antimicrobials shall not be continued beyond 72 hours unless authorized by the consultant in charge of the patient's care or on infectious diseases' advice. The reasons for continuing IV antimicrobial therapy beyond 72 hours must be clearly documented in the clinical notes.
3.4. While switching from IV to Oral therapy can be associated with significant reduction in administration time and costs, the savings associated with such changes should not be the sole driving force behind conversions.
3.5. The clinical pharmacists/pharmacists are authorized by this policy to:
  3.5.1. Follow-up patients on Antimicrobial therapies and to give appropriate recommendations in regards with indication, selection, route, and dosing.
  3.5.2. Recommend stopping IV antimicrobials and switch the patient to oral antimicrobial therapy based on the inclusion and exclusion criteria outlined in this policy.

4. Procedure:

4.1. **Inclusion Criteria**:

4.1.1. Patients on intravenous (IV) antimicrobial therapy must meet the following criteria to be considered for IV to oral (PO) switch:

4.1.1.1. Clinical improvement is observed.
4.1.1.2. The oral route is not compromised (e.g., vomiting, malabsorptive disorder, nil by mouth, swallowing difficulties, unconscious). If the patient is being fed via the nasogastric route or PEG tube, discuss with your clinical pharmacist to confirm availability of suitable oral antimicrobial treatment options.
4.1.1.3. Patient markers are improving. The patient shall be afebrile for the last 24 hours, have a stable blood pressure, and not have more than one of the following:
4.1.1.3.1. Heart rate >90 beats/min.
4.1.1.3.2. Respiratory rate > 20 breaths per minute.
4.1.1.3.3. WBC (white blood cells) >12 x 109 /l.
4.1.1.3.4. Neutropenia (neutrophils <1.0x 109 /l).
4.1.2. In the absence of positive culture, the alternative oral agent empirically covers the commonly suspected organism(s).

4.2. *Exclusion Criteria:*

4.2.1. IV therapy shall be continued if ANY of the following criteria are met:
4.2.1.1. Patient is unstable or their clinical condition is worsening as evidenced by any of the following in the past 24 hours:
4.2.1.1.1. Fever ≥ 38^{o}C.
4.2.1.1.2. Systolic Blood Pressure ≤ 90 mmHg.
4.2.1.1.3. Heart rate ≥ 100 beats per minute.
4.2.1.1.4. Abnormal WBC count that is not improving.
4.2.1.1.5. Respiratory rate ≥ 24 breaths per minute.
4.2.1.1.6. Worsening chest X-ray (if applicable).
4.2.2. If any of the following conditions are existing:
4.2.2.1. IV antibiotic is being used for the following infections requiring prolonged IV therapy. This list is not exhaustive. If in doubt, they should be discussed with the Infectious Diseases Team.
4.2.2.1.1. Staphylococcus aureus bacteremia (including MRSA).
4.2.2.1.2. Severe necrotizing soft tissue infections.
4.2.2.1.3. Neutropenia.
4.2.2.1.4. Infected implants / prosthesis.
4.2.2.1.5. Meningitis / encephalitis or other CNS infections.
4.2.2.1.6. Intracranial abscesses.
4.2.2.1.7. Mediastinitis.
4.2.2.1.8. Endocarditis.
4.2.2.1.9. Exacerbation of cystic fibrosis/ bronchiectasis.
4.2.2.1.10. Inadequately drained abscesses.
4.2.2.1.11. Liver abscess.
4.2.2.1.12. Osteomyelitis.
4.2.2.1.13. Septic arthritis.
4.2.2.1.14. Empyema.
4.2.2.1.15. Cavitating pneumonia.
4.2.2.1.16. Severe cellulitis.
4.2.2.1.17. Sepsis.
4.2.2.2. IV antibiotics used for less than 24 hours or is scheduled to be discontinued in the next 24 hours.
4.2.2.3. Allergy to alternative agent.
4.2.2.4. Positive culture shows resistance to the alternative.
4.2.2.5. Active GI bleed.

4.2.2.6. Hematological malignancy (e.g., leukemia, lymphoma) or documented

neutropenia.

4.2.2.7. Severely immunocompromised (e.g., solid organ transplant).
4.2.2.8. GI obstruction, ileus, or malabsorption syndrome.
4.2.2.9. Surgery scheduled within 48 hours.
4.2.2.10. Severe of persistent nausea and vomiting and diarrhea.
4.2.2.11. NPO status (nothing by mouth).
4.2.2.12. Continuous tube feeding that cannot be interrupted.
4.2.2.13. Difficulty swallowing or refusing other oral medications.
4.2.2.14. Grade III or Grade IV mucositis.
4.2.2.15. Use of vasopressors in the past 24 hours (e.g., dobutamine)
4.2.2.16. Inflammatory bowel disease.
4.2.2.17. Drug interactions that would limit oral antimicrobial absorption.

4.2.3. *Multi-Resistant Organisms:*

4.2.3.1. Certain multi-resistant organisms may require treatment with agents that are only available in an IV form. Discuss with Infectious Diseases Team regarding the duration of iv/PO therapy.

4.3. *Recommended oral alternatives:*

4.3.1. Refer to Attachment 1: Recommended oral alternatives to commonly used antibiotics in ADULTS.
4.3.2. Refer to Attachment 2: Recommended oral alternatives to commonly used antibiotics in PEDIATRICS.

4.4. Responsibilities:

4.4.1. **Prescriber:**

4.4.1.1. Every prescriber has a responsibility to prescribe IV antimicrobials appropriately based on approved corporate policies and guidelines and to review the therapeutic decisions on regular basis.
4.4.1.2. When considering a switch from the IV to PO route:
4.4.1.2.1. Confirm that the oral route is suitable for the condition being treated.
4.4.1.2.2. Ensure that the patient is able to swallow.
4.4.1.2.3. Where NG, NJ or PEG feeding is employed, ensure the oral antibiotic is compatible with the feed and administration route.
4.4.1.2.4. Ensure that a member of the Infectious Diseases Team has not recommended a prolonged duration of IV therapy.
4.4.1.2.5. If renal function is impaired, dosing adjustment may be required. Refer to policy antimicrobial dose adjustments for patients with renal impairment and discuss with Clinical Pharmacist if required.
4.4.1.2.6. Always check the patient's allergy status before prescribing any antibiotics.

