ANTIBIOTIC GUIDELINES 2018

FOR ADULTS

CHRISTIAN MEDICAL COLLEGE, VELLORE

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2018

Antibiotic Guidelines for Adults 2018

Christian Medical College, Vellore

Prepared on behalf of the
Hospital Infection Control Committee by
Dr. OC Abraham
Dr. George M Varghese
Dr. Dhanalakshmi Venkatesan
Dr. Joy S Michael
Dr. V Balaji
Dr. Sujith J Chandi
Ms. Catherine Truman

We acknowledge the input given by various departments

Approved by:
Dr. Prasad Mathews (Medical Superintendent)

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Chapter 1: **Introduction**

Increasing antimicrobial resistance today poses a significant threat to public health in India. This threat is compounded by the lack of development of new antibiotics. Prudent antimicrobial utilization and a stringent adherence to infection control practices therefore remain the major strategies to counter this threat. A safe and effective strategy for antibiotic use involves prescribing an antibiotic only when it is needed and selecting an appropriate and effective agent at the recommended dose, with the narrowest spectrum of antimicrobial activity, fewest adverse effects and lowest cost.

Good antibiotic prescription practices include:

1. Prescribing empiric antibiotics for suspected bacterial infections only if:
   - Symptoms are significant or severe
   - There is a high risk of complications
   - The infection is not resolving or is unlikely to resolve
2. Using first-line antibiotics first
3. Reserving broad spectrum antibiotics for specifically indicated conditions

The following information is intended to serve as a guide, to aid in the selection of an appropriate antimicrobial for patients with infections commonly seen in clinical practice. Individual patient circumstances and resistance patterns may alter treatment choices. The hospital antibiogram with susceptibility pattern of various organisms is reviewed every year and antibiotic recommendations are modified accordingly. These recommendations are based not only on current scientific knowledge but also take the local resistance patterns, our collective clinical experience and cost into consideration. The recommendations relate to empiric, targeted or definitive therapy for a clinical infection and prophylaxis in

beneficial situations. If empiric therapy is initiated, the treatment should be reviewed once the culture and susceptibility results are ready (usually within 72 hours) and argeted therapy should be done whenever possible to give the narrowest spectrum antibiotic based on culture and susceptibility data, the site of infection and the clinical status of the patient.

Chapter 2: **Principles of rational antibiotic prescribing**

1. **Empiric antimicrobial treatment should be limited to conditions where immediate / early initiation of antimicrobials has been shown to be beneficial**. Some examples are:
   - Severe sepsis (sepsis-induced tissue hypoperfusion or organ dysfunction) and septic shock
   - Acute bacterial meningitis
   - Community acquired pneumonia
   - Ventilator associated pneumonia
   - Necrotizing fasciitis
   - Febrile neutropenia
2. **Fever, leukocytosis or elevated c-reactive protein (CRP) levels by themselves should not be considered indications for starting empiric antimicrobials**, as these have been shown to have very poor specificity to diagnose bacterial sepsis. Always consider multiple data points (history, physical findings and investigation reports) together to make an accurate diagnosis.
3. **Incomplete or inaccurate diagnosis is the most important reason for inappropriate use of antimicrobials.**
4. **Always obtain cultures** (two sets of **blood cultures and other appropriate samples as clinically indicated –** e.g. normally sterile body fluids, deep pus etc.) before starting empiric antimicrobial treatment.
   - **Avoid the practice of obtaining "pan cultures" unless clinically indicated**
5. **Avoid sending cultures from superficial wounds, decubitus ulcers, and chronic wounds and draining sinuses**. Surface swab cultures are either inadequate or provide misleading

information regarding diagnosis (as they cannot differentiate infection from colonization / contamination).

6. **When starting antimicrobials, use full therapeutic doses, paying close attention to dose, frequency, and route of administration and duration of treatment.**
7. **Review all antimicrobial prescriptions after 48 to 72 hours ("antimicrobial timeout") with a view to modify or stop the initial empiric therapy**.
8. **De-escalate (targeted or pathogen-specific therapy)** the antimicrobial regimen once culture and susceptibility reports are available, **and** the patient is showing signs of improvement with the initial empiric broad-spectrum antimicrobials.

· Examples of optimization include switch

i. To a narrow-spectrum antimicrobial,

ii. From combination to single agent,

iii. To less toxic or expensive drug, or

iv. From i.v. to an oral formulation.

9. **Stop antimicrobials if the cause of initial symptoms is found to be non-infectious**
10. The doses mentioned in these guidelines are for patients with normal renal function. The doses have to be modified for those with renal insufficiency

Chapter 3: **Initial Empiric Antibiotics for Common Infections**

A1. GI and intra-abdominal infections

Condition	Most likely microbial etiology	First choice	Alternatives	Comments
1. Acute gastroenteritis (acute onset nausea, vomiting, watery diarrhea)	• Viral (calciviruses, rotaviruses) • Entero-toxigenic and entero-pathogenic *E. coli* • *Salmonella* spp.	None indicated		• Rehydration • Symptomatic treatment
2. Acute watery diarrhea, cholera suspected	• *Vibrio cholerae*	Doxycycline 300 mg p.o. x 1 doses	• Azithromycin 1 g p.o. x 1 dose • Ciprofloxacin 500 mg p.o. BID x 3 days	Prompt rehydration essential
3. Bacillary dysentery (acute onset fever and bloody diarrhea)	• *Campylobacter* spp. • *Shigella* spp.	• None needed for previously healthy patient with mild symptoms • Treat patients with o Severe symptoms. o Immuno-compromised status	• Ciprofloxacin 500 mg p.o. BID x 3 days • Azithromycin 500 mg p.o. OD x 3 days	Prompt rehydration
4. Enteric fever – suspect if AFI ≥7 days, other etiology ruled out	• *Salmonella* Typhi • *Salmonella* Paratyphi A	• Antibiotic treatment should be based on culture & susceptibility reports (see Enteric fever in section on definitive therapy)		

Condition	Most likely microbial etiology	First choice	Alternatives	Comments
5. Cholangitis	Enterobacteriaceae Anaerobes	• Piperacillin-Tazobactam 4.5 g i.v. Q8H • Ertapenem 1 g i.v. OD (for severely ill patients – sepsis or septic shock)	• Cefoperazone-Sulbactam 3 g i.v. BID	• Duration: 7 days • Biliary drainage
6. Acute cholecystitis	Enterobacteriaceae	• Piperacillin-Tazobactam 4.5 g i.v. Q8H • Ertapenem 1 g i.v. OD (for severely ill patients – sepsis or septic shock)	• Cefoperazone-Sulbactam 3 g i.v. BID	Patients undergoing cholecystectomy should have antimicrobials discontinued within 24 h unless there is evidence of infection outside the wall of the gallbladder
7. Spontaneous bacterial peritonitis	*E. coli*	• Piperacillin-Tazobactam 4.5 g i.v. Q8H • Ertapenem 1 g i.v. OD (for severely ill patients – sepsis or septic shock)	• Cefoperazone-Sulbactam 3 g i.v. BID	Duration: 7 days
8. Secondary peritonitis (bowel perforation)	Enterobacteriaceae Anaerobes (*Bacteroides* species)	Ertapenem 1 g i.v. OD	• Cefoperazone-Sulbactam 3 g i.v. BID	• Emergency surgery to eliminate source of contamination, reduce bacterial load & prevent recurrence • Duration: 5 - 7 days; longer if source control inadequate
9. Intra-abdominal abscess	Enterobacteriaceae Anaerobes (*Bacteroides* species)	Ertapenem 1 g i.v. OD	• Cefoperazone-Sulbactam 3 g i.v. BID · Tigecycline 100 mg i.v. x 1 dose, followed by 50 mg i.v. BID	• Emergency drainage • Duration: 5 - 7 days; longer if source control inadequate

Condition	Most likely microbial etiology	First choice	Alternatives	Comments
10. Amoebic liver abscess (suspect in patients with single abscess in right lobe of liver with no IHBRD and no primary intra-abdominal source)	*E. histolytica*	Metronidazole 500 mg i.v. TID or 800 mg p.o. TID + Diloxanide furoate 500 mg TID x 10 days		• Therapeutic drainage for: (1) high risk of abscess rupture; (2) left lobe liver abscess; (3) failure to respond to medical therapy within 5-7 days; and (4) cannot differentiate from a pyogenic liver abscess
11. Acute pancreatitis		• Routine use of prophylactic antibiotics NOT recommended		• Infected pancreatic necrosis should be considered in patients who o Deteriorate or fail to improve after 7–10 days of hospitalization o CT scan with gas in the pancreas • In these patients, either o CT-guided FNA for Gram stain and culture to guide use of appropriate antibiotics or o Empiric antibiotics (e.g., Meropenem 1 g i.v. TID)may be given • Ref: ACG Guidelines 2013

*When using a carbapenem (e.g., ertapenem or meropenem) or beta-lactam + beta-lactamase inhibitor combination (e.g., piperacillin-tazobactam) for intra-abdominal infections, there is NO NEED to add metronidazole. Carbapenems and BI + BLI combinations have excellent activity against anerobes.

A2. CNS infections

I. Management protocol for acute meningitis (community acquired)

1. Suspect if patient (no neurosurgical procedure in the previous two weeks; not immuno-compromised) has any combination of the following:

a. Symptoms: fever, headache, altered mental status (new onset confusion, disorientation, drowsiness, coma)

b. Signs: Temp >38 °C, neck stiffness, other signs of meningeal irritation.

2. Confirm by a lumbar puncture (to be done as soon as possible)

a. CSF findings highly suggestive of bacterial meningitis

i. Gross appearance turbid

ii. Total WBC count >1000 cells/mm^3

iii. Neutrophilic pleocytosis

iv. Low CSF glucose (<50% of concomitant blood glucose)

3. CT scan brain

a. Should NOT be ordered as a routine test before LP in all cases of suspected acute meningitis

b. Indications for CT scan brain before LP

i. Papilledema

ii. New onset seizures

iii. Focal neurological deficits (e.g., hemiparesis)

iv. Decreased level of consciousness (GCS <10)

v. Immunocompromised patients (e.g., HIV infection)

4. **Lab tests**
    a. CSF analysis
        i. WBC count (total and differential)
        ii. Glucose
        iii. Protein
        iv. Gram stain and culture
        v. Virology panel (PCR)
        vi. Additional investigations if duration of symptoms >5 days
            1. Xpert MTB/RIF
            2. Mycobacterial (MGIT) culture
            3. India ink preparation
            4. Cryptococcal antigen
            5. Fungal culture
            6. VDRL
    b. Blood culture
    c. CBC
    d. Urea, creatinine, electrolytes

5. Antimicrobial management:

a. All patients should receive the first dose of antimicrobials as soon as the diagnosis of acute bacterial meningitis is suspected.

b. DO NOT delay antimicrobials if there is a delay in obtaining a CSF sample.

- Prior administration of antimicrobials tends to have **minimal effects on the chemistry and cytology findings**, but can **reduce the yield of Gram stain and culture**

c. Initial empiric antimicrobials

a. Ceftriaxone 2 g i.v. BID + Vancomycin 10–20 mg/kg q8 - 12h to achieve serum trough concentrations of 15–20 mg/mL
b. Modify antimicrobial regimen based on results of culture & susceptibility reports
c. Duration: 10 – 14 days
d. Adjunctive steroid therapy (to be started for patients with **strong clinical suspicion of acute bacterial meningitis or CSF results as described below**):
    a. Indications:
        i. Cloudy CSF
        ii. CSF WBC count >1000/ml, or
        iii. Bacteria in CSF on Gram's staining
    b. Contra-indications
        i. Septic shock
        ii. Patients who have already received antimicrobials
    c. Dose and duration: Dexamethasone 0.15 mg/kg Q6H x 4 days; first dose 15 min before or along with first dose of antimicrobial
    d. Discontinue if culture grows organisms other than *Strep pneumoniae*

II. Other CNS infections

Condition	Most likely microbial etiology	First choice	Alternative	Comments
1. Brain abscess	Streptococci (aerobic & anaerobic) Anaerobes Enterobacteriaceae	• Empiric therapy to be avoided • Treat as per culture & sensitivity reports		Neurosurgery referral for aspiration or excision of abscess. Duration: until resolved
2. Septic cavernous sinus thrombosis	*Staph aureus*	Cloxacillin 2 g i.v Q4H		Duration: 3 - 4 weeks

A3. Infections of cardiovascular system (see section on definitive therapy)

A4. Skin and soft tissue infections (SSTI)

I. Management protocol for necrotizing fasciitis (NF)

1. **Suspect** NF in any patient presenting with SSTI who has severe pain, severe sepsis or septic shock
2. **Symptoms and signs**:
   a. Pain (out of proportion to physical findings), swelling, redness and warmth of affected area;
   b. Changes in skin color from red-purple to patches of blue-gray;
   c. Bullae containing thick pink or purple fluid; crepitus;
   d. Cutaneous gangrene;
   e. Compartment syndrome;
   f. MOSF;
   g. Hypotension
3. Obtain **urgent surgical consultation**. Surgical exploration is the **only** way to definitively establish the diagnosis of necrotizing infection.
4. Labs
   a. CBC
   b. Urea, creatinine, electrolytes
   c. CPK
   d. Blood culture
   e. Gram stain and culture of tissue and pus sample obtained at surgery
5. **Imaging** (plain x-rays, CT scan, MRI scan) to look for presence of gas. The presence of gas in the fascial planes is a highly specific finding, but not very sensitive. **DO NOT delay surgical intervention**.

6. Management

a. Surgery: Aggressive debridement of all necrotic tissue

b. Antimicrobials:

i. Initial empiric treatment: Meropenem 1 g i.v. TID + Clindamycin 900 mg i.v. TID

ii. Modify antimicrobials according to culture and sensitivity report

iii. For **confirmed group A streptococcus infection**: Penicillin G 2 million units i.v. Q4H + Clndamycin 900 mg i.v. TID

II. Other SSTI

Condition	Most likely microbial etiology	First choice	Alternative	Comments
1. Skin infections				
Cellulitis (no purulent drainage)	*Strep pyogenes, Staph aureus*	1. Cefazolin 1 g i.v. Q8H x 7-10 days (for hospitalized patients with moderate illness) 2. Cloxacillin 1 g i.v. Q6H	Cloxacillin 500 mg p.o. Q6H x 7-10 days	• Oral therapy for milder illness and step-down following improvement with i.v. therapy • Duration: until clinical cure
Furuncules, carbuncles, cutaneous abscesses (purulent SSTI)	*Staph aureus*	Cloxacillin 500 mg Q6H p.o. x 7-10 days		Incision & drainage
Tinea versicolor	*Malassezia furfur*	Topical clotrimazole 1% OD	Topical miconazole 2% OD	Duration 1- 2 weeks
Tinea corporis	T. rubrum	Topical clotrimazole 1% OD	Topical miconazole 2% OD	Duration 2- 4 weeks

Condition	Most likely microbial etiology	First choice	Alternative	Comments
Scabies	*Sarcoptes scabiei*	Permethrin cream 5% to be applied all over the body from neck downwards		• Wash off after 8-14 hours • Clothing should be washed in hot water and dried before reuse
2. Diabetic foot infections				
Mild (local infection involving only skin and subcutaneous tissue, erythema <2 cm, no systemic signs)	*Staph aureus* *Strep pyogenes*	Cefazolin 1 g i.v. Q8H	Cloxacillin 500 - 1000 mg p.o. Q6H x 7-10 days	• Cultures should not be taken from clinically non-infected wounds
Moderate (local infection with erythema >2 cm, or involving structures deeper than skin and subcutaneous tissues (e.g., abscess, osteomyelitis, septic arthritis, fasciitis)	Polymicrobial - *Staph aureus*, Group A *Strep*, aerobic Gram- negative bacilli, anaerobes	• Piperacillin-Tazobactam 4.5 g i.v. Q8H + Vancomycin 15 mg/kg i.v. Q12H		Surgical consultation for drainage or debridement
Severe (limb threatening - severe cellulitis / gangrene / severe sepsis / septic shock)	Polymicrobial - *Staph aureus*, Group A *Strep*, aerobic Gram- negative bacilli, anaerobes	• Meropenem 1 g i.v. TID + Vancomycin 15 mg/kg i.v. Q12H	Tigecycline 100 mg i.v. x 1 dose followed by 50 mg i.v. BID	Surgical consultation for drainage or debridement.

Condition	Most likely microbial etiology	First choice	Alternative	Comments
3. VZV infections				
Chickenpox	Varicella zoster virus	Valacyclovir 1000 mg p.o. TID x 7 days	Acyclovir 800 mg p.o. five times / day x 7 days	To be started within 24 hours of onset of rash.
Herpes zoster	Varicella zoster virus	Valacyclovir 1000 mg p.o. TID x 7 days	Acyclovir 800 mg p.o. five times / day x 7 days	• Begin within 72 hours of onset of rash • Immunocompromised patients: Acyclovir 10 mg/kg i.v. TID. Change to valacyclovir 1000 mg p.o. TID once infection is controlled. Total duration 7 – 10 days
4. Bites				
Bites (cat, dog, human, rat)	• *Pasteurella multocida* • Capnocytophaga • Eikenella • *Strep viridans* • *Spirillum minus* • *Streptobacillus moniliformis*	Amoxicillin-Clavulanate 625 mg p.o. TID		• Duration: 3 - 5 days • Administer rabies vaccination as appropriate

A5. Bone and joint infections

Condition	Most likely microbial etiology	First choice	Alternative	Comments
Acute osteomyelitis	*Staph aureus*	Cefazolin 2 g i.v. TID		o For optimal treatment, microbial etiology should be confirmed o Orthopedic referral for bone biopsy and debridement of necrotic material o Modify initial empiric regimen based on culture report o Duration: 6 weeks from last debridement
Chronic osteomyelitis • Secondary to a contiguous focus of infection (e.g., decubitus ulcer), • Osteomyelitis that develops as a result of contaminated open fractures or surgical treatment of closed fractures	Staphylococci Aerobic GNBS treptococci Anaerobes	Avoid empiric treatment		o For optimal treatment, microbial etiology should be confirmed o Orthopedic referral for bone biopsy and debridement of necrotic material o Obtain cultures (bone and blood) before antimicrobialso Avoid sending swab cultures form chronic discharging sinuses and ulcers o Duration: 6 weeks from last debridement
Chronic osteomyelitis with orthopedic implants		Avoid empiric antimicrobials unless patient seriously ill		o For optimal treatment, microbial etiology should be confirmed o Orthopedic referral o Obtain cultures (bone and blood) before antimicrobials o Modify initial empiric regimen based on culture report

Condition	Most likely microbial etiology	First choice	Alternative	Comments
Osteomyelitis associated with diabetic foot infection	See section on diabetic foot infections			o Implant removal and debridement of necrotic material
Septic arthritis	Staph aureus	Cloxacillin 2 g i.v Q6H	Cefazolin 2 g i.v. TID	o Orthopedic referral o Obtain joint fluid for culture before starting antimicrobials o Modify initial empiric regimen based on culture report o Duration: 4 weeks; change to p.o. after 2 weeks i.v. therapy

A6. Respiratory tract infections

I. Community acquired pneumonia (CAP) management protocol

1. **Suspect** if patient **(not been hospitalized in the previous 90 days; not immuno-compromised; no structural lung disease like bronchiectasis)** has any combination of the following:
   a. Symptoms: fever, cough (with or without expectoration), shortness of breath, chest pain
   b. Signs: Temp >38 °C, tachypnea, tachycardia, impaired percussion notes, bronchial breath sounds, crackles, altered VF/VR.

   In a patient presenting with cough, normal vital signs and physical examination findings rule out a diagnosis of pneumonia
2. **Confirm** with chest x-ray (to be done as soon as possible). In patients with a clinical suspicion of CAP, but no abnormalities on chest x-ray, repeat the x-ray within 48 hours.
3. **Severity assessment** based on CURB 65 score:
   a. 6 point score (range 0 - 5)
   b. Gives one point each for:
      i. **C**onfusion (new onset disorientation in person, place, or time)
      ii. **U**rea >126 mg/dL
      iii. **R**espiratory rate > 30/min
      iv. Low **B**lood pressure (SBP < 90 mm Hg or DBP < 60 mm Hg)
      v. Age **> 65** years
   c. Interpretation
      i. CURB-65 score 0 or 1: low risk of death
      ii. CURB-65 score 2: moderate risk of death

iii. CURB-65 score >3: high risk of death

CURB 65 score is NOT a replacement for good clinical judgment

4. Lab tests

a. CBC

b. Urea, creatinine, electrolytes

c. For patients with CURB 65 score >2

i. ABG

ii. Blood culture

iii. Sputum Gram stain & culture ***Sputum sample should be transported promptly to the lab***

iv. Respiratory sample (NP swab, throat swab, nasal swab, ET aspirate or BAL) for respiratory viral panel (includes influenza testing by RT-PCR)

- In patients with pneumonia, BAL or ET aspirate should be collected for influenza testing if NP swab is negative

5. Setting of care

a. CURB-65 score 0 or 1: out-patient

b. CURB-65 score 2: in-patient (ward)

c. CURB-65 score ≥ 3: in-patient (ICU)

6. Antimicrobial management:

a. All patients should receive the first dose of antimicrobials as soon as the diagnosis of CAP is confirmed

b. Change to an oral regimen as soon as clinical improvement occurs and the temperature has been normal for 24 h, and there is no contraindication to the oral route.

c. Modify antimicrobial regimen based on results of culture & susceptibility reports

d. Consider unusual microbial etiology (e.g., *Burkholderia pseudomallei* in poorly controlled diabetes and *Staph aureus* (MSSA & MRSA) in post-influenza bacterial pneumonia

CURB-65 score	Most likely microbial etiology	Preferred	Alternate	Comments
0 or 1	• Respiratory viruses • *Strep pneumoniae* • *Mycoplasma pneumoniae*· *Chlamydophila pneumoniae*	Amoxicillin 500 mg p.o. TID x 5 days	1. Azithromycin 500 mg p.o. OD x 5 days 2. Doxycycline 100 mg p.o. BID x 5 days 3. Levofloxacin 750 mg p.o. OD	See section on "influenza" for indications for oseltamivir
2	• Respiratory viruses • *Strep pneumoniae* • *Mycoplasma pneumoniae* • *Chlamydophila pneumoniae* • *Legionella*	Penicillin G 20 L i.v. Q4H + Azithromycin 500 mg i.v. OD x 5 – 7 days +Oseltamivir 75 mg p.o. BID x 5 days	Ceftriaxone 1 g i.v. OD + Azithromycin 500 mg i.v. OD x 5 – 7 days + Oseltamivir 75 mg p.o. BID x 5 days	• Antiviral treatment might still be beneficial in patients with severe, complicated, or progressive illness and in hospitalized patients when started after 48 hours of illness onset, as indicated by observational studies (CDC, 2013) • Discontinue oseltamivir if PCR negative o **Continue if clinical suspicion of influenza high** • No virological or clinical advantages with double dose oseltamivir compared with standard dose in patients with severe influenza admitted to hospital (BMJ, 2013)
≥ 3	• *Strep pneumoniae* • *Legionella* • *Klebsiella pneumoniae* • *H influenzae* • Respiratory viruses, primarily influenza	Piperacillin-Tazobactam 4.5 g i.v. Q8H + Azithromycin 500 mg i.v. OD x 5 – 7 days + Oseltamivir 75 mg p.o. BID x 5 days		

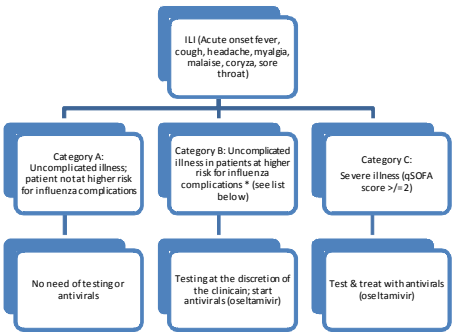
II. Ventilator associated pneumonia management protocol

1. Diagnosis
   a. Develops 48 – 72 hours after endotracheal intubation
   b. Clinical features: fever, alteration in sputum characteristics (increased purulence and /or volume), worsening oxygenation (increasing FiO_2 &PEEP requirement, worsening PF ratio)
   c. Labs: leukocytosis (WBC >11000), leukopenia (WBC <4000) or band forms >10%, elevated PCT / CRP
   d. Chest x-ray: new or worsening infiltrates

      ***No gold standard for diagnosis of VAP; combination of above findings increases probability of VAP**

   e. Obtain ET aspirate for Gram stain, cultures and virology (No advantage of BAL over ETA)
   f. Negative ET aspirate culture rules out VAP (very high negative predictive value)
2. Antimicrobials (to be started after obtaining cultures) (65% of VAP in CMC MICU caused by *A. baumannii*)
   a. If **hemodynamic instability (systolic BP <90 mm Hg)** requiring inotropes: Meropenem 2 g i.v. TID + Colistin 9 million units i.v. loading dose, followed by 4.5 million units i.v. BID
   b. If **no hemodynamic instability**: Meropenem 1 g i.v. TID + Amikacin 15 mg/kg i.v. OD
   c. Modify once culture and sensitivity reports available
   d. Duration of appropriate antimicrobial therapy: 8 – 10 days.

III. Influenza-like illness (ILI) management protocol



*Patients at higher risk of influenza complications

- Children <2 years
- Adults >65 years
- Pregnant women
- Persons with following comorbidities
  - Morbid obesity
  - COPD, bronchial asthma
  - CAD, heart failure
  - CKD
  - CLD
  - Hematological conditions (including sickle cell disease)
  - DM
  - Neurological & neuromuscular disorders
  - Immunosuppression (HIV infection, immunosuppressive treatment)

IV. Other respiratory infections

Condition	Most likely microbial etiology	Preferred	Alternative	See Comments*
1. Acute pharyngitis	• Group A streptococcus (GAS) • Respiratory viruses	Amoxicillin 500 mg p.o. TID x 10 days	1. Azithromycin 500 mg p.o. OD x 5 days 2. Penicillin 250 mg p.o. QID x 10 days	
* Limit antibiotic prescriptions to patients who are most likely to have GAS infection (identified by Centor criteria - fever, no cough, tonsillar exudates, & tender anterior cervical lymphadenopathy) • The **large majority of adults with acute pharyngitis have a self-limited viral illness**, for which supportive care (analgesics, antipyretics, saline gargles) only is needed				
2. Acute epiglotitis	*H. influenzae*	Ceftriaxone 1 – 2 g i.v. OD x 7 days		• Airway management
3. Deep neck space infection including Ludwig's angina	Polymicrobial (oral anaerobes) • Streptococous spp • Peptostreptococous • Bacteroides spp	Amoxicillin-Clavulanate1.2gm i.v. BDx 14 days	Clindamycin 600 mg i.v. Q8H x 14 days	• Airway management • Surgery • Continue antibiotics till clear evidence of clinical improvement
4. Acute bronchitis	Viral	None needed		• Symptomatic treatment only
5. Acute bacterial rhinosinusitis (Antimicrobials if symptoms of fever, facial pain and purulent nasal discharge persist >7 days)	*Strep. pneumoniae* *H. influenzae* *M. catarrhalis*	Amoxicillin-Clavulanate 1 g p.o. BID x 7 days		

Condition	Most likely microbial etiology	Preferred	Alternative	Comments
6. Acute bacterial exacerbation of COPD (presence of at least 2 of the following 3 symptoms: a. Increased dyspnea, b. Increased sputum volume, and c. Increased sputum purulence)	*Strep. pneumoniae* *H. influenzae* *M. catarrhalis* Respiratory viruses	Amoxicillin-Clavulanate 1 g p.o. BID x 7 days	• Azithromycin 500 mg p.o. OD x 3 days • Doxycycline 100 mg p.o. BID x 7 days	• Start oseltamivir if clinical suspicion of influenza high • Antimicrobials for all patients who require mechanical ventilation
Bronchiectasis, acute exacerbation (increased cough, sputum volume and purulence)	H. influenzae S. pneumoniae P. aeruginosa	• Initial empiric therapy based on previous sputum culture reports when available		• Modify based on culture reports • Duration: 14 days
		• If no report available: Piperacillin-Tazobactam 4.5 g i.v. TID		
Lung abscess	• Oral anaerobes (*Peptostreptococcus*, *Prevotella*, *Bacteroides* (usually not *B. fragilis*), and *Fusobacterium* spp.)	Amoxicillin-Clavulanate 1.2 g i.v. TID		Duration: Till clinical and radiological resolution; usually 3 to 4 weeks
Empyema thoracis	• *Streptococcus milleri* *Strep.* pneumoniae anaerobes	As per culture reports	Clindamycin 600 mg i.v. TID • Amoxicillin-Clavulanate 1.2 g i.v. TID • Penicillin G 20 L i.v. Q4H	Modify antibiotics once culture reports available Intercostal tube drainage when pleural fluid
1. Has pH <7.2 2. Is frankly purulent 3. Shows bacteria on Gram stain or culture				

A7. Genitourinary infections

I. UTI management protocol

1. Symptoms and signs

a. Young women: dysuria, frequency of urination, and negative history of vaginal discharge (post-test probability 90%); fever; costo-vertebral angle tenderness

b. Older patients may have these additional symptoms
   i. Cloudy, malodorous or bloody urine
   ii. Worsening incontinence
   iii. Systemic symptoms (altered mental status, MOSF, hypotension)

c. Symptoms of urinary catheter associated UTI (CAUTI): new onset or worsening of fever, rigors, altered mental status, malaise, or lethargy with no other identified cause; flank pain; costo-vertebral angle tenderness; acute hematuria; pelvic discomfort

2. Lab tests

a. Urinalysis (leukocyte esterase and nitrite by dipstick)**. Absence of pyuria and bacteriuria rules out UTI** (high negative predictive value)

b. CBC

c. U & E

d. Urine culture

e. Blood culture

f. Imaging (ultrasound or CT KUB) indicated for
   i. Severe sepsis or septic shock
   ii. Palpable kidneys
   iii. Persistent symptoms after 72 hrs appropriate treatment
   iv. DM
   v. Immune suppression
   vi. Recurrent UTI

3. Antimicrobial management

Condition	Most likely microbial etiology			Comments
Asymptomatic bacteriuria (positive urine culture from an individual without symptoms or signs of UTI)	*E. coli*	No antimicrobial needed		Screening for and treatment of asymptomatic bacteriuria is indicated for 1. Pregnant women 2. Patients undergoing urologic procedures in which mucosal bleeding is anticipated
Acute uncomplicated cystitis in women – dysuria and frequency in healthy, adult, non-pregnant women with normal urinary tract (no structural or functional abnormalities)	*E. coli*	Nitrofurantoin 100 mg p.o. BID x 7 days		
Pyelonephritis – uncomplicated (no underlying GU disease)	*E. coli*	• Mild to moderate illness: Piperacillin-Tazobactam 4.5 g i.v. TID • Severe illness (sepsis or septic shock) Ertapenem 1 g i.v. OD.		• Definitive therapy based on culture and susceptibility report • Duration: • Mild to moderate cases – 7 days • Severe cases – 14 days
Complicated UTI (underlying GU disease, e.g., neurogenic bladder, renal stones, