KING ABDULAZIZ MEDICAL CITY

ANTIMICROBIAL GUIDELINES 2012

Version August 2012

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INTRODUCTION

The emergence of antimicrobial resistance among bacterial, fungal and viral pathogens has been alarming. This is mainly the attribution of injudicious use of these agents in the hospital and community settings. It is well known that pathogens when exposed to antimicrobial agents over time develop methods to evade these agents, a simple formula for survival! A review of the literature has elicited that over 50 % of antimicrobial use is considered inappropriate in North American hospitals and such has been proven in many other countries.

Reasons for injudicious use of antimicrobial agents, which we also refer to it as the inappropriate use, may be from choosing the incorrect: antibiotic, combination, dose, route or duration. As this may be complicated further by the incorrect diagnosis, unavailability of proper testing, the improper interpretation of certain tests, which may all lead to the inappropriate use of antimicrobial agents.

From all or even some of these pitfalls in the management of patients-when prescribing antimicrobial agents- we have experienced firsthand the emergence of antimicrobial resistance, to the extent that some patients end with no options for treatment of severe infections. On top of that the side effects from the use of antibiotics have been experienced with clear morbidity, mortality and cost implications to patients and the institution.

In an effort to curtail this problem, the hospital leadership has made it a priority to improve the use of antimicrobial agents. In doing so, efforts for: educating prescribers, improving diagnostics, improving formularies and most importantly implementing a restriction policy on certain agents through capable consultation services have been underway. This document is only one of many facets to a newly established *A*ntimicrobial *S*tewardship *P*rogram (ASP) at the National Guard Health Affairs. It was prepared based on the thorough review of literature, international guidelines, local antibiogram(s), the current National Guard hospital formulary and the deliberations of the members of the Antimicrobial Corporate Committee Members with consultation of other experts outside of the committee as deemed necessary. It is to be used as guidance to prescribing physicians at the healthcare facilities of the National; the guidelines, however, do not replace the infectious disease consultation when needed. The guidelines will be updated on a yearly basis and will be available as a PDF document on the intranet.

HANAN BALKHY, MD, MMED. FAAP, CIC.
Chairman, Corporate Antimicrobial Committee and on behalf of the members

3. NGHA FORMULARY AND RESTRICTION DRUGS

Antimicrobial Restrictions

ANTIBIOTICS	RESTRICTED TO CONSULTANTS
Ampicillin/Sulbactam	• Infectious Diseases • Intensivists
Amikacin	• Hematologists/Oncologists • Infectious Diseases • Intensivists
Azithromycin IV	• Infectious Diseases • Intensivists • Pulmonologists
Cefepime	• Hematologists/Oncologists • Infectious Diseases • Intensivists
Ceftazidime	• Hematologists/Oncologists • Hepatobiliary Sciences • Infectious Diseases • Intensivists
Ciprofloxacin	• Hematologists/Oncologists • Hepatobiliary Sciences • Infectious Diseases • Intensivist • Nephrologists • Pulmonologists
Colistin	• Infectious Diseases
Imipenem	• Hematologists/Oncologists • Infectious Diseases • Intensivists
Linezolid	• Infectious Diseases
Meropenem	• Infectious Diseases
Nalidixic Acid	• Pediatric Infectious Diseases
Paromomycin Topical	• Dermatologists •Infectious Diseases
Piperacillin/Tazobactam	• Hepatobiliary Sciences • Hematologists / Oncologists • Infectious Diseases • Intensivists
Tigecycline	• Infectious Diseases
Vancomycin	• Hematologists / Oncologists • Hepatobiliary Sciences • Infectious Diseases • Intensivists • Nephrologists

ANTI-FUNGAL	RESTRICTED TO CONSULTANTS
Caspofungin	• Hematologists/Oncologists • Infectious Diseases • Intensivists
Itraconazole	• Dermatologists • Infectious Diseases • Pediatric Hematologists / Oncologists • Pediatric Immunologists
Lipid Complex Amphotericin B	• Infectious Diseases • Intensivists
Voriconazole	• Infectious Diseases
Amphotericin B	• Infectious Diseases • Intensivists
ANTI-VIRAL	**RESTRICTED TO CONSULTANTS**
Adefovir	• Gastroenterologists • Hepatobiliary Sciences
Didanosine	• Infectious Diseases
Entecavir	• Gastroenterologists • Hepatobiliary Sciences
Ganciclovir	• Hematologists/Oncologists • Hepatobiliary Sciences • Infectious Diseases • Intensivists • Nephrologists
Hepatitis B Immunoglobulin	• Hepatobiliary Sciences • Infectious Diseases
Indinavir	• Infectious Diseases
Lamivudine	• Gastroenterologists • Hepatobiliary Sciences • Infectious Diseases
Lopinavir/Ritonavir	• Infectious Diseases
Pegylated Interferon Alfa	• Hepatobiliary Sciences • Gastroenterologists
Ribavirin	• Hepatobiliary Sciences • Gastroenterologists
Valganciclovir	• Infectious Diseases • Hepatobiliary Sciences • Nephrologists
Zidovudine	• Infectious Diseases

3.1 HOW TO PRESCRIBE RESTRICTED ANTIMICROBIAL AGENTS AT NGHA

Restricted antimicrobial agents will require proper approval of a consultant within 48 hours of initiating the prescription, please see restriction list. Authorizing consultant should be contacted prior to using their badge number. Hence, authorizing physicians should then check their inbox to clear all pending approvals.

Prescribers at any level will need to go thru a process of discussing the restricted agent with the appropriate consultant service or consultant sub-specialist. While prescribing the restricted agents, a dropdown list will appear with the consultant who is allowed to approve the agent. Prescribers are also required to carefully read the disclaimer showing on the screen encouraging them to discuss the case with the appropriate consultant. The prescribers are also requested or mandated to choose whether or not they had discussed the case with the consultant. Prescribers who do not discuss the case with the appropriate consultant are not allowed to re-write the prescription after its expiration for a second term of 48 hours and will be automatically discontinued in the system. Such cases will undergo investigation and review by the Corporate Antimicrobial Committee for further clarification and action.

For further details on how to prescribe a restricted antimicrobial agent, please refer to the Antimicrobial Stewardship Team in your hospital.

4. AGENT-SPECIFIC GUIDELINES

4.1 King Abdulaziz Medical City Guidelines for the Use Antibiotics

1. Ciprofloxacin

Ciprofloxacin is a Quinolone antibiotic. It has activity against gram-negative cocci (except N. gonorrhoeae due to high prevalence of resistance), gram-negative bacilli (including ESBL, *Legionella sp.*), *Chlamydophilia* and *M. pneumoniae.* It no activity against anaerobic organisms.

Acceptable uses:

- UTI, acute uncomplicated cystitis in females. Acute and chronic bacterial prostatitis.
- Lower respiratory tract infections, acute sinusitis.
- Severe skin and soft tissue infections.

- Bone and joint infections.
- Complicated intra-abdominal infections (in combination with Metronidazole).
- Infectious diarrhea, Typhoid fever due to Salmonella typhi.
- Empirical therapy for febrile neutropenic patients in combination with a beta lactam agent.

Acceptable off label uses:

- Acute pulmonary exacerbation in cystic fibrosis (children).
- Cutaneous/gastrointestinal/oropharyngeal anthrax (treatment, children and adults).
- Chancroid in adults.
- Prophylaxis after exposure to a patient with documented infection with *Neisseria meningitidis*.
- Empirical therapy (oral) for febrile neutropenia in low-risk cancer patients in combination with a beta lactam agent.

Unacceptable uses:

- Simple skin and soft tissue infection.
- Community acquired pneumonia.
- Gonococcal infections in adults.
- Acute exacerbation of COPD

Usual dose:

- Oral: 500-750 mg every 12 hours
- I.V: 400 mg every 12 hours

Adverse events:

- Tendinopathy (over age of 60) risk increased with concomitant steroidal agents and renal impairment.
- CNS toxicity: varies from mild (light-headedness) to moderate (confusion) to severe (seizures). May be aggravated by NSAIDs.
- Photosensitivity.
- QT interval prolongation (increase in woman,↓Mg,↓K).
- Hypoglycemia/Hyperglycemia.

Comment:

- Avoid using concomitantly with drugs with potential to prolong the QT interval (i.e. amiodarone, azoles, and protease inhibitors) and in patients with cardiac arrhythmias.

- No to be administered within 2 hours of dairy products or calcium containing products.

2. Moxifloxacin

Moxifloxacin is a Quinolone antibiotic. It has activity against gram-positive cocci except gram-negative cocci (except N. gonorrhoeae due to high prevalence of resistance), gram-negative bacilli (including ESBL organisms, *Legionella* sp.), *Chlamydophilia* and *M. pneumoniae*, activity against anaerobes except C.difficle.

Acceptable uses:

- Mild to moderate CAP, including multidrug resistant *streptococcus pneumoniae* (MDRSP).
- Acute bacterial exacerbation of chronic bronchitis.
- Acute bacterial sinusitis.
- Uncomplicated skin and skin structure infections.
- Intra-abdominal infections.
- Bacterial conjunctivitis.

Acceptable off label use:

- Treatment of infections caused by *Legionella spp.*

Unacceptable uses:

- Avoid in use in community acquired pneumonia if suspecting TB.
- Urinary tract infection.

Usual dose:

- Oral and IV 400 mg Q24 H
- Duration depends on infection.

Adverse effects:

- Tendinopathy (over age of 60). Risk increased with concomitant steroidal agents and renal impairment.
- May prolong the QT interval.

Comments:

- Avoid using concomitantly with drugs with potential to prolong the QT interval (i.e. Amiodarone, Azoles, and protease inhibitors) and in patients with cardiac arrhythmias.

3. Imipenem/cilastatin

Imipenem/cilastatin is a carbapenem antibiotic. It has activity against staphylococci (MSSA) and streptococci, *Listeria monocytogenes, Enterobacteriaceae*, ESBL, and anaerobes.

Acceptable uses:

- Treatment of bacterial septicemia.
- Treatment of lower respiratory tract infections.
- Bone and joint infections.
- Complicated abdominal infections.
- Complicated skin and/or soft tissue infections.
- Urinary tract infections if ESBL is suspected.

Acceptable off label uses:

- Neutropenic fever.
- Treatment cystic fibrosis.
- Infective endocarditis, due to penicillin-, aminoglycoside, and vancomycin-resistant *Enterococcus faecalis*.

Unacceptable uses:

- CNS infections.
- For infections caused by pathogens susceptible to other B-lactams.
- Infections in patients with end stage renal disease.
- Patients with history of seizures or at risk of seizures.

Dose:

- 0.5 -1 gm IV Q6H, for *P. aeurginosa* 1 g IV Q6H.

Adverse effects:

- Seizures.
- Cardiovascular adverse effects: palpitations and tachycardia.
- Local infusion site reaction or induration and thrombophlebitis.
- Alteration in taste.
- Thrombocytopenia.

4. Meropenem

Meropenem is a carbapenem antibiotic. It has activity against staphylococci (MSSA) and streptococci, *Listeria monocytogenes, Enterobacteriaceae*, ESBL, and anaerobes.

Acceptable uses:

- Treatment of bacterial meningitis.
- Complicated skin and/or soft tissue infections.
- Complicated abdominal infections.

Acceptable off label use

- Treatment of healthcare associated pneumonia.
- Febrile neutropenia.

Unacceptable uses:

- Community acquired pneumonia.

Dose:

- 1 g IV Q8H, maximum dose 2 g IV Q8H.

Adverse effects:

- Inflammation at site of infusion/injection site.
- Leukopenia, neutropenia and agranulocytosis.
- Angioedema, erythema multiform.
- Hypersensitivity reaction, Stevens-Johnson syndrome.

5. Piperacillin/Tazobactam

Piperacillin/Tazobactam is a Beta-lactam/Beta-lactamase inhibitor combination antibiotic. It is an antipseudomonal Penicillin. It also has activity against MSSA, streptococci, enterococcus facecalis, gram-negative and anaerobes.

Acceptable uses:

- Moderate to Severe intrabdominal infections.
- Healthcare associated pneumonia.
- Aspiration pneumonia.
- Complicated infection of skin and/or soft tissues.
- Pelvic inflammatory disease.
- Endometritis.
- Febrile neutropenia.

Unacceptable uses:

- CNS infections.

Dose:

- 4.5 g IV Q6H.

Adverse effects:

- GI side effects, antibiotic associated diarrhea.
- Drug fever/rash.
- Eosinophilia increase or decrease of platelets, increase PT/PTT, leukopenia (with prolonged use of more than 14 days).

6. Tigecycline

Tigecycline is a tetracycline derivative. It has *in-vitro* activity against most strains of staphylococci and streptococci (including MRSA and VRE), anaerobes, and many Gram-negative organisms with the exception of some *Proteus spp.* and *Pseudomonas aeruginosa*. It is FDA approved for skin and skin-structure infections and intra-abdominal infections.

Acceptable uses:

- Treatment of intra-abdominal and skin and soft tissue infections in selected patients with multiple drug allergies.

Unacceptable:

- Tigecycline should not be used in cases where other effective agents are available.
- Should not be used as monotherapy.
- Tigecycline should not be used as empiric therapy for healthcare associated pneumonia.

Usual dose:

- Loading Dose 100 mg IV x1; maintenance dose 50 mg IV Q12H.
- Adjust for liver impairment (Child Pugh C score).

Comments:

- The use of tigecycline requires ID approval and known susceptibility of the infecting organism to the drug.

Adverse Effects:

- Abdominal pain.
- Diarrhea.
- Nausea & Vomiting.

- Increased liver enzymes.
- Pancreatitis.

7. Rifampin

Rifampin is a rifamycin. It is a potent inducer of the cytochrome P450 system. It acts by inhibiting bacterial RNA synthesis by binding to the beta subunit of the DNA dependent RNA polymerase enzyme thereby blocking RNA transcription. The drug is bacteriocidal in its action.

Uses:

- Treatment of active tuberculosis (1st line drug) in combination.
- Latent tuberculosis.
- Infective endocarditis (prosthetic valve) caused by *Staphylococcus aureus*.
- Brucellosis in combination.
- MRSA hardware infections in combination.

Acceptable off label:

- *Chemoprophylaxis for contacts of N. Meningiditis* cases.
- *Chemoprophylaxis for contacts of H. Influenzae* cases.
- Leprosy.
- *Legionella* pneumonia.
- Management of Bortanella infection.
- Lung disease caused by atypical mycobacterium.
- Synergistic use in the management of staphylococcal infections
- Prophylaxis of *Haemophilus influenzae* type b infection.

Unacceptable uses:

- Monotherapy.
- Non MRSA hardware infections.

Dose:

- See specific dosage based on diagnosis.

Drug Interactions:

- Rifampin decreases the effectiveness of oral contraceptive agents.
- Interacts with multiple hepatically eliminated drugs please review for drug-drug interactions and adjust accordingly.

Side Effects:

- Increase transaminases.
- Orange-brown discoloration of body fluids (urine, tears, sweat and contact lenses).
- Flu like symptoms(fever, chills, headache, bone pain and shortness of breath)
- Drug induced fever.
- Thrombocytopenia, Leukopenia and Hemolytic anemia.

4.2 Vancomycin Dosing Regimen

Vancomycin is considered to be a concentration independent or time dependent killer of bacteria. Therefore, increasing antibiotic concentrations beyond the therapeutic threshold will not result in faster killing or eliminate a larger portion of the bacterial population. Vancomycin dosing should be based upon actual body weight (ABW), is generally used at doses of 10-15 mg/kg, and dosing intervals should be renally adjusted per the chart below.

Estimated CrCl (mL/min)	Frequency
> 50	Q12H
40-49	Q18H
20-29	Q24H
10-19	Q36 H
Dialysis	Variable (q3-6 days)

Vancomycin is NOT recommended for:

- Routine surgical prophylaxis.
- Treatment of a single positive blood culture for coagulase-negative staphylococci.
- Empiric therapy of a febrile neutropenic patient where no evidence of gram-positive infection exists.
- Continued empiric therapy if microbiologic testing does not confirm an infection due to a beta- lactam-resistant gram positive organism. Selective gut decontamination MRSA colonization. Primary therapy for mild or moderate Clostridium difficile infections. Topical application or irrigation. Treatment of MSSA or other susceptible gram-positive infections in dialysis patients. Prophylaxis in CAPD patients.
- Prophylaxis in low birth weight infants. Systemic or local prophylaxis for indwelling central or local catheters.

Vancomycin levels are recommended in the following settings:

- Serious or life-threatening infections. TROUGH ONLY.
- Patients receiving Vancomycin/Aminoglycoside or Vancomycin/Amphotericin B combination therapy. TROUGH ONLY.
- Anephric patients undergoing hemodialysis and receiving infrequent doses of Vancomycin for serious systemic infections. RANDOM TROUGH 4 hours after dialysis.
- Patients receiving higher than usual doses of Vancomycin (adults: > 20 mg/kg/dose, pediatrics: > 60 mg/kg/day). INITIAL PEAK & TROUGH. Once therapeutic, do not repeat levels if fluid status and renal function are stable.
- Patients with rapidly changing renal function (50% increase/decrease or 0.5 mg/dl increase/decrease in SCr over 24-48 hours). RANDOM TROUGH only.
- Morbidly obese patients. TROUGH ONLY.
- Reaffirm a seriously abnormal or unusual serum concentration (i.e., line draws, inappropriate times, etc.). TROUGH ONLY.
- Neonates: a) determine a therapeutic level has been achieved after culture results have been reported and b) monitor serum levels with prolonged therapy >10 days. INITIAL: PEAK AND TROUGH; TROUGH ONLY after therapeutic levels achieved for prolonged administration with stable renal function.
- Patients receiving prolonged (>14 days) Vancomycin therapy. TROUGH ONLY.

Monitoring is NOT recommended in the following settings:

- Patients treated for less than five days.
- Patients receiving oral Vancomycin.
- Patients with stable renal function who are treated for up to 5 days for mild to moderate infections.

Drug level recommendations:

Drug	Time to obtain	Therapeutic range	Hospital Cost
Trough	Half- hours before 5th dose	7-14 µmol/l	
Peak	One hour after infusion stopped	17-28 µmol/l	

4.3 Aminoglycoside Dosing Regimen

I. Calculation of the initial dose :

To calculate a loading dose for a patient, refer to the following steps:

A. The Loading Dose (LD) should be recommended for all patients and should be based on the patient's weight and desired peak concentration.

1. If the total body weight (TBW) is less than or equal to the ideal body weight (IBW), then TBW is the dosing weight.
2. If the TBW is > 30 % of the IBW estimate, calculate the adjusted body weight (ABW) using the following equation:
   ABW = IBW + 0.4 (TBW-IBW)
3. Equations for IBW are as follows:
   a. Males
      IBW (kg) = 50kg + 2.3kg (2.5cm over150cm)
   b. Females
      IBW (kg) = 45.5 kg + 2.3 kg ((2.5cm over150cm)

B. After calculating the patient's dosing weight, the creatinine clearance should be calculated.
1. To calculate the patient's creatinine clearance (CrCl), one needs to know the patient's age, dosing weight (IBW or ABW) and serum creatinine (Scr).
2. Estimate patient's creatinine clearance (CrCL) via the following equation:
   - CrCL (male) ml/min = $\frac{(140 - \text{age}) \times \text{BW (kg)}}{72 \times 0.0113 \times \text{SrCr (umol/L)}}$
     - For females, adjust CrCl by multiplying the above result by a factor of 0.85
     - Patients whom are elderly, cachectic, malnourished or bedridden, round the Scr up to 88.4 umol/L (if <88.4 umol/L) to avoid overestimation of CrCL. (If Scr is >88.4 umol/L, use actual Scr value)
     - Which body weight to use in Crcl calculation?
       - Use actual body weight (ABW) if it is less than ideal body weight (IBW)
       - Use IBW (if it is within 30% of ABW)
       - For Obese patients (defined as ABW > 30% of IBW), use adjusted body weight (AdjBWT)
   - Calculation of IBW: (weight in kg, height in cm)
     - IBW males (kg) = 50 + [0.9 (HT -152 cm)]

- IBW females (kg) = 45.5 + [0.9(HT -152 cm)]
- AdjBWT = IBW + 0.4 (ABW- IBW)

II. **Calculation of loading dose:**

- Loading dose Dose = 0.3 * Peak desired * dosing weight
- To choose a loading dose which will target the desired serum concentrations for suspected or documented infection, use the following table:

Aminoglycosides	Expected peak
Gentamicin	4 –10 mcg/ml
Amikacin	20–35 mcg/ml

III. Calculation of Maintenance Dose:

A. Select a maintenance dose (80 % of your loading dose)
B. Select dosing interval, based on the creatinine clearance from the following table:

Creatinine clearance, mL/min	Dose interval, hours
> 90	8
50-89	12
25-49	24
< 25 and dialysis	Per random levels

* Redose once level has dropped to a predetermined point (often 1-2 mcg/ml)

- These recommendations apply to patients receiving traditional dosing regimens and not to patients receiving Once-daily dosing.
- Round off maintenance doses to the nearest 10 mg.

- You may consult the clinical pharmacist for any pharmacokinetic advice during dosing and monitoring of aminoglycosides.

IV. Aminoglycosides dosing based on the Hartford Hospital Once Daily Program (ODA)

There are several studies suggesting that larger doses of aminoglycosides given once-daily are just as effective as conventional dosing given three times a day. ODA regimens take advantage of concentration-dependent killing through the optimization of peak concentration / MIC ratios. In addition, there are potential cost savings for laboratory personnel.

A. **Inclusion Criteria:** All patients ordered aminoglycosides for prophylaxis, empiric therapy, or documented infection.

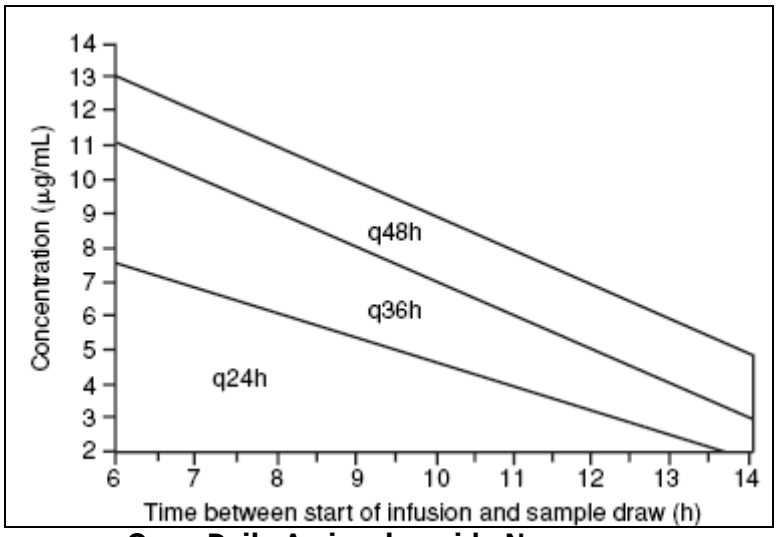
B. **Exclusion criteria:**
1. Pregnant women

2. Pediatric patients (<18 yrs of age)
3. Patients with renal impairment (estimated CrCl < 50 ml/min)
4. Patients receiving gentamicin for synergistic effect or not requiring peak concentrations > 3-4 mcg/ml.
5. Patients with ascites.
6. Patients with burns on >20% of total body surface area
7. Patients with gram positive bacterial endocarditis
8. Cystic fibrosis patients
9. CNS infection
10. Tuberculosis
11. Osteomyelitis
12. Anticipated duration of therapy greater than 14 days

C. **Dosing and monitoring:**

1. Doses should be based on **ideal body weight** (refer to the same criteria for body weight as per multiple dosing mentioned above)
2. Administer 5-7 mg/kg gentamicin and 15-20 mg/kg amikacin (consider higher dose for septic , pesudomonous infections or ICU patients)
3. The dose should be infused over 30minutes
4. Peak levels are not necessary.
5. Obtain timed serum concentration 8 to 14hours after the first dose.
6. Alter dosage interval to that indicated by the nomogram zone.
7. For gentamicin, If the interval falls in the area designated q24h, q36h, or q48h, the interval should be q24h, q36h, or q48h, respectively; however if the point is on the line, one should choose the longer interval.
8. For Amikacin : Divide the level measured in half, plot this newly calculated level on the Hartford Nomogram to determine the dosing schedule.

   Example: Amikacin 15 mg/kg dose given at 0900. A level drawn at 1800 is 8 mcg/mL. To plot this on the nomogram, first divide the level by two (8 mcg/mL / 2). This gives you a calculated level of 4 mcg/mL. Plotting it on the nomogram yields a 24 hour dosing schedule.
9. If the level above q48h zone, stop the scheduled therapy and administer next dose when serum concentration <1 mcg/ml for gentamicin and < 10 mcg/ml for amikacin.
10. Serum creatinine should be monitored regularly and the dosing interval is adjusted if the creatinine increases by 50% or it is trending upward.
11. Monitor for signs and symptoms of ototoxicity with duration of therapy beyond 7 to 10 days



Once-Daily Aminoglycoside Nomogram

V. Monitoring a patient while on aminoglycosides

A. Monitoring for signs of toxicity

- Nephrotoxicity:

  Patients are at higher risk for nephrotoxicity in case of :

  - Combined nephrotoxic medications
  - Elevated troughs above the recommended guidelines
  - Extended duration of therapy beyond 10 days

- Ototoxicity

  a. Cochlear dysfunction is often irreversible. Vestibular damage (dizziness, vertigo, ataxia) can be overcome by physiologic compensatory functions, although the patient may have some difficulty maintaining balance.

  b. Ototoxicity has been associated with high peaks and troughs as indicated maintaining balance.

- Neuromuscular Blockade

  a. Neuromuscular blockade occurs as the aminoglycoside interferes with calcium and inhibits the release of acetylcholine at the level of the presynaptic membrane.

  b. This reaction usually occurs in severely ill patients and may lead to delaying to difficulty weaning off the ventilator. This has been associated with rapid administration, concurrent use of neuromuscular blocking agents, hypocalcemia, aminoglycoside accumulation or over dosage, and neuromuscular disease

VI) Determination of serum and monitoring levels

Sampling time:

- Desired trough: 30 minutes before the next scheduled dose
- Desired peak : 30 minutes after the end of the infusion or 60 minutes after IM injection
- Troughs should be obtained before the 4th dose of therapy unless the patient has renal failure or unstable kidney function
- Frequent sampling and monitoring may be required for patients with unstable kidney function
- For dialysis patients, obtain serum concentration before dialysis and consider 50% removal of the drug during the dialysis session (divide level obtained by 2 to decide on redosing interval as per targeted levels)
- The following table should be used as a guide to select desired peak and trough concentration for patients on aminoglycosides antibiotics:

Desired serum levels	Gentamicin		Amikacin	
	Peak mcg/ml	Trough mcg/ml	Peak_mcg/ml	Trough mcg/ml
UTI and G +ve synergy	3-5	< 0.5	20-27	< 5
Systemic infections	6-8	<1-2	32-35	< 10
Pneumonia and sepsis	8-10	< 1-2	32-35	<10

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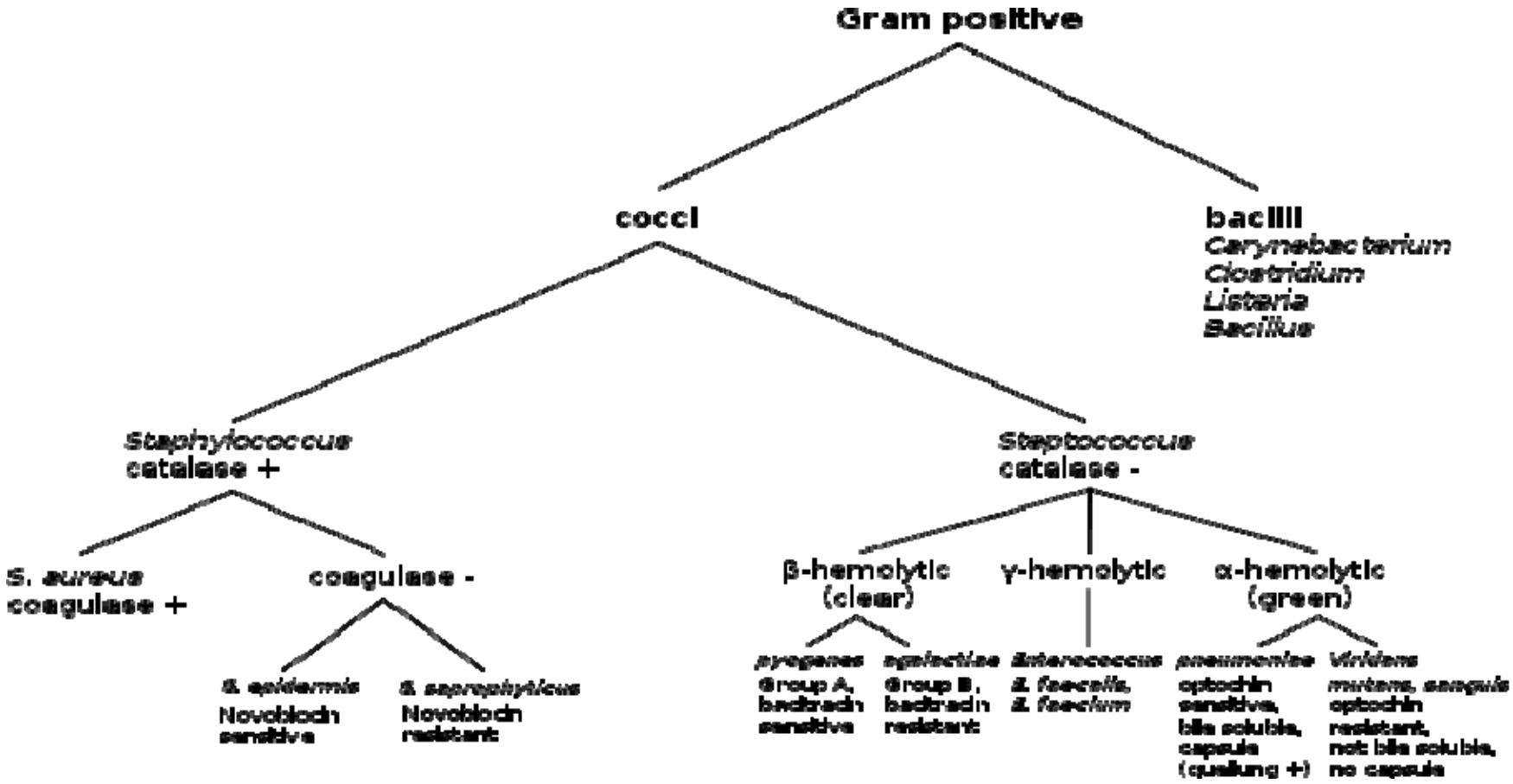
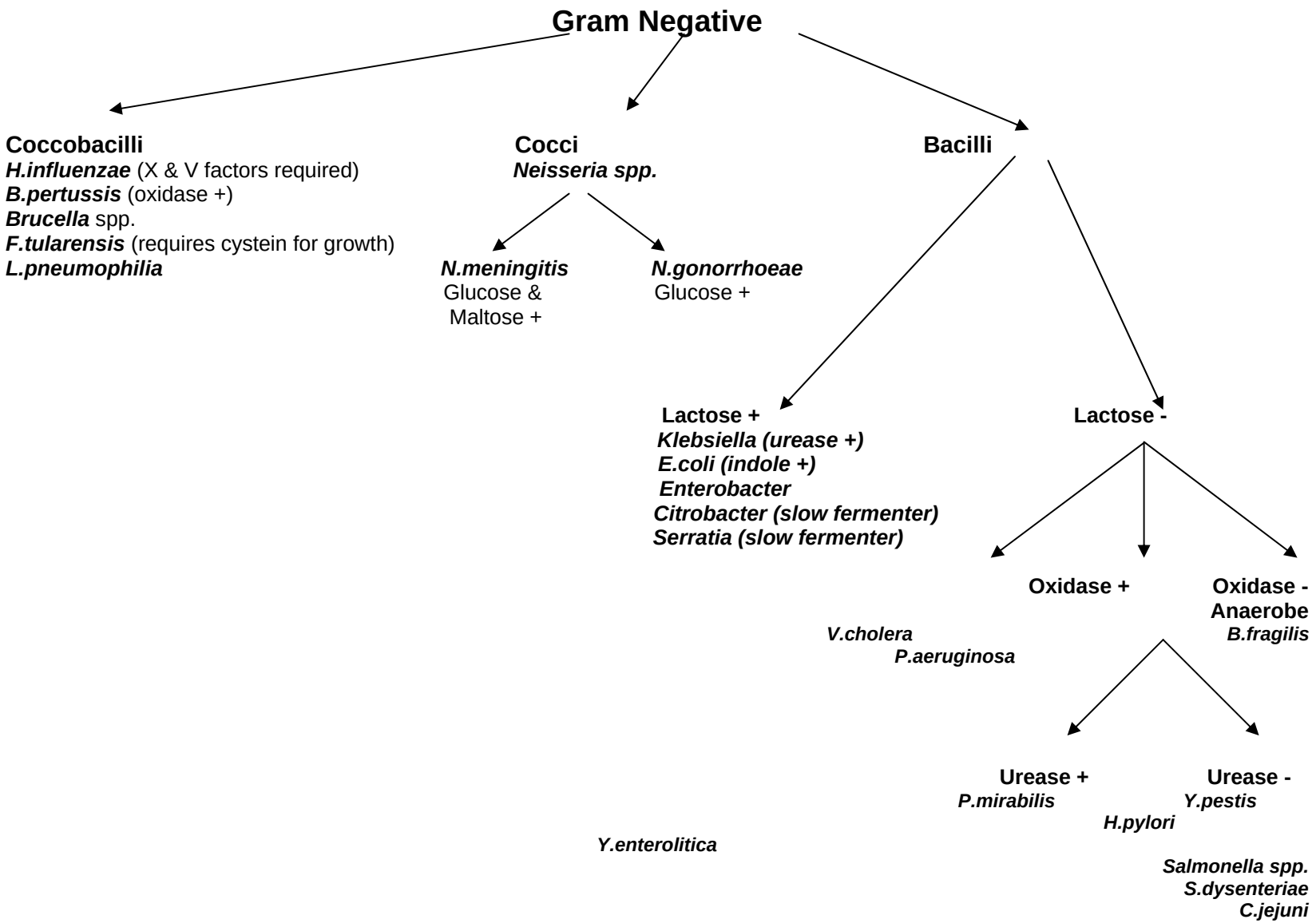
5. MICROBIOLOGY INFORMATION

5.1 Interpreting the Microbiology report

Microscopic examination remains the initial diagnostic test in the processing of specimens in the clinical microbiology laboratory. The timely report of a Gram-stain result gives the physician important information about the presence and cause of infection. The Gram-stain classifies bacteria as either gram-positive or gram-negative.

	Gram-positive cocci	Gram-negative cocci	Gram-positive rods	Gram-negative rods
Aerobic	**In clusters :**	**Diplococcus:**	**Large:** Bacillus spp.	**Lactose fermenting:**
	S.aureus (Coagulase +) S.epidermedis (Coagulase -)	N.meningitis, N.gonororrhoeae, Moraxella catarrhali	**Cocco-Bacillus:** L.monocytogens, Lactobacillus.	citrobacter spp, Enterobacter spp, E.coli, Klebsiella spp, Serratia spp.
	In chains:	**Cocco-bacillus:**	**Small, pleomorpic:** Corynbacterium spp.	**Non-Lactose fermenting:**
	Diplococcus: S.penumoniae Alphahemolytic: S.Viridans Beta-hemolytic: S.pyogene (group A) S.agalactiae (group B) Strep group C, D, G	H.influenzae, acinetobacter spp. Brucella spp.	**Branching filaments:** Nocardia spp, Streptomyces spp	Acinetobacter spp, Burkhloderia spp, Proteus spp, Salmonella spp, Shigella spp, Serratia spp, Stenotrophomonas spp, P.aeruginosa, Vibrio spp, Campylobacter spp.
Anaerobic	Peptostreptococcus spp.	Veillonaella spp.	**Large:** Clostridium spp. **Small, pleomorphic:** Actinomyces spp.	Bacteroids spp, Fusobacterium spp.


Gram positive
cocci
bacIII
Carynebac terium
Clostridium
Listeria
Bacillus
Staphylococcus
catalase +
Staptococcus
catalase -
S. aureus
coagulase +
coagulase -
β-hemolytic
(clear)
γ-hemolytic
α-hemolytic
(green)
S. epidermis
Novobiocin
sensitive
S. saprophyticus
Novobiocin
resistant
pyogenes
Group A,
bacitracin
sensitive
agalactiae
Group B,
bacitracin
resistant
Enterococcus
E. faecalis,
E. faecium
pneumoniae
optochin
sensitive,
bile soluble,
capsule
(quellung +)
Viridans
mutans, sanguis
optochin
resistant,
not bile soluble,
no capsule


Gram Negative
Coccobacilli
H.influenzae (X & V factors required)
B.pertussis (oxidase +)
Brucella spp.
F.tularensis (requires cystein for growth)
L.pneumophilia
Cocci
Neisseria spp.
N.meningitis
Glucose &
Maltose +
N.gonorrhoeae
Glucose +
Bacilli
Lactose +
Klebsiella (urease +)
E.coli (indole +)
Enterobacter
Citrobacter (slow fermenter)
Serratia (slow fermenter)
Lactose -
Oxidase +
V.cholera
P.aeruginosa
Oxidase -
Anaerobe
B.fragilis
Urease +
P.mirabilis
Y.enterolitica
Urease -
Y.pestis
H.pylori
Salmonella spp.
S.dysenteriae
C.jejuni

5.2 Specimen sampling:

The quality of a laboratory report is influenced by many variables such as the quality of the specimen collected, the time of transporting the specimen to the laboratory and the provision of appropriate and correct information on the laboratory request form to guide the laboratory in processing and interpreting the culture results.

The laboratory procedures are quality controlled to guarantee relevant, reliable, timely, and correctly interpreted reports that will guide patient management. However, poor-quality specimens may lead to misleading results, inappropriate antimicrobial therapy and delay in diagnosis.

It is very important to remember that:

- The site from where the specimen was collected is very important to determine the significance of the organisms isolated.
- Organisms from non-sterile sites such as the respiratory tract may be colonizers and not necessarily the cause of infection.
- Swabs are inferior to aspirated pus or tissue specimens in the recovery of pathogens.
- Swabs from non-sterile sites often yield mixed growths due to colonization or contamination that are generally not clinically significant.
- Contamination of blood cultures with skin and environmental flora or so-called 'contaminants' is a common problem as a result of an inappropriate blood culture technique.
- To establish the clinical significance of 'contaminants', repeated isolation of the same organism from different sterile sites is required.
- If the patient does not respond to the chosen antibiotic therapy according to the microbiological susceptibility profile, consider: inadequate therapy for the infection site; inadequate dosage; poor source control and the possible selection of resistant mutants.

5.3 KAMC-NGHA ANTIBIOGRAM

For the current antibiogram for your hospital please refer to your hospitals intranet site under the department of Pathology. The antibiogram will be updated on a yearly basis.

5.4 Susceptibility:

Different methods are employed at the Microbiology Department at NGHA-KAMC Riyadh to determine antimicrobial activity: the disk diffusion (measure zone of inhibition), the automated broth dilution and the E-test method which measure minimum inhibitory concentration (MIC). Susceptibility results are interpreted according to the Clinical Laboratory Standards Institute (CLSI) guidelines.

Depending on the method, detection of resistance may not be reliable for certain agents, and laboratories will automatically select an appropriate alternative method.

Always remember:

If the patient does not respond to appropriate antibiotics according to culture and susceptibility results of good-quality specimens, the following possible reasons should be investigated:

1. Poor source control--septic foreign material such as intravascular catheter/ prosthesis that has not been removed; pus collection not drained or necrotic tissue/ bone not debrided.

2. Inadequate therapy--suboptimal antibiotic concentration at site of infection due to poor penetration, e.g. endocarditic or inadequately administered (doses missed, too low dose for patient).

3. Resistant organism subpopulations not detected with routine susceptibility methods, e.g. subpopulations of *S. aureus* heteroresistant to Vancomycin, or that may have been selected on treatment, e.g. resistant mutant populations of Enterobacter spp. selected on Cephalosporin treatment.

5.5 Rapid diagnostic tests

Rapid diagnostic tests which detect and identify the presence of microorganisms are very important and useful in helping physicians in making *early treatment*. It is also important for the tests to be: accurate, simple to use, low-cost or cost-effective and easily interpretable.

1. **Chlamidia trachomatis and Neisseiria gonorrhoeae** identification in urine and genital samples using the Amplified DNA Assay are performed every Wednesday and results are available in 1 day.

2. **Clostridium difficile Toxins A and B** detection using the Enzyme-Immunoassay (EIA). Detection by PCR is available for the Intensive Care Units.

3. **Cryptosporidium parvum and Giardia lamblia** in stool using the EIA. The results are available in 1 day.

4. **HSV1, HSV2 and VZV** detection using the DFA. Results are released in few hours if the slide is inoculated at bed site. The tests are done during the week days (5 days/week).

5. **Legionella** antigen in urine. The results are available in 1 day.

6. **MRSA** PCR test using the genexpert machine is performed to detect the MRSA DNA from the nasal specimen. Results are released within few hours as positive or negative. For the Border line results, routine culture is performed for confirmation and results will be released in 1 or 2 additional days.

7. **Mycobacterium tuberculosis** detection in the respiratory samples using the Amplified DNA Assay. The test is performed every Tuesday and results are available in 1 day. In addition, this technique has a higher sensitivity than sputum AFB smears.

8. **Respiratory viruses** detection (Adenovirus, Influenza A, Influenza B & Parainfluenza 1, 2 & 3) using the Direct Fluorescent Assay (DFA). Tests are performed daily and results are available in 1 day if specimen is received prior to 10 am. (Nasopharyngeal aspirate is the preferred specimen).

9. **RSV** detection using the EIA. If positive, results are released in 1 hour. If negative, DFA is performed.

10. **Rota Virus** antigen detection using the EIA.

6. ABDOMINAL INFECTIONS

6.1 Cholangitis

Diagnosis	Empiric Treatment	Likely Microorganisms	Duration of therapy	Treatment note
Acute Cholangitis (mild – moderate disease not health care associated).	Ceftriaxone 1 gm IV Q12H **plus** Flagyl 500 mg IV Q8H	*E.coli* *Klebsiella spp.* *Enterobacter spp.* *Enterococcus* and anaerobes often of unclear relevance.	7 days	Treatment of enterococci is usually not needed in mild /moderate disease. Empiric treatment for yYeast is not recommended unless generally should be treated only if they are recovered from biliary culture not empirically.
Hospital acquired infections or patients with prior biliary procedures or patients who are severely ill.	Meropenem 1gm IV Q8H		10 days	

6.2 Cholecystitis

Diagnosis	Empiric Treatment	Likely Microorganisms	Duration of therapy	Treatment note
Uncomplicated acute cholecystitis/ community acquired/ mild-moderate. Usually inflammatory and noninfectious.	Operation and abx for 24-48H <u>If operation delayed :</u> Ceftriaxone 1 gm Q12H **<u>plus</u>** Flagyl 500 mg IV Q8H	If infectious *E.coli* *klebsiella spp.*	3-5 days	
Severe/community acquired acute cholecystitis of Severe physiologic disturbance, advanced age, or immunocompromised state.	Piperacillin/Tazobactam 4.5 gm IV Q6H	*E. coli* *Klebsiella spp.* *Proteus spp.* *Pseudomonas* (in pts with prior procedures or on broad spectrum Abx) Anaerobes (in more serious infections or history of biliary manipulation).	7days For biliary sepsis 10 days	In severely ill patients with cholangitis and complicated cholecystitis, adequate biliary drainage is crucial as antibiotic will not enter bile in presence of obstruction.

6.3 Cirrhotic Patient with Gastrointestinal Hemorrhage

Diagnosis	Empiric Treatment	Likely Microorganisms	Duration of therapy	Treatment note
Cirrhotic patient with gastrointestinal hemorrhage.	Ceftriaxone 1 gm Q12H	N/A	7 days	

6.4 Crohn's Disease

Diagnosis	Empiric Treatment	Likely Microorganisms	Duration of therapy	Treatment note
Crohn's disease (Colitis, Ileitis, perineal or perianal disease).	Ciprofloxacin 500 mg IV Q12H **plus** Flagyl 500 mg IV Q8H	*Enterobacteraciae* *Bacteroides* *Enterococci*	3-5 days	

6.5 Intra-abdominal Sepsis

Diagnosis	Empiric Treatment	Like Microorganisms	Duration of therapy	Treatment note
Intra-abdominal sepsis	Mild to moderate disease or community acquired: Ceftriaxone 1 gm IV Q12H **plus** Flagyl 500 mg Q8H If severe or healthcare associated: Meropenem 1gm IV Q8H	*E.coli* *B. fragilis* and other colonic anaerobes and gram negative flora	7 days	

6.6 Pancreatitis

Diagnosis	Empiric Treatment	Like Microorganisms	Duration of therapy	Treatment note
Acute Pancreatitis	None	Non-infectious		Most common cause of pancreatitis is non-Infectious.
Acute pancreatitis with >30% necrosis by CT.	None			Prophylactic antibiotics for necrotizing pancreatitis is generally not recommended. Consideration for needle aspiration for gram stain and culture in special cases
Acute Pancreatitis with possible infected necrosis. Infected necrosis usually presents in the 2^{nd} -3^{rd} week.	Imipenem 500 mg IV Q6H	GI flora (aerobes and anaerobes)	14 days but may be longer	Surgical consultation is recommended Infected necrosis must be diagnosed CT guided Aspirate and drained (percutaneously or surgically).

6.7 Peritonitis

Diagnosis	Empiric Treatment	Like Microorganisms	Duration of therapy	Treatment note
Peritonitis, spontaneous ascites with >250 PMN cells/ml.	Ceftriaxone 1gm Q12H	*E. coli* *Klebsiella spp.* *Streptococcus spp.*	5 days	SBP variant forms (culture negative neutrophilic ascitis and monomicrobial non neutrophilic) Bacterial ascites treated the same. Consider repeat paracenthesis in 48H. Patients who develop SBP should get life long prophylaxis with ciprofloxacin 500 mg PO Q24H.
Secondary peritonitis /GI perforation. If patient is immuno-compromised or severely ill.	Ceftriaxone 1 gm q 12hr **plus** Metronidazole 500 iv q 8 hr Piperacillin/Tazobactam 4.5 gm IV Q6H If antifungal added use fluconazole 400 mg IV Q24H	*B. fragilis* *Enterobacteriaceae*	If operated within 24H give abx for total of 48 hr If late operation or no operation or necrotic /gangrenous appendix give for 7days	Add antifungal if one of these risk factors are present: esophageal perforation , immunosuppression, prolonged anti acid use, prolonged hospitalization, persistent GI leak Treat enterococcus in critically ill patients or the immunocompromised

7. BRUCELLOSIS

Diagnosis	Empiric Treatment	Like Microorganisms	Treatment note
Clinically and positive blood/body fluid culture. **or** A single high Brucella serology	1. Adult or Child >8 years : Doxycyline 100 mg PO Q12H for 6 wks (maximum 200mg/day) + Streptomycin: 1 g/d IM for 2-3 wk **or** Doxycycline 100 mg PO Q12H for 6 wks maximum 200mg per day + Rifampin 600-900mg PO OD for 6 weeks 2. Child < 8 years: Trimethoprim 10mg/kg/day (max 480mg/day) sulfamethoxasole PO in 2 divided doses **plus** Rifampicin 20mg/kg/day (max 600mg/day PO in 2 divided doses) **plus** Gentamicin 7.5mg/kg/day I.V Q8H for hospitalized patients (max for 7 days)	*Brucella spp.* *B. abortus-cattle* *B. melitensis-goats* *B.canis*	Pregnancy: ID consultation is preferred Trim/sulfa + Rifampin regimen is reasonable Trim/Sulfa Ds tab PO Q12H for 6 weeks, and Rifampin 600-900 PO Q12H for 6 weeks.

References: *Antibiotic guidelines. Johns Hopkins 2010-2011 * Brucellosis .NEJM 2005 * Brucellosis HPA Sep,2009

8. CENTRAL NERVOUS SYSTEM INFECTIONS

Diagnosis	Empiric Treatment	Like Microorganisms	Duration of therapy	Treatment note
8.1 Meningitis Immunocompetent age <50	Ceftriaxone 2gm IV Q12H	*S. pneumoniae* *N. meningitidis* *H. influenzae*	*S. pneumoniae* 10-14 days	Dexamethasone for all adult patients with suspected pneumococcal meningitis 0.15mg/kg IV Q6H for 2-4 days
Immunocompetent age>50	Ceftriaxone 2gm IV Q12H **plus** Ampicillin 2 gm IV Q4H	*S. pneumo, N. mening, H. influ*, listeria , group B Strep	*N. meningitidis* 7 days *Listeria* 21 days	The first dose 10-20 minutes or with the first dose of abx Dexamethasone should be given to patients who started antibiotics
Immunocompromised	Vancomycin plus Ceftriaxone plus Ampicillin	*S. pneumo, N. mening, H. influ, listeria* , gram negative	*H. influenzae* 7 days	Consult ID service for all CNS infections
Post neurosurgery or penetrating head trauma	Vancomycin plus Cefepime	*S. pneumo if CSF leak, H,influenza,* Staphylococci, gram negative	Gram negative 21 days	Vancomycin load with 25mg/kg then 15-20 mg/kg Q8-12H
Infected shunt	Vancomycin plus cefepime	*S .aureus*, coagulase negative staph, gram negative		

8.2 Brain abscess unknown source	Vancomycin plus ceftriaxone plus flagyl	*S. aureus*, streptococci, gram negative anaerobes		
Sinusitis	Ceftriaxone plus Flagyl	Streptococci, anaerobes		
Chronic Otitis	Cefepime plus Flagyl	Gram negative, streptococci, anaerobes		
Post neurosurgery	Vancomycin plus Cefepime	Staphylococci, gram negative		
Cyanotic heart disease	Ceftriaxone	Streptococci (*S. viridans*)		

9. DEVICE-ASSOCIATED INFECTIONS

9.1 Catheter-Associated Urinary tract Infection

Diagnosis	Empiric Treatment	Likely organisms	Duration of therapy	Comments
Symptomatic UTI: Signs and symptoms (fever with no other source is the most common; patients may also have suprapubic or flank pain) **AND** Pyuria (> 5-10 WBC/hpf) AND Positive urine culture ≥ 1000 colonies	Remove catheter when possible **Patient stable with no evidence of upper tract disease:** • If catheter removed, consider observation alone **OR** Ciprofloxacin 500 mg PO Q12H or 400 mg IV Q12H (avoid in pregnancy and in patients with prior exposure to quinolones) **OR** • Ceftriaxone 1g IV Q24H • (Bactrim?) **Patient severely ill, with evidence of upper tract disease, or hospitalized >48 H:**	*E.coli* Enterococci Other GNB Candida spp.	7 days for uncomplicated cases 10-14 days for complicated cases. **3 days** if catheter removed in female patient < 65 years with lower tract infection.	**Specimen collection**: the urine sample should be drawn from the catheter port using aseptic technique, NOT from the urine collection bag. In patients with long term catheters (≥ 2 weeks), replace the catheter before collecting a specimen. Urine should be collected before antibiotics are started. Remove the catheter whenever possible. Prophylactic ATBs at the time of catheter removal or replacement are NOT recommended due to low incidence of complications and

Asymptomatic bacteriuria: Positive urine culture ≥ 100,000 colonies with no signs or symptoms of infection Note: routine culture in asymptomatic patients is not recommended.	• Cefepime 1 g IV Q8H • OR • PCN allergy: aztreonam 1 g IV Q8H (Cipro IV or Bactrim IV) Remove the catheter No treatment unless the patient is: • Pregnant • Post renal transplant • Neutropenic • About to undergo a urologic procedure			concern for development of resistance. Catheter irrigation should not be used routinely.

9.2 Catheter-Associated Bloodstream Infections (CA-BSI)

Diagnosis	Empiric Treatment	Likely Microorganisms	Duration of therapy	Treatment note
If there is more than minimal erythema or any purulence at the exit site, the catheter is likely infected. It should be removed and replaced at a different site. 2 sets of blood cultures should be drawn with at least one (and preferably both) from peripheral sites.	Vancomycin +/- Cefepime 1g IV Q8H **OR** <u>Severe PCN allergy</u>: Vancomycin +/- Cipro 400 mg IV Q8H <u>Gram stain :</u> Gram (+) cocci in clusters in 2 ore more sets of blood cultures Vancomycin	**Coagulase (-) Staph** Single positive cultures SHOULD not be treated unless they are confirmed by follow-up cultures, accompanied by signs and symptoms, the patient is immuncompromised and/or critically ill. *S. aureus*	5-7 days if catheter removed 10-14 days if catheter salvage attempt 14 days is the minimum course of therapy if endocarditis has been ruled out.	The routine culture of the catheter itself is not recommended unless there is suspicion of clinical infection and MUST be accompanied with 2 sets of blood cultures. If the catheter tip culture is positive and the blood cultures are negative, antimicrobials are not recommended. Exceptions for the positive catheters tips with negative blood cultures are for the isolation of *S.aureus* and therapy is recommended for 5-7 days.
Patients with *S.aureus* bacteremia should have an echocardiogram to rule out		*Enterococcus Faecalis*	7-14 days	For Enterococcus Faecium: Do not use Gentamicin if the lab reports

Endocarditis. Transthoracic echo is acceptable only if the study adequately views the left-sided valves. Otherwise, a transesophageal echocardiogram is indicated.		Can be contaminant. Draw repeat cultures to confirm before starting treatment. *Enterococcus Faecium* Can be contaminant. Draw repeat cultures to confirm before starting treatment. **Gram-Negative Bacilli**	7-14 days 7-14 days	no synergy with a cell wall agent. If synergy is present, gentamicin should be added to Ampicillin or Vancomycin in the treatment of endocarditis. However the addition of gentamicin doesn't appear to change outcomes in CA-BSI in the absence of Endocaridits if catheter has been removed. Do not use Gentamicin with Linezolid or Quinupristin /Dalfopristin given lack of supportive evidence for supportive evidence for synergy. Catheter removal is STRONGLY recommended for infections with *S.aureus*, yeast and Pseudomonas, and the chance for catheter salvage is low and the risks of ongoing infection can be high.

			7-14 days	Catheter salvage can be considered in CA-BSI caused by coag(-) Staph if the patient is clinically stable. When catheter salvage is attempted, ATBs should be given through the infected line.

9.3 Ventilator-Associated Pneumonia (VAP)

Diagnosis	Empiric Treatment	Likely Microorganisms	Duration of therapy	Treatment note
The diagnosis of VAP is suspected if the patient has a radiographic infiltrate that is new or progressive, along with clinical findings suggesting infection, which include the new onset of fever, purulent sputum, leukocytosis, and decline in oxygenation. When fever, leukocytosis, purulent sputum, and a positive culture of a sputum or tracheal aspirate are present without a new lung infiltrate, the diagnosis of healthcare associated tracheobronchitis should be considered. Bacteria in endotracheal section may represent colonization and not infection. The accuracy of the clinical diagnosis of VAP has been investigated on the basis of	A reliable tracheal aspirate gram stain can be used to direct initial empiric antimicrobial therapy. Vanco + Pip/Taz **OR** Vanco + Cefepime +/- gentamicin Empiric treatments must be narrowed as soon as sputum culture results are known. If a patient is on ATB therapy or has recently been on ATB therapy, choose an agent from a different class.	*P.aeruginosa* *Enterobacter spp* *Serratia marcenes* Klebsiella spp *Acinetobacter spp* MSSA MRSA	8 days if the patient has clinical improvement. If symptoms persist at 8 days consider reevaluation. VAP associated with S.aureus bacteremia should be treated for at least 14 days.	Vancomycin should be stopped if resistant grams (+) organisms are not recovered. Gram (-) coverage can be reduced to a single susceptible agent in most cases. Enterococci and Candida species are often isolated from the sputum. They should be considered colonizing organisms and should not be treated. Inadequate initial treatment of VAP is associated with higher mortality.

autopsy findings or quantitative cultures of either protected specimen brush or bronchoalveolar lavage as the standard for comparison. All patients with suspected VAP should have blood cultures collected, recognizing that a positive result can indicate the presence of either pneumonia or extrapulmonary infection				

10. PULMONARY INFECTIONS

Diagnosis	Empiric Treatment	Likely Microorganisms	Duration of therapy	Treatment note
10.1 COPD exacerbation: Uncomplicated	Doxycycline 100 mg Q 12H Amoxicillin 1 gm Q12H	*H. influenza* *S. pneumoniae* *M. catarrahlis* Viruses	10 days	Abx not indicated in asthma flare in the absence of pneumonia
10.2 COPD exacerbation: Complicated history of more than 4 exacerbation in last 12 months, CAD, CHF, home oxygen, chronic steroid, abx use in the past 3 months	Azithromycin 500 mg PO Q24 H **or** Augmentin 1 gm Q12H		For azithromycin : 5 days For augmentin: 10 days	Empiric therapy with quinolone is discouraged
10.3 CAP: In hospitalized patients. Sputum and blood culture should be sent for all patient before abx use Pt not in ICU No risk for pseudomonas	Ceftriaxone 1gm Q24 H **plus** Azithromycin 500 mg Q24H Ceftriaxone 1 gm Q24H **Plus** Azithromycin 500 mg IV Q24H	*S. pneumoniae* *H. influenza* *M. catarrhalis* *Chlamydia* *Legionella* *Myco. pneumonia* *Viruses: influenza, adeno, RSV, para influenza*	Therapy can be stopped if the patient is afebrile for 48-72 hr. 5 days if pt not immunocompromised or no structural lung disease 7 days if pt immunocompromised or structural lung disease. 10-14 days if pt with poor clinical response or severely immunocompromised.	Consider CA-MRSA in the setting of necrotizing pneumonia with cavitation in the absence of aspiration esp. if associated or preceded with viral illness, comorbidities, such as chronic heart, lung, liver, or renal disease; diabetes mellitus; alcoholism; malignancies; asplenia; immunosuppressing conditions or use of immunosuppressing drugs; use of antimicrobials within the previous 3 months.

Risk for pseudomonas : • prolonged hospital stay • long term facility> 5 days • structural lung disease (bronchiectasis) • steroid therapy • broad spectrum abx >7 days in the past month • granulocytopenia Outpatient treatment (pt healthy no risk factors for DRSP). If co-morbidities or exposure to abx in the previous 3 months.	Piperacillin/Tazobactam 4.5 gm IV Q6H **Plus** Azithromycin 500 mg Q24H If MRSA suspected add vancomycin 15-20 mg/kg IV Q12H aiming for a trough 15-20 ug/ml. but if MRSA is documented replace vancomycin with Linezolid 600mg IV/PO Q12H. Azithromycin 500 mg first day then 250 mg Q day for 4 days Azithropmycin 500mg then 250 mg for 4 days plus Augmentin 2gm po Q 12 H or cefuroxime 500 mg PO Q12H			

11. SEPSIS IN ICU PATIENTS

Diagnosis	Empiric Treatment	Likely Microorganisms	Duration of therapy	Treatment note
Sepsis in ICU patient with no clear source	Piperacillin/Tazobactam 4.5 gm IV Q6H + /- Amikacin 15mg/kg once daily (if patient is severely ill) +/ - Vancomycin 15-20 mg/kg IV Q12H aiming for a trough 15-20 ug/ml.	Risk for MRSA: • Central venous catheter • Indwelling hardware • Known colonization with MRSA • Recent prolonged hospitalization • Transfer from nursing home • Injection drug user		Pan culture should be sent (blood, tracheal aspirate), consider urine culture if no other source to explain the sepsis. Stop Vancomycin if no resistance gram positive. Consider double gram negative coverage in empiric tx of serious infection with hypotension and pressers or documented infection with resistant gram negative organism .

12. SEXUALLY TRANSMITTED DISEASES (STDs)

Diagnosis	Empiric Treatment	Likely Organism	Duration of Therapy	Comments
12.1 Chancroid	Ceftriaxone 250 mg IM injection once **or** Azithromycin 1 gm PO once	*Haemophilus ducreyi*	Single dose	
12.2 Non gonococcal urethritis, cervicitis	Doxycycline 100 mg PO Q12H for 7 days **or** Azithromycin 1 g PO once	*Chlamydia spp, Mycoplasma hominis, Mycoplasma genetalia, others Trichomonas*	1-7 days	In pregnancy, Erythromycin 500 mg PO Qid x 7 days
12.3 Gonorrhea, urethritis, cervicitis, proctitis	Ceftriaxone 250 mg IM injection once **plus** Azithromycin 1 g PO once **or** Doxycycline 100 mg PO Q12H for 7 days	*Niessierria gonorrhoea*	1-7 days	50 % of patients will have concomitant Chlamydia Trachomatis infection, combination therapy is recommended.
11.4 Lymphogranuloma venereum	Doxycycline 100 mg PO Q12H	*Chlamydia trachomatis serovars L1-3*	21 days	
11.5 Granuloma ingunale	Doxycycline 100 mg PO Q12H, or Septra- DS PO Q12H **or**	*Klebsiella granulomatis*	21 days	

	Azithromycin 1 g PO once weekly x3 doses			
12.6 Syphilis Early primary, secondary or early latent (< 1 year)	Benzathine Penicillin 2.4 million units (MU) IM injection once **or** Doxycycline 100 mg PO Bid x 14 days **or** Ceftriaxone 1 g IM/IV Q24H x10 days	*Treponema pallidum*	1-14 days	ID consult is recommended. Confirmation of syphilis should be with IgM testing For pregnant women the only choice is penicillin so if allergic will need to be desensitized.
Late Latent (> 1 year)	Benzathine Penicillin 2.4 Mu IM injection weekly x 3 **or** Doxycycline 100 mg PO Q12Hx 28 days		21-28 days	
Neurosyphilis	Penicillin G 3 MuIV Q4Hx 14 days **Or** Ceftriaxone 2g IV Q24H x 14 days		14 days	Close follow-up.
Congenital syphilis	Aqueous crystalline pen G 50,000 u/kg IV Q12H x 7 days, then Q8H x 10 days or Ceftriaxone 75-100 mg/kg IV Q24H x 14 days		14-17 days	Pediatric ID consult is recommended. Ophthalmologic exam is needed.

12.1 OTHER GENITAL INFECTIONS

Diagnosis	Empiric Treatment	Likely Organism	Duration of Therapy	Comments
A. Women: **A.1 Amnionitis, septic abortion**	Ampicillin-Sulbactam 3g IV Q6H or Pip/Taz 4.5 g IV Q6h + Doxycycline 100 mg IV PO Q12H **or** Clindamycin 600 mg IV Q8H + gentamicin 5 mg /kg IV Q24H	*Bacteroides spp., Provetella bivius, Grp B streptococci, Entebacteriacae and Chlamydia trachomatis.*	Not specified	For pregnant women ID consultation is mandatory.
A.2 Endomyometritis, septic pelvic phlebitis ▪ Early "first 48 hrs post partum"	Same as Amnionitis	*Same as amnionitis*	14 days	- Stop breast feeding during therapy ID consult is recommended.
▪ Late "48 hrs-6 weeks post partum"	Doxycycline 100 mg IV Q12H (in case of septic pelvic phlebitis prolonged abx theray recommended and anticoagulation should be added.	*Chlamydia trachomatis, Mycoplasma hominis* *Niessiera gonorrhea, Chlamydia spp, Bacteroides spp, Enterobacteriaceae, Streptococcal spp.*	14 days	

A.3 Pelvic Inflammatory Diseases (PID), outpatient regimen	Ceftriaxone 250 mg IM once **Plus** Doxycycline 100 mg PO Q12H x 14 days. **Plus/minus** Metronidazole 500 mg PO Q12H x 14 days			
Pelvic Inflammatory Diseases (PID), inpatient regimen	Ampicillin Sulbactam 3gm IV Q6H Plus Doxycycline 100 mg PO Q12H x 14 days.			

A.4 Vaginitis: Candidiasis	Fluconazole 150 mg PO once **or** Itraconazole 200 mg PO Q12H x 1 day or Intravaginal azoles.	*Candida albicans*		
Trichomoniasis	Metronidazole 2 g PO once or 500 mg PO Q12H for 7 days.	*Trichomonas vaginalis treat husband*		
Bacterial vaginosis	Metronidazole 500 mg PO Bid x 7 days **or** Clindamycin 450 mg PO Q8H x 7 days **or** Clindamycin cream 2% vaginally at bedtime for 7 days	*Gardnella vaginallis, Myocoplasma hominis, Prevotella spp* and others *treat husband*		
B. Men: **B.1 Balanitis**	Fluconazole 150 mg PO once **or** Augmentin 1g PO Q12H x 7 days	*Candida spp or* *Group B streptococcus or* *Staphylococcus aureaus*		Direct therapy will depend on culture results
B.2 Epididymo-orchitis	Ceftriaxone 250 mg IM once	*Niessiera gonorrhea*		For Brucella treat as a case of brucellosis

	Plus Doxycycline 100 mg PO Q12H x 10 days	*Chlamydia trachomatis* *Brucella*		
B.3 Prostatitis: Acute Age < 35 yrs	Ceftriaxone 250 mg IM once **plus** Doxycycline 100 mg PO Q12H x 10 days	*N. gonorrhea, Chlamydia trachomatis*		
Acute Age > 35 yrs	Ciprofloxacin 500 mg PO Q12H 14days **or** trimethoprim sulfa DS PO Q12H 14 days	*Enterobacteriacea*		
Chronic	Ciprofloxacin 500 mg PO Q12H upto 28-120 days **or** trimethoprim sulfa DS PO Q12H upto 28-120 days	*Enterobacteriacea* *Entrococcus spp* *Pseudomonas aeruginosa*		

13. SKIN INFECTIONS

Diagnosis	Empiric Treatment	Likely Organism	Duration of Treatment	Comments
13.1 Boils, Furunculosis Carbuncles	Cephalexin 500 mg PO Qid **or** Clindamycin 450 mg PO Q8H **or** Trimethoprim sulfa DS PO Q12H	*Staphylococcus aureus* (MSSA or MRSA) or *Streptococcus pyogenes*	5-7	If there is an abscess incision and drainage is indicated
13.2 Cellulitis Mild- Moderate	Augmentin 625 mg PO Q8H or Cephalexin 500 mg PO Qid or Clindamycin 450 mg PO Q8H	*Streptococcus pyogenes* (Grp A,B,C and G Strept.) *Staphylococcus aureus* (MSSA or MRSA)	7-10 days	
Severe	Cefazolin 1g IV Q8 H **or** Augmentin IV acid 1.2g IV Q8 hr **or**	*Streptococcus pyogenes* (Grp A,B,C and G Strept.) *Staphylococcus aureus* (MSSA or MRSA)	Not specified	

	Vancomycin 15-20 mg/kg IV Q12H.			
13.3 Bites **Cat**	Augmentin 625 mg PO Q8H **or** Doxycycline 100 mg PO Q12H	*Pasteurella multocida,* *S. aureus*	7 days	Cleaning, irrigation and debridement is needed Consider tetanus prophylaxis
Dog	Augmentin 625 mg PO Q8H **or** Clindamycin 450 mg PO Q8H **plus** Cipro 400 mg Q12H for adults **or** Bactirm for children	*Pasteurella multocida,* *S. aureus, Bacteroides spp., Fusobacterium spp and others*	7 days	Cleaning, irrigation and debridement is needed Consider antirabies prophylaxis
Human	Augmentin 625 mg PO Q8H 7-10 days **or** Augmentin 1.2 gm IV Q8H 7-10 days **or** Clindamycin **plus** Cipro (bactrim for children)	*Streptococcus viridans* *S. epidermidis,* *Corynebacterium spp.,* *S. aureus, Eikenella spp and Bacteroides spp*		Cleaning, irrigation and debridement is needed Consider HIV and HBV testing

Rat	Augmentin 625mg PO Q8H or Doxycycline 100mg PO Q12H	*Spirillum minus, Streptobacillus moniliformis*	7-10 days	
13.4 Burns Initial burn wound care	No need for antibiotics	None		
Burn wound infection	Pip -Tazo 4.5 g IV Q6H **plus** Vancomycin 15-20mg/kg IV Q12H **plus** Amikacin 7.5 mg/kg Q12H	*Strep pyogenes* *Enterbacter spp.* *S. aureus* *coagulase negative Staphylococcus Enterococcus faecalis* *E.coli* *Pseudomonas*	Not specified	ID consult is preferred
13.5 Diabetic Foot Infection: Mild	Augmentin 625 mg PO Q8H **or** Clindamycin 450 mg PO Q8H	*Streptococcus pyogenes, S. aurues*	7-14 days	
Moderate	Augmentin 625 mg PO Q8H **or** Ampicillin-sulbactam 3 g IV Q6H ±Clindamycin 600 mg IV Q8H	*Streptococcus pyogenes* *Streptococcus groupA, B* *S. aureus,* *Enterococcus sp* *Gram negative bacilli*	14 days	Surgical debridement is indicated Rule out Osteomylitis

Severe	Amp-sulbactam 3g IV Q6H **plus** Ciprofloxacin 400 mg Q12H **Plus/minus** Vancomycin 15-20mg/kg IV Q12H **or** Pip Tazo 4.5 g IV Q6H **Plus/minus** Vancomycin 15-20mg/kg IV Q12H **or** Imipinem 500 mg IV Q6H. **Plus/minus** Vancomycin 15-20mg/kg IV Q12H	*same as moderateplus Pseudomonas aurigenosa*	Not specified	ID consult is needed
13.6 Necrotizing fasciistis	Pip-Tazo 4.5 g IV Q6H **Plus** Vancomycin 15-20mg/kg IV Q12H **Plus/minus** Clindamycin 900 mg IV Q8H **Or** Imipinem 500 mg IV Q6H **Plus** Vancomycin 15-20mg/kg IV Q12H **Plus/minus** Clindamycin 900 mg IV Q8H	Type 1: Streptococcus Gp A Type 2: Clostridium Type 3: polymicrobial Type 4:community acquired MRSA		

References:

- Sanford Guide 2010
- John Hopkins Guidelines, 2010

14. TUBERCULOSIS

Diagnosis	Empiric Treatment	Likely Microorganism	Duration of therapy	Treatment note
14.1 ACTIVE TUBERCULOSIS: Clinically and microbiologically i.e. positive AFB smear or culture for *M. tuberculosis* or tissue histopathology consistent with TB (air born isolation required if sputum is positive for AFB or positive PCR-M.TB or pulmonary TB is likely)	Same as the direct therapy *First Line Drugs* <u>Adult Dose:</u> • Isoniazid (INH) 300mg PO OD • Rifampin (RIF) 600mg PO OD • Pyrazinamide (PZA) 1.0g-2.0g PO OD • Ethambutol (EMB) 0.8-1.6 PO OD <u>Children Dose:</u> • Isoniazid (INH) 10-15mg/kg PO OD (300mg) • Rifampin (RIF) 10-20mg/kg PO OD (600mg) • Pyrazinamide (PZA) maximum 15-30mg/kg (2.0g) • Ethambutol (EMB) maximum 15-20mg/kg per day (2.5g) *Second line Drugs:* *1. Cycloserine:* <u>Adults (maximum)</u>: 10-15mg/kg per day (1,000mg) usually 500-	*Mycobacterium tuberculosis*	Pulmonary TB 6-9 months Extrapulmonary TB 6-12months	ID consultation is strongly recommended Add *Pyridoxine* 40mg PO OD if INH used Rifinah is INH 150mg + Rif 300mg PO tablet 4 drugs are necessary for initial phase (2 months) LFT baselines should be tested prior to the initiation of the RX and repeated 1-2 weeks later. Optometric eye exam is needed if EMB is used. Second-line drugs are used for treating patients with drug-resistant tuberculosis caused by organisms

	750mg/day given in two doses. Children (maximum): 10-15mg/kg per day (1.0g/day) *2. Ethionamide:* Adults (maximum): 15-20mg/kg per day (1.0/day), usually 500-750mg/day in a single daily dose or two divided doses Children (maximum): 15-20mg/kg per day (1.0g/day) **3.** *Streptomycin (SM):* Adults (maximum): 15mg/kg per day (1g/day) parenterally, usually given as a single daily dose (5-7 days/week) initially, and then reducing to two or three times a week after the first 2-4 months or after culture conversion. Children (maximum): 20-40mg/kg per day (1g/day) *4. Amikacin:* Adults (maximum): 15mg/kg per day (1.0g/day), intramascular or intravenous, usually given as a single daily dose (5-7 days/week) initially, and then reducing to two or three times a week after the first 2-4 months or after			with known or presumed susceptibility to the agent

	culture conversion. <u>Children (maximum):</u> 15-20 mg/kg per day (1g/day) intramascular or intravenous as a single daily dose. *5. Fluoroquinolones:* Moxifloxacin <u>Adults:</u> 400mg daily			
14.2 Latent TB			9 months	Treatment for latent TB should be started with a clear follow-up plan *Pyridoxine 40mg PO daily*

15. UPPER RESPIRATORY INFECTION

15.1 ACUTE OTITIS MEDIA (AOM)

Diagnosis	Empiric Treatment	Likely Microorganisms	Duration of therapy	Treatment note
Certain diagnosis of Otitis media is based on: • History of acute onset of signs and symptoms **and** • The presence of middle ear effusion (indicated by bulging of the TM or limited/absent TM mobility (bulb insufflators must be used) or otorrhea or air-fluid level) **and** • Signs or symptoms of middle-ear inflammation (indicated by distinct erythema of the TM or distinct otalgia)	**First line:** Amoxicillin, 80 to 90 mg/kg/d Q12H Maximum dose 2-3 gm/day **Second line:** For persistent or recurrent AOM amoxicillin/clavulanic 80-90 mg/kg/d Q12H Cefprozil 30mg/kg/d Ceftriaxone IM/IV 50mg/kg/d **For severe Penicillin allergies (hives or anaphylaxis):** azithromycin 10mg/kg/once daily for 3 days Observation for 48-72H is an appropriate option only when follow-up can be ensured and Abx therapy is started if symptoms persist for more than 2 days.	*S.pneumoniae* Non typable *Haemophilus influenzae* *Moraxella catarrhalis*	5 days 10 days if < 6 years 5-7 days 5-7 days 3 days	For children > 2 years, consider treating symptomatically with topical or systemic analgesia (acetaminophen or ibuprofen) and reassessing. If not improved in 48-72 H treat with antibiotic. Otitis media with effusion (OME) also known as **middle ear effusion (MEE)** should not be treated with antibiotics. For persistent effusion > 3 months, consider: hearing evaluation and consultation with ENT. For repeated treatment failure consider Tympanocentesis for culture/ susceptibility and consultation with ENT.

	1. For patients < 6 months Abx therapy. 2. For patients: 6 months to 2 years consider Abx treatment for certain diagnosis. For uncertain diagnosis, consider antibiotic therapy if the illness is severe (moderate to severe otalgia or fever >39). If non severe illness, consider observation option. 3. For patients >2 years and the diagnosis is certain consider ATB therapy if severe illness otherwise observe. If the diagnosis is uncertain, observation option is considered.			

References: CDC-Otitis Media: Physiciam Information Sheet (Pediatrics)

15.2 Pharyngitis in Adults & Children

Diagnosis	Likely Microorganisms	Emperic Therapy	Duration of therapy	Treatment note
Most sore throats are caused by viral agents. Clinical findings alone do not adequately distinguish Strep vs. Non-Strep pharyngitis. BUT, prominent rhinorrhea, cough, hoarseness, conjunctivitis, or diarrhea, suggest a VIRAL etiology. All patients should be screened for the following: 1- History of fever 2- Lack of cough 3- Tonsillar exudates 4- Tender anterior cervical adenopathy Patients with none or only one of these findings should not be tested or treated. If 2 or more of these findings are present, obtain throat culture.	Group A Streptococcus. *(S. pyogenes*)	**adults:** Amoxicillin 500 mg PO Q8H **or** Single dose benzathine penicillin 1.2 million unit IM for non compliant patients **Children <12 years:** < 27 kg weight Penicillin V 250mg Q12H daily > 27 kg Penicillin V 500 mg twice daily **or** Amoxicillin 50 mg/kg/d (max 1000 mg) Q12H **or** <27 kg 0.3-0.6 million units IM once >27kg o.9 million units IM once	10 days 10 days 10 days 10 days	**NO** group A strep found to be resistant to penicillin. Treatment is 90% effective at elimination of strep, and may be higher in the prevention of acute rheumatic fever (ARF). Carriers are at very low risk for both ARF and spreading infection. Experts discourage treatment pending culture results but if you do, make sure to stop antibiotics when culture is negative Extended spectrum macrolides and fluoroquinolones are not appropriate for uncomplicated Group A Strep. pharyngitis.

		(Max dose 1.2 million units) **<u>Penicillin allergic</u>**: Clindamycin 20 mg/kg/d (max 1.8g) Q8H for 5 days **<u>or</u>** azithromycin 10 mg/kg/d (max 500 mg) once daily for 3 days		

15.3 Acute sinusitis

Diagnosis	Likely Microorganisms	Therapy	Duration of therapy	Treatment note
Symptoms lasting more than 7 days	*S. pnemoniae* *H. influenzae* *M. catarhalis* Viruses	**Adults:** **Mild disease, no recent Abx use:** Amoxicillin 500-1500 mg PO Q8H for 10-14 days **or** Cefuroxime 500 mg PO BID for 10-14 days **Moderate disease or recent Abx use:** Amoxicillin-clavulanate 500 mg PO Q8H **or** Moxifloxacin 400 mg PO once a day 10 days **Pen-allergy (hives or anaphylaxis):** Azithromycin 500 mg PO for 3 days **or** Doxycycline 100 mg PO Q12H for 5 days		

	S. pnemoniae *H. influenzae* *M. catarhalis* Viruses	**<u>Children</u>**: Amoxicillin 80-90 mg/KG/d Q12H for 14-21 days (max dose 2-3 gm/d). If no improvement in 2-3 days: Amox-clav 80-90 mg/kg/d Q12 hrs for 14-21 days **<u>or</u>** Cefuroxime 30 mg/Kg/d Q12 hrs for 14-21days	**<u>For mild disease:</u>** Should see improvement in 2-3 days. Continue treatment for 7 days after symptoms improve or resolve (usually a 10 - 14 day course). If no improvement after 3 days, consider drugs listed under moderate disease. **For moderate disease**: If no improvement after 3 days, consider imaging studies, sinus aspirate or ENT consultation**.**	

16. URINARY TRACT INFECTION

Diagnosis	Likely Microorganisms	Empiric Treatment	Treatment Note
Acute uncomplicated cystitis	Enterobacteriaceae (*E. coli*), *Staph. saprophyticus*, Enterococcus species	Nitrofurantoin 100mg PO Q12H x 5 days **or** TMP-SMX tab DS Q12H x 3 days	Patients are usually young females
Acute uncomplicated pyelonephritis Mild/moderate	*Enterobacteriaceae (E. coli)*	Ciprofloxacin 500mg PO Bid for 7-14 days **Or** Augmentine 625 mg PO Q8H for 7-14 days	Initial dose may be parenteral
Severe uncomplicated pyelonephritis	*Enterobacteriaceae (E. coli)*	Ciprofloxacin 400mg IV Q12H for 14 days **or** Cefepime 1g IV Q8H for 14 days **or** Piperacillin/Tazobactam 4.5g IV Q6hrs	
Acute complicated UTI	*Enterobacteriaceae (E.coli), P. aurigousa, enterococci, rarely S. aureus*	Piperacillin/Tazobactam 4.5g IV Q6H for 14-21 days	Switch to oral therapy when possible ID consult is preferred
Asymptomatic bacteriuria	Enterobacteriaceae (*E. coli*) *Staphylococcus haemolyticus*	**None**	Treatment is required in pregnancy and patients to undergo (or undergoing) urologic procedures.

Intravenous to Oral Therapy Conversion

Objectives:

1. To improve patient care and safety, the oral route is more convenient and relatively safer.
2. To decrease the risk of complications associated with intravenous line (IV) and to decrease the risk of line infections.
3. To decrease the length of hospital stay.
4. To decrease the time for the preparation and administration of IV meds by the pharmacy and the nursing staff.
5. To provide a cost effective regimen: by providing IV to PO conversions for medications with high bioavailability according to the following criteria.

Eligible patients for IV to PO conversion:

1. Patient must have an intact and functioning gastrointestinal tract as evidenced by :
    - Patient is tolerating food, fluids or enteral feeds
    - Patient is receiving other oral medications
    - No nausea, emesis or diarrhea in the past 24 hours
2. Patients is clinically improving as evidenced by :
    - Signs and symptoms of clinical improvements
    - Hemodynamically stable
    - Afebrile for at least 48 hours
    - WBC is trending towards normal (4000 – 12,000) (consider if patient is on any medications that might sustain leukocytosis eg. corticosteroids)
3. Patient has received antimicrobial therapy for at least 48 -72 hours (except patients treated with Metronidazole for C.difficile, you may convert earlier)
4. Patient is day 3 post operatively (in case of surgery)

Ineligible patients to IV to PO conversion:

1. Patients with severe life threatening infections: (osteomyleitis, endocarditis, enterococcus bacteremia, septic arthritis, meningitis) or other infections that require extended anti-infective therapy.
2. Patients with gastrointestinal dysfunction (Nausea, vomiting, diarrhea in the past 24 hours, or gastrointestinal obstruction, malabsorption syndrome, short bowel syndrome, ileus or biliary drain).
3. Patients with active gastrointestinal bleeding.
4. Patients receiving total parenteral nutrition.
5. Patients who have difficulty swallowing or refuse oral medications, loss of consciousness
6. NPO status: (and no medications to be administered orally).
7. Continuous tube feedings (cannot be interrupted)
8. Severely immunocompromised patients (neutropenic , HIV, patients on immunosuppressant medications who are severely ill).
9. Patients on vasopressors in the critical care unit.

Antimicrobials IV- PO conversion equivalent doses:

Antimicrobials	Parenteral IV dose	PO (equivalent dose)	Comments
Azithromycin	500 mg IV daily	500 mg daily	With and without food for the tab Suspension: take 1 hr before or 2 hours after food
Cefuroxime *	750 – 1500 mg IV Q8 hours	500 mg PO Q12hours	
Ciprofloxacin *	400 MG IV q8hours 400 mg IV q12 hours 400 mg IV q24 hours	750 mg PO q12hours 500 mg PO q12 hours 500 mg PO q24 hours	• Give 2 hours before calcium , iron or dairy products • Not for pts with continous enteral feeding or jejunostomy tube • stop tube feeding 2 hours before and 2 hours after administration**
Moxiflooxacin	400 mg IV daily	400 mg PO daily	
Clindamycin	600 mg IV q8 hours	300 mg PO q6 hours Or 600 mg q8hrs for severe skin infections	With or without food
Doxycycline	100 mg IV q12 hours	100 mg PO q 12 hours	Take 1 hour before or 2 hours after meals
Linezolid	600 mg IV q12 hours	600 mg PO q12 hours	Avoid tyramine rich foods
Metronidazole *	500 mg IV q 8 -12 hours	500 mg PO q 8 -12 hours	
Fluconazole *	IV dose daily	Same dose PO daily	Not affected by food (1:1 conversion) (patients with candidemia or disseminated candidiasis, keep IV)

Note :
*Consider renal dosing for patients with renal impairment.
** Patients with feeding tubes: tubes should be flushed with water both before and after medication administration.

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