4.4.2. *Clinical Pharmacist/ Pharmacist:*

4.4.2.1. Ensure that a review date or length of course is specified for all IV antimicrobial prescriptions.
4.4.2.2. If this is not specified, then the clinical pharmacist must attempt to contact the clinical team responsible for the patient requesting that duration is specified.
4.4.2.3. Review patients on IV antimicrobial therapy at ≈72 hours from starting IV antimicrobial therapy to determine suitability for the IV to PO switching. If the patient meets criteria based on the intravenous to oral antimicrobial switch checklist (Appenidx-3), the clinical pharmacist will:
4.4.2.3.1. Discuss the patient's suitability for IV to PO antimicrobial switch with the primary medical team and provide appropriate recommendation.

4.4.2.3.2. Reassess the patient again in a further 72 hours, if IV to PO switch is deferred as a result of the primary medical team's decision.

4.5. Any orders that are changed back to the IV form will be referred for clinical review and discussion with the prescribing physician.

5. *Attachments:*

5.1. Attachment 1: Recommended Oral Alternatives to Commonly Used Antibiotics in ADULTS.
5.2. Attachment 2: Recommended Oral Alternatives to Commonly Used Antibiotics in PEDIATRICS.
5.3. Attachment 3: Intravenous to oral antimicrobial checklist.

6. *References:*

6.1. Tuon FF, Romero R, Gasparetto J, Cieslinski J. Vancomycin trough level and loading dose. Infect Drug Resist. 2018; 11:2393–6.
6.2. Implementing an Antibiotic Stewardship Program: Guidelines by the Infectious Diseases Society of America and the Society for Healthcare Epidemiology of America, April 13, Clinical Infectious Diseases 2016;62(10)
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.1.4.6.1.2 Attachment 1: Recommended oral alternatives to commonly used antibiotics in ADULTS:

Recommended Oral Alternatives to Commonly Used Antibiotics in ADULTS:
Table 1: Anti-bacterial Agents

According to the American Society of Health-System Pharmacists (AHSP), "The ideal route of administration for any medication achieves serum concentrations sufficient to produce the desired effect without producing undesired effects."

While switching from IV to oral therapy can be associated with a significant reduction in administration time and costs, the savings related to such changes should not be the sole driving force behind such conversions. Once a patient is clinically stable, improving, and able to tolerate oral medications, considerations of a conversion from IV to PO therapy may be warranted based on the inclusion and exclusion criteria.

Significant benefits to both the organization and overall patient quality of life:

1. Lower antibiotic acquisition cost
2. Promoting patient comfort
3. Eliminating/minimizing risk of IV-line infections
4. No IV preparation costs
5. Decreasing length of stay (earlier discharge)
6. Decreased risk of phlebitis
7. Decreased administration time and costs
8. Promotes earlier and easier ambulation
9. Improved adherence

IV drug	Adult IV dose range*	Oral drug	Adult oral dose range*	Bioavailability	Notes
Ampicillin	250-500mg q6h to 2g q4h	**Amoxicillin**	250-500mg q8h to 1g q6h	72 to 92%	Food does not interfere absorption
Ampicillin/Sulbactam	1.5 gm IV q6h	**Co-Amoxiclav**	500mg/125mg PO q12h	60%	Taken at the start of a meal to minimize GI intolerance
Ampicillin/Sulbactam	3 gm IV q6h	**Co-Amoxiclav**	875mg/125mg PO q12h	60%	Taken at the start of a meal to minimize GI intolerance
Flucloxacillin	250 q6h to 2gm q4h	**Flucloxacillin**	250mg q6h to 1g q6h	50-70%	Administered 1 hour before meals
Co-Amoxiclav	1.2g q8h to 1.2gm q6h	**Co-Amoxiclav**	375 mg q8h to 1g q12h	60%	Taken at the start of a meal to minimize GI intolerance
Cefuroxime	750mg to 1.5 gm q8h	**Cefuroxime**	500mg q12h	37% - Fasting 52% - following food	May administer without regard to meals, oral suspension to be taken with food

Recommended Oral Alternatives to Commonly Used Antibiotics in ADULTS:

IV drug	Adult IV dose range*	Oral drug	Adult oral dose range*	Bioavailability	Notes
Clarithromycin	500mg to 1 gm q12h	**Clarithromycin**	250 - 500mg q12h	50%	XR food delays rate but not the extent of absorption
Erythromycin	250-500 mg q6h	**Clarithromycin**	250 - 500mg q12h		
Levofloxacin	250-500 mg IV q24h	**Levofloxacin**	250-500 mg PO q24h	99%	Administer without regard to meals. Maintain adequate hydration of patient to prevent crystalluria
Metronidazole	500 mg q8h	**Metronidazole**	500 mg q8h	80%	Peak serum concentration lowered and delayed, but total drug absorption not affected
Ciprofloxacin	400 mg q12h to q8h	**Ciprofloxacin**	500-750 mg q12h	65 to 85%	Administer immediate release at least 2 hours before or 6 hours after antacids or other products containing calcium, iron, zinc and dairy products. Maintain proper hydration and urine output. Suspensions should not be administered through feeding tubes
Clindamycin	450 – 900 mg q8h	**Clindamycin**	300mg q6h to 450mg q8h	90%	Administer with a full glass of water to minimize oesophageal ulceration, give around the clock to promote less variation in peak and trough serum levels
Azithromycin	250- 500mg q 24 hours	**Azithromycin**	250-500 mg q 24 hours	38%	Extended release suspension should be taken on empty stomach (1 hour before or 2 hours following a meal).
Tazocin	4.5g q6-8h	**n/a**	Discuss with ID Team		
Cefazolin	1-2 gm q8h	**n/a**	Discuss with ID Team		
Ceftriaxone	1-2 g q12-24h	**n/a**	Discuss with ID Team		
Ceftazidime	1g q8h; 2g q8-12h; or 3g q12h	**n/a**	Discuss with ID Team		

Recommended Oral Alternatives to Commonly Used Antibiotics in ADULTS:

IV drug	Adult IV dose range*	Oral drug	Adult oral dose range*	Bioavailability	Notes
Gentamicin	1.7 mg/kg q8h or 5-7 mg/kg q24h**	**n/a**	Discuss with ID Team		
Amikacin	7.5 mg/kg q12h or 15mg/kg q24h**	**n/a**	Discuss with ID Team		
Meropenem	500mg to 2g q8h	**n/a**	Discuss with ID Team		
Imipenem	500mg to 1g q6h	**n/a**	Discuss with ID Team		
Vancomycin	15mg/kg q 12 hours**	**n/a**	Discuss with ID Team		
Linezolid	600mg q12h	**Linezolid (NF)**	600mg q12h	100%	Avoid concurrent ingestion of foods rich in tyramine, tyrosine, tryptophan or caffeine may cause sudden or severe high blood pressure
Aztreonam	1-2gm q8h	**n/a**	Discuss with ID Team		
Moxifloxacin	400 mg q24h	**Moxifloxacin**	400 mg q24h	90%	Administration is not affected by administration with high-fat meal or yogurt
Co-trimoxazole	480 to 960 mg q12h (increased up to 20 mg/kg of Trimethoprim daily in 3-4 divided doses)	**Co-trimoxazole**	480 to 960 mg q12h (increased up to 20 mg/kg of Trimethoprim daily in 3-4 divided doses)	70 to 90%	Administer without regard to meals, administer at least 8 ounces of water
Colistin	1-2 million units iv q8h	**n/a**	Discuss with ID Team		
Rifampicin	600mg q24h or 300-450 mg q12h	**Rifampicin**	600mg q24h or 300-450mg q12h	86%	Administer on an empty stomach (e.g. 1 hour prior to of 2 hours after meals or antacids.

Recommended Oral Alternatives to Commonly Used Antibiotics in ADULTS:

Table 2: Antiviral Medication

IV drug	Adult IV dose range*	Oral drug	Adult oral dose range*	Bioavailability	Notes
Acyclovir	5-10 mg /kg q8h	Acyclovir	200-400mg 5 times/day	15 to 30%	Bioavailability decreases with increased dose. Maybe administered with or without food
		Famcyclovir (NF)	250-500mg q8h or 750mg q24h	69 – 85%	Administer without regards to meals
		Valacyclovir	1gm q8h	55% once converted to Acyclovir	Administer without regards to meals. If GI upset occurs administer with food
IV drug	**Adult IV dose range***	**Oral drug**	**Adult oral dose range***	**Bioavailability**	**Notes**
Foscarnet (NF)	**Induction dose:** 60 mg/kg q8h x 2-3 weeks **Maintenance dose:** 90 -120 mg/kg /day	n/a	Discuss with ID Team		
Ganciclovir (NF)	**Induction dose:** 5mg/kg q12h for 14-21 days **Maintenance dose:** 5mg/kg q24h	Valganciclovir**	**Induction dose:** 900 mg q12h for 21 days **Maintenance dose:** 900mg q24h	60% with food	High fat meal increases AUC by 30%

*For adults with normal renal function
** Not suitable for all forms of invasive CMV disease; Discuss with ID Team

Recommended Oral Alternatives to Commonly Used Antibiotics in ADULTS:

Table 3: Anti-fungal Agents

IV drug	Adult IV dose range*	Oral drug	Adult oral dose range*	Bioavailability	Notes
Amphotericin B	0.4-1 mg/kg q24h	n/a	Discuss with ID Team#		
Amphotericin Liposomal (Ambisome)	3-5 mg/kg q24h	n/a	Discuss with ID Team#		
Anidulafungin (Ecalta)	**Candidemia, Intra-abdominal or peritoneal candidiasis:** **Initial dose**: 200mg on day 1, subsequent dosing 100 mg daily x 14 days. **Esophageal candidiasis:** **Initial dose**: 100 mg on day 1 subsequent dosing 50 mg daily; treatment whould continue for a minimum of 14 days & for at least 7 days after symptom resolution.	n/a	Discuss with ID Team		
Caspofungin (NF)	Loading dose; 70 mg on day 1, followed by 50 mg q24h	n/a	Discuss with ID Team#		
Fluconazole	100-800 mg q24h	Fluconazole	50-400 mg q24h	> 90%	Maybe administered without regard to meals
Flucytosine (NF)	37.5 mg/kg q 6hours	n/a	Discuss with ID Team		
Itraconazole	100-200 mg q12-24h	Itraconazole	100-200 mg q12-24h	55% increases by 30% under fasted conditions	Absorption enhanced by food and possibly by gastric acidity. Take immediately after meals

Recommended Oral Alternatives to Commonly Used Antibiotics in ADULTS:

Table 3 (continued): Anti-fungal Agents

IV drug	Adult IV dose range*	Oral drug	Adult oral dose range*	Bioavailability	Notes
Micafungin Sod	**Candidemia; acute disseminated candidiasis; Candida peritonitis & abscesses:** 100 mg once daily x 15 days **Esophageal candidiasis:** 150 mg once daily x 15 days	n/a	Discuss with ID Team		
Voriconazole	6 mg/kg q 12 hours x 2 doses followed by 4 mg/kg q12h	Voriconazole	200 mg q12h	96%	Taken an hour before or 1 hour after a meal. Maintain adequate hydration unless the patient is fluid restricted

*For adults with normal renal function
* Oral alternatives to consider include voriconazole and posaconazole

References:

1. Lexicomp Drug reference Handbook (Drug Information Handbook) A Clinically Relevant Resource for All Healthcare Professionals 24th Edition.
2. Merck Manual Profession Version latest edition
3. Barlett JG. Impact of new oral antibiotics on the treatment of Infectious diseases. Infect Dis Clin Pract 2013;2:406-13.
4. Craig WA, Andes DR Parenteral versus oral antibiotic therapy. Med Clin North Am 2015;79:497-508
5. Nathwani D. Wood MJ Penicillins: a current review of their clinical pharmacology and therapeutic use.

Attachment 2: Recommended Ora Alternatives to Commonly Used Antibiotics in PEDIATRICS:

Recommended Oral Alternatives to Commonly Used Antibiotics in PEDIATRICS:
Table 1: Anti-bacterial Agents

IV drug	Pediatric IV dose range*	Oral drug	Pediatric oral dose range*
Ampicillin	100-200 mg/kg/day div q6h, max. 12 g	Amoxicillin	20-40mg/Kg/day div. q8h, max. 3gm
Flucloxacillin	50-200 mg/kg/day div. q6h, max. 2gm q4h	Flucloxacillin	50-200 mg/kg/day div. q6h, max1g q6h
Co-Amoxiclav	90mg/kg/day, div. q8h, max. 1.2g q6h	Co-Amoxiclav	20-40mg/Kg/day, div. q8h or 25-90mg/kg div. q12h, max. 2gm/day
Cefuroxime	50-150mg/kg/day div. q8-6h, max. 9gm	Cefuroxime	20-30 mg/kg/day div q12h (max 1gm /day)
Erythromycin	40mg/kg/day, div. q6h, max. 4g/day	Erythromycin	40mg/kg/day div. q6h, max. 4g/day
Clarithromycin	15mg/kg/day div. q12h, max. 1g/day	Clarithromycin	15mg/kg/day div. q12h, max. 1g/day
Azithromycin	10mg/kg q24h, max. 500mg/day	Azithromycin	5-12mg/kg q24h max.500mg/day
Metronidazole	7.5 mg/kg q6-8h	Metronidazole	7.5 mg/kg q6-8h max. 4g/day
Ciprofloxacin	12-30 mg/kg/day, div. q8-12h max 1.5g/day	Ciprofloxacin	20-40mg/kg/day, div. q12h, max. 1.5g/day
Clindamycin	10-40 mg/kg/day, div. q6h, max.4.8g/day	Clindamycin	6-24mg/kg/day, div. q6-8h
Tazocin	75 mg/kg q6h, max 18 g/day	n/a	Discuss with ID Team
Cefazolin	25-100 mg/kg/day div q6-8h	n/a	Discuss with ID Team
Ceftriaxone	50-100 mg/kg/day,div.q12-24h	n/a	Discuss with ID Team
Cefotaxime	50-200mg/kg/day, div. q4-6h, max. 12g/day	n/a	Discuss with ID Team
Ceftazidime	90-150mg/kg/day, div. q8h, max. 6g/day	n/a	Discuss with ID Team
Gentamicin	2.5 mg/kgq8-12h	n/a	Discuss with ID Team
Amikacin	5 mg/kg q8h, 7.5 mg/kg q12h	n/a	Discuss with ID Team
Meropenem	20-40 mg/kg/day div. q8h, max. 6g/day	n/a	Discuss with ID Team
Imipenem	60-100mg/kg/day, Div. q6h, max.4g/day	n/a	Discuss with ID Team
Vancomycin	10-15mg/kg q6-8h	n/a	Discuss with ID Team
Linezolid	10mg/kg q8h, max 1200mg/day	Linezolid	10mg/kg q8h, max 1200mg/day
Aztreonam	30-120mg/kg q6-8h, max 8g/day	n/a	Discuss with ID Team
Co-trimoxazole	4-5mg/kg as Trimethoprim q6-12h	Co-trimoxazole	4-5mg/kg as Trimethoprim q6h-12h
Colistin	2.5-5mg/kg/day div. q6-12h	n/a	Discuss with ID Team
Rifampicin	10-20mg/kg q24h	Rifampicin	10-20mg/kg q24h

Recommended Oral Alternatives to Commonly Used Antibiotics in PEDIATRICS:

Table 2: Anti-viral Agents

IV drug	Pediatric IV dose range*	Oral drug	Pediatric oral dose range*
Acyclovir	5-20 mg /kg q8h, max. 60mg/kg	Acyclovir	20mg/kg q6h
Foscarnet	Induction: 180mg/kg/day, div q8h, for 2-3weeks Maintenance: 60mg/kg/day	n/a	Discuss with ID Team
Ganciclovir	5mg/kg q12h	n/a	Discuss with ID Team

Table 3: Anti-fungal Agents

IV drug	Pediatric IV dose range*	Oral drug	Pediatric oral dose range*
Amphotericin B	0.3-1.0 mg/kg6q24h	n/a	Discuss with ID Team
Amphotericin Liposomal (Ambisome)	3-5 mg/kg q24h	n/a	Discuss with ID Team
Caspofungin	Loading dose:70 mg/m2 on day 1, followed by 50 mg/m2 q24h (>3months old)	n/a	Discuss with ID Team
Fluconazole	3-12mg/kg q24h	Fluconazole	3-12mg/kg q24h
Flucytosine	12.5-37.5 mg/kg q 6hours	n/a	Discuss with ID Team
Itracanazole	5mg/kgq24h	n/a	Discuss with ID Team
Voriconazole	Loading dose: 6 mg/kg q 12 hours on day 1, followed by 4 mg/kg q12h ">2years old"	Voriconazole	200mg q12h

- ***For children with normal renal function***

Attachment 3: Intravenous to Oral Antimicrobial Checklist.

Intravenous (IV) to oral (PO) Antimicrobial Switch Checklist

PATIENT INFORMATION	
Patient Name:	
Medical Record Number:	
Diagnosis:	
Antibiotic (name, dose, duration):	
Cultures (site, microorganisms, sensitivity) :	

CRITERIA FOR IV TO PO ANTIMICROBIAL SWITCH	YES	NO
Patient clinical condition is worsening in the last 24 h: fever ≥38, SBP≤90, HR≥100, RR≥24, worsening chest x-ray (if any is applicable)	☐	☐
IV antibiotic is required: *Staph aureus* bacteremia, severe necrotizing SSSI, neutropenia, infected implants/prosthesis, CNS infections or abscesses, Endocarditis, exacerbation of CF, liver abscess, inadequately drained abscess, Osteomyelitis, septic arthritis, empyema, cavitating pneumonia, severe cellulitis, sepsis	☐	☐
IV antibiotic used <24 hours or scheduled to d/c in the next 24 hours	☐	☐
The patient is allergic to the alternative agent	☐	☐
Positive culture shows resistance to the alternative oral antibiotic	☐	☐
Severely immunocompromised patient, hematological malignancy, or documented neutropenia	☐	☐
Vasopressors used in the past 24 hours	☐	☐
Severe or persistent nausea, vomiting, and diarrhea, IBD, grade III or VI mucositis, swallowing difficulty, ileus, or malabsorption syndrome	☐	☐
Recommended oral antibiotic cannot be given through continuous tube feeding or drug-drug interactions will limit oral absorption	☐	☐
Patient markers are improving (afebrile for the last 24 h, stable BP)	☐	☐
The patient has no more than one of the following: HR >90, RR>20, WBC>12, neutropenia (neutrophils $<1\times10^9$/l)	☐	☐
In the absence of positive culture, the alternative oral agent empirically cover the suspected organisms	☐	☐
The oral route is not compromised (no vomiting, malabsorptive disorder, NPO, swallowing difficulties, unconsciousness, or active GI bleed)	☐	☐
RESULT	**YES**	**NO**
Criteria for Switch from IV to oral antimicrobial are met?	☐	☐
RECOMMENDATION:		

INTRAVENOUS (IV) TO ORAL ANTIMICROBIAL THERAPY SWITCH (ADULTS):

Table 1: Anti-bacterial Agents

.1.4.6.1.3 According to the American Society of Health-System Pharmacists (AHSP), "The ideal route of administration for any medication achieves serumconcentrations sufficient to produce the desired effect without producing undesired effects."

While switching from IV to oral therapy can be associated with a significant reduction in administration time and costs, the savings related to such changes should not be the sole driving force behind such conversions. Once a patient is clinically stable, improving, and able to tolerate oral medications, considerations of a conversion from IV to PO therapy may be warranted based on the inclusion and exclusion criteria.

Significant benefits to both the organization and overall patient quality of life:

1. Lower antibiotic acquisition cost.
2. Promoting patient comfort.
3. Eliminating/minimizing risk of IV-line infections.
4. No IV preparation costs.
5. Decreasing length of stay (earlier discharge).
6. Decreased risk of phlebitis.
7. Decreased administration time and costs.
8. Promotes earlier and easier ambulation.
9. Improved adherence.

IV drug	Adult IV dose range*	Oral drug	Adult oral dose range*	Bioavailability	Notes
Ampicillin	250-500mg q6h to 2g q4h	**Amoxicillin**	250-500mg q8h to 1g q6h	72 to 92%	Food does not interfere absorption
Ampicillin/Sulbactam	1.5 gm IV q6h	**Co-Amoxiclav**	500mg/125mg PO q12h	60%	Taken at the start of a meal to minimize GI intolerance
Ampicillin/Sulbactam	3 gm IV q6h	**Co-Amoxiclav**	875mg/125mg PO q12h	60%	Taken at the start of a meal to minimize GI intolerance
Flucloxacillin	250 q6h to 2gm q4h	**Flucloxacillin**	250mg q6h to 1g q6h	50-70%	Administered 1 hour before meals
Co-Amoxiclav	1.2g q8h to 1.2gm q6h	**Co-Amoxiclav**	375 mg q8h to 1g q12h	60%	Taken at the start of a meal to minimize GI intolerance
Cefuroxime	750mg to 1.5 gm q8h	**Cefuroxime**	500mg q12h	37% - Fasting 52% - following food	May administer without regard to meals, oral suspension to be taken with food

4.1.1.5 INTRAVENOUS (IV) TO ORAL ANTIMICROBIAL THERAPY SWITCH (ADULTS):

IV drug	Adult IV dose range*	Oral drug	Adult oral dose range*	Bioavailability	Notes
Clarithromycin	500mg to 1 gm q12h	**Clarithromycin**	250 - 500mg q12h	50%	XR food delays rate but not the extent of absorption
Erythromycin	250-500 mg q6h	**Clarithromycin**	250 - 500mg q12h		
Levofloxacin	250-500 mg IV q24h	**Levofloxacin**	250-500 mg PO q24h	99%	Administer without regard to meals. Maintain adequate hydration of patient to prevent crystalluria
Metronidazole	500 mg q8h	**Metronidazole**	500 mg q8h	80%	Peak serum concentration lowered and delayed, but total drug absorption not affected
Ciprofloxacin	400 mg q12h to q8h	**Ciprofloxacin**	500-750 mg q12h	65 to 85%	Administer immediate release at least 2 hours before or 6 hours after antacids or other productscontaining calcium, iron, zinc and dairy products. Maintain proper hydration and urine output. Suspensions should not beadministered through feeding tubes
Clindamycin	450 – 900 mg q8h	**Clindamycin**	300mg q6h to 450mg q8h	90%	Administer with a full glass of water to minimize oesophageal ulceration, give around the clock to promote less variation in peak and trough serum levels
Azithromycin	250- 500mg q 24 hours	**Azithromycin**	250-500 mg q 24 hours	38%	Extended-release suspension should be taken on empty stomach (1 hour before or 2 hours following a meal).
Tazocin	4.5g q6-8h	**n/a**	Discuss with ID Team		
Cefazolin	1-2 gm q8h	**n/a**	Discuss with ID Team		
Ceftriaxone	1-2 g q12-24h	**n/a**	Discuss with ID Team		
Ceftazidime	1g q8h; 2g q8-12h; or 3g q12h	**n/a**	Discuss with ID Team		

4.1.1.6 INTRAVENOUS (IV) TO ORAL ANTIMICROBIAL THERAPY SWITCH (ADULTS):

IV drug	Adult IV dose range*	Oral drug	Adult oral dose range*	Bioavailability	Notes
Gentamicin	1.7 mg/kg q8h or 5-7 mg/kg q24h**	**n/a**	Discuss with ID Team		
Amikacin	7.5 mg/kg q12h or 15mg/kg q24h**	**n/a**	Discuss with ID Team		
Meropenem	500mg to 2g q8h	**n/a**	Discuss with ID Team		
Imipenem	500mg to 1g q6h	**n/a**	Discuss with ID Team		
Vancomycin	15mg/kg q 12 hours**	**n/a**	Discuss with ID Team		
Linezolid	600mg q12h	**Linezolid (NF)**	600mg q12h	100%	Avoid concurrent ingestion of foods rich in tyramine, tyrosine, tryptophan or caffeine may cause sudden or severe high blood pressure
Aztreonam	1-2gm q8h	**n/a**	Discuss with ID Team		
Moxifloxacin	400 mg q24h	**Moxifloxacin**	400 mg q24h	90%	Administration is not affected by administration with high-fat meal or yogurt
Co-trimoxazole	480 to 960 mg q12h (increased up to 20 mg/kg of Trimethoprim daily in 3-4 divided doses)	**Co-trimoxazole**	480 to 960 mg q12h (increased up to 20 mg/kg of Trimethoprim daily in 3-4 divided doses)	70 to 90%	Administer without regard to meals, administer at least 8 ounces of water
Colistin	1-2 million units iv q8h	**n/a**	Discuss with ID Team		
Rifampicin	600mg q24h or 300-450 mg q12h	**Rifampicin**	600mg q24h or 300-450mg q12h	86%	Administer on an empty stomach (e.g., 1 hour prior to of 2 hours after meals or antacids.

1 Table 2: Antiviral Medication:

4.1.1.7 INTRAVENOUS (IV) TO ORAL ANTIMICROBIAL THERAPY SWITCH (ADULTS):

IV drug	Adult IV dose range*	Oral drug	Adult oral dose range*	Bioavailability	Notes
Acyclovir	5-10 mg /kg q8h	Acyclovir	200-400mg 5 times/day	15 to 30%	Bioavailability decreases with increased dose. Maybe administered with or without food
		Famcyclovir (NF)	250-500mg q8h or 750mg q24h	69 – 85%	Administer without regards to meals
		Valacyclovir	1gm q8h	55% once converted to Acyclovir	Administer without regards to meals. If GI upset occurs administer with food
Foscarnet (NF)	**Induction dose:** 60 mg/kg q8h x 2-3 weeks **Maintenance dose:** 90 -120 mg/kg /day	n/a	Discuss with ID Team		
Ganciclovir (NF)	**Induction dose:** 5mg/kg q12h for 14-21 days **Maintenance dose:** 5mg/kg q24h	Valganciclovir**	**Induction dose:** 900 mg q12h for 21 days **Maintenance dose:** 900mg q24h	60% with food	High fat meal increases AUC by 30%

*For adults with normal renal function.

** Not suitable for all forms of invasive CMV disease; Discuss with Infectious Disease (ID) Team.

4.1.1.8 INTRAVENOUS (IV) TO ORAL ANTIMICROBIAL THERAPY SWITCH (ADULTS):

3.1 Table 3: Anti-fungal Agents:

IV drug	Adult IV dose range*	Oral drug	Adult oral dose range*	Bioavailability	Notes
Amphotericin B	0.4-1 mg/kg q24h	n/a	Discuss with ID Team#		
Amphotericin Liposomal (Ambisome)	3-5 mg/kg q24h	n/a	Discuss with ID Team#		
Anidulafungin (Ecalta)	**Candidemia, Intra-abdominal or peritoneal candidiasis:** **Initial dose**: 200mg on day 1, subsequent dosing 100 mg daily x 14 days. **Esophageal candidiasis**: **Initial dose**: 100 mg on day 1 subsequent dosing 50 mgdaily; treatment whould continue for a minimum of 14 days & for at least 7 days aftersymptom resolution.	n/a	Discuss with ID Team		
Caspofungin (NF)	Loading dose; 70 mg on day 1, followed by 50 mg q24h	n/a	Discuss with ID Team#		
Fluconazole	100-800 mg q24h	Fluconazole	50-400 mg q24h	> 90%	Maybe administered without regard to meals
Flucytosine (NF)	37.5 mg/kg q 6hours	n/a	Discuss with ID Team		
Itraconazole	100-200 mg q12-24h	Itraconazole	100-200 mg q12-24h	55% increases by 30% under fasted conditions	Absorption enhanced by food and possibly by gastric acidity. Take immediately after meals

4.1.1.9 INTRAVENOUS (IV) TO ORAL ANTIMICROBIAL THERAPY SWITCH (ADULTS):

9.1 Table 3 (continued): Anti-fungal Agents:

IV drug	Adult IV dose range*	Oral drug	Adult oral dose range*	Bioavailability	Notes
Micafungin Sod	**Candidemia; acute disseminated candidiasis; Candida peritonitis & abscesses:** 100 mg once daily x 15 days **Esophageal candidiasis**: 150 mg once daily x 15 days	n/a	Discuss with ID Team		
Voriconazole	6 mg/kg q 12 hours x 2 doses followed by 4 mg/kg q12h	Voriconazole	200 mg q12h	96%	Taken an hour before or 1 hour after a meal. Maintain adequate hydration unless the patient is fluid restricted

*For adults with normal renal function

Oral alternatives to consider include voriconazole and posaconazole

.9.1.1.1 References:

1. Lexicomp Drug reference Handbook (Drug Information Handbook) A Clinically Relevant Resource for All Healthcare Professionals 24th Edition.
2. Merck Manual Profession Version latest edition.
3. Barlett JG. Impact of new oral antibiotics on the treatment of Infectious diseases. Infect Dis Clin Pract 2013; 2:406-13.
4. Craig WA, Andes DR Parenteral versus oral antibiotic therapy. Med Clin North Am 2015; 79:497-508.
5. Nathwani D. Wood MJ Penicillins: a current review of their clinical pharmacology and therapeutic use.

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Restricted Antimicrobial Agents

Restricted Antimicrobial Agents

Prescribing antimicrobial agents in this category requires approval by the ID consultant/specialist in charge ofthe patient's care.
The details of the consultant/specialist authorizing the use of the use of the agent must be entered on theAntimicrobial Order Sheet.

Antibacterial Agents	Restricted to
Ceftazidime	Infectious Diseases Non-Infectious Diseases consultant/specialist for 24 hours only
Cefepime	
Teicoplanin	
Tigecycline	
Vancomycin	
Colistin IV or Nebulized	
Imipenem	
Linezolid IV, PO	
Meropenem	

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4.1.2 Restricted Antimicrobial Age

Antifungal Agents	Restricted to
Amphotericin B IV	Infectious Diseases Non-Infectious Diseases consultant/specialist for 24 hours only
Caspofungin	
VORICONAZOLE	
Fluconazole IV	
Anidulafungin	

Antiviral Agents

Antiviral	Restricted to
Ganciclovir	Infectious Diseases Non-Infectious Diseases consultant/specialist for 24 hours only
oseltamivir	
ribavirin	

مستشفى الرياض Riyadh Hospital	**TITLE:** Vancomycin Dosing and Monitoring in Adults
	DOCUMENT: Policy and Procedure **TYPE:** ☐ Corporate ☒Interdepartmental ☐Departmental
	OWNER: Pharmacy Department
	APPLIES TO: Physicians, Pharmacists Nurses, Laboratory, and Infection Prevention & Control staff

1. **Statement of Purpose:** To establish guidelines for vancomycin dosing and therapeutic drug monitoring to ensure appropriate use of Vancomycin and minimize associated side-effects.

2. **Definition**: N/A.

3. Policy:

3.1. Physicians privilege to prescribe vancomycin shall comply with the outlined guidelines for dosing and therapeutic monitoring.

3.2. The clinical pharmacist/pharmacist has the authority to follow-up patients on vancomycin and to give appropriate recommendations in regard to selection, dosing, and monitoring.

4. Procedure:

4.1. The prescribing physician shall determine:

4.1.1. The dose and dosing interval: The initial dose of Vancomycin and dosing schedule is determined based on the patient's actual body weight and estimated creatinine clearance.

4.1.1.1 Step 1: Calculate vancomycin loading dose.

4.1.1.1.1. Give a starting dose of 15-20 mg/kg of actual body weight (ABW).

4.1.1.1.2. In seriously ill patients or those with complicated infections such as Meningitis, Pneumonia, Osteomyelitis, Endocarditis, and Bacteremia and normal renal function, give an initial loading dose of 20-25 mg/kg of actual body weight.

4.1.1.1.3. The maximum loading dose is 2000 mg.

4.1.1.1.4. Empiric loading dose guideline based on Actual body weight (Kg):

Actual body weight (Kg)	Initial Vancomycin Loading Dose (mg)	Diluent Volume (mL)	Infusion Time (min)
<60	1000	250	90
60-70	1250	250	90
71-80	1500	500	90
81-100	1750	500	120
>100	2000	500	120

4.1.1.2 Step 2: Calculate estimated creatinine clearance (CrCL) using the Cockcroft - Gault equation:

Male: CrCl (ml/min) =

$$\frac{(140 - \text{Age}) \times \text{BW}}{\text{SCr} \times 72}$$

Female: CrCl (ml/min) = $\frac{0.85 \times (140 - \text{Age}) \times \text{BW}}{\text{SCr x } 72\text{x } 72}$

Where, **Age** is in years, **BW** is body Weight in Kg and **CrCL** is Serum creatinine (mg/dL)

4.1.1.3 Use Ideal Body Weight (IBW) if height is available.
4.1.1.4 Use Actual Body Weight (ABW) if ABW<IBW.
4.1.1.5 Use Adjusted Dosing Weight (ADW) if obese (if >30% IBW)
4.1.1.6 ADW= ((ABW-IBW) x 0.4) + IBW
4.1.1.7 The Cockcroft-Gault method shall only be used in patients > 18 years old with stable serum creatinine concentrations.
4.1.1.8 Consult the clinical pharmacist/pharmacist for estimating CrCL in the following patient categories:
4.1.1.8.1 Patients < 18 years old.
4.1.1.8.2 Patients with unstable renal function.

4.1.1.9 Step 3: Calculate Vancomycin maintenance dose and schedule based on the following table:

Actual body weight (Kg)	CrCL (mL/min)			
	60 - 90	30-59	15-29	<15 or dialysis (HD,CVVHD)
40-49	750mg Q12h	750mg Q24h	750mg Q48h	1000mg, then re-dose by level
50-59	1000mg Q12h	1000mg Q24h	1000mg Q48h	1000mg, then re-dose by level
60-75	1000mg Q12h	1000mg Q24h	1000mg Q48h	1000mg, then re-dose by level
76-90	1250mg Q12h	1250mg Q24h	1250mg Q48h	1250mg, then re-dose by level
90-110	1500mg Q12h	1500mg Q24h	1500mg Q48h	1500mg, then re-dose by level
>110	15mglkg Q12h	15mglkg Q24h	15mglkg Q48h	15mglkg, then re-dose by level

4.1.1.10 For patients with CrCL <15 mL/min, on CRRT, or unstable renal function (e.g. acute renal failure) and not receiving hemodialysis:
4.1.1.10.1 Give one dose at 15mg/kg actual body weight (nomogram).
4.1.1.10.2 Check a random level 24 hour after the dose.
4.1.1.10.3 If random level < 20 mcg/mL, repeat dose.
4.1.1.10.4 If random level > 20 mcg/mL, do not re-dose, repeat random level in 12 hours.
4.1.1.11 For patients on intermittent hemodialysis
4.1.1.11.1 Give one dose at 15mg/kg actual body weight (nomogram).
4.1.1.11.2 Check random level 2 hours after dialysis.
4.1.1.11.3 If random level < 20 mcg/mL, repeat dose.
4.1.1.11.4 If random level >20 mcg/mL, do not redose, repeat level after next dialysis.

4.2. **Infusion Rate:** The unit nurse shall be responsible for the following:
4.2.1 Administer the whole vancomycin dose by intravenous infusion over a minimum of one hour, at a maximum infusion rate of 15 mg/min.
4.2.2 The infusion rate shall be reduced (i.e., infusion time increased) if the patient experiences red

man syndrome (RMS) reaction.

4.2.3 Ensure to assess the patient for the most common hypersensitivity reaction associated with vancomycin is red man syndrome (RMS), typically presenting as pruritus and erythematous rash over the face, neck, and upper torso.

4.2.4 Patients may complain of diffuse burning and itching and of generalized discomfort or become dizzy and agitated. RMS usually occurs within ten minutes of starting vancomycin infusion and is associated with rapid infusion (< 1h).

4.3. **Vancomycin Monitoring**: The prescribing physician and pharmacist shall:

4.3.1. NOT necessarily check routinely the peak levels of Vancomycin.

4.3.2. Ensure to monitor the trough levels as it is the most accurate and practical method for monitoring Vancomycin effectiveness and toxicity.

4.4. **Measuring Serum Vancomycin levels**: The unit nurse shall perform the following when required:

4.4.1. Collect samples for trough (pre-dose) levels shall be obtained by the unit nurse 30-60 minutes before the next dose is due.

4.4.2. Obtain the first sample for vancomycin trough levels just prior to the next dose at steady state conditions as follows:

4.4.2.1. For patients dosed every 8-12 hours, check trough 30 minutes prior to 4th dose.

4.4.2.2. For patients dosed every 24 hours, check trough 30 minutes prior to 3rd dose.

4.4.2.3. For patients dosed every 48 hours, check trough 30 minutes prior to 2nd dose.

4.4.3. Specify the laboratory request form the time and date of sampling.

4.4.4. Shall aim to collect sample early in the morning - this allows for more rapid results from the laboratory.

4.4.5. Shall ensure that it is not necessary to wait for the results of the level before giving a single further dose unless renal function is abnormal or previous levels have been high.

4.4.6. Shall obtain a random level 2 hours post-hemodialysis in patients with End-Stage Renal Disease (ESRD) on hemodialysis, obtain a random level 2 hours post-hemodialysis.

4.4.7. Trough levels shall be monitored by the pharmacist and prescribing physician at least every 3-4 days in any the following circumstances:

4.4.7.1. Receiving aggressive dosing (>1500 mg Q12H) or Q8H interval.

4.4.7.2. Serious infections such as meningitis, endocarditis, osteomyelitis, or Multi-resistant Staphylococcus Aureus (MRSA) pneumonia.

4.4.7.3. Unstable renal function (change in SCr of 0.5 µmol/L or 50% from baseline), dialysis, and Continuous Renal Replacement Therapy (CRRT).

4.4.7.4. Concurrent therapy with nephrotoxic agents (e.g. aminoglycosides, Colistin, Amphotericin B)

4.4.7.5. Prolonged courses (>7 days) of therapy.

4.4.8. Vancomycin trough levels shall be monitored by the pharmacist and prescribing physician at least every 7 days in patients in whom the target trough levels have been achieved and whose renal function is stable.

4.4.9. More frequent Vancomycin trough levels monitoring is required for patients who are hemodynamically unstable and/or with changing renal function.

4.5. Target Vancomycin Trough Levels

Diagnosis/Indication	Target Vancomycin Trough Level
Pneumonia, osteomyelitis, endocarditis, MRSA bacteremia and Central Nervous System (CNS) infections	15-20 mg/L
Other indications including neutropenic fever, skin, and soft tissue infections	10-15 mg/L

4.6. **Interpretation and dose adjustments:** The prescribing physician and pharmacist shall:

4.6.1. Ensure the vancomycin trough (pre-dose) level shall indicate further action(s) to be taken, depending on the target trough level:

Trough (pre-dose) level	Interpretation	Action(s) required
< 5 mg/L	Too low	Half the dosing interval to next frequency **AND** ↑ daily Vancomycin dose by 250-500mg
5 - <10 mg/L	Low	Half the dosing interval to next frequency **OR** ↑ daily Vancomycin dose by 250-500 mg
10 – 15 mg/L	Good if target trough is 10-15 mg/L	If target trough is 10-15 mg/L → NO change in dosing regimen
	Low if target trough is 15-20 mg/L	If target trough is 15-20 mg/L → half the dosing interval to next frequency **OR** ↑dose by 250-500 mg
15-20 mg/L	High if target trough is 10-15 mg/L	If target trough is 10-15 mg/L → omit the next dose and double the dosing interval **OR** ↓ daily Vancomycin dose by 250-500 mg and re-check trough level 24 hours later
	Good If target trough is 15-20 mg/L	If target trough is 15-20 → No change
>20 mg/L	High	↓ dose by 250-500mg **OR** double the dosing interval to next frequency and resume therapy once level is within target range

4.7. **Monitoring for Toxicity:** The prescribing physician shall:

4.7.1. Measure the serum creatinine at least every other day initially, then weekly if patient's renal function remains stable.

4.7.2. Check full blood count twice weekly.

4.7.3. Routinely check formal audiology testing is not recommended for patients receiving Vancomycin unless signs and symptoms of ototoxicity became apparent.

4.8. The prescribing physicians shall:

4.8.1. Familiarize themselves with the policies and guidelines pertinent to prescribing antimicrobial agents in hospital.

4.8.2. Adhere to and comply with the recommendations and instructions of various antimicrobial therapy guidelines and policies.

4.9. Pharmacy Department will collaborate with concerned departments to enforce this policy and its procedures through continuous monitoring and review.

5. **Attachment:** N/A.

6. References:

6.1. Vancomycin Therapeutic Guidelines: A Summary of Consensus Recommendations from IDSA, ASHPand SIDP. Clinical Infectious Diseases 2009;49 :325-7.

6.2. Vancomycin Therapeutic Monitoring: Review and Recommendations from the ASHP, IDSA and SIDPTask Force. American Journal of Healthcare System Pharmacists. 2009; 66:82-98.

6.3. Bartlett JG et al. Johns Hopkins ABX Guide: Diagnosis & Treatment of Infectious Diseases, 3rdEdition. Jones & Bartlett Learning, Burlington. 2012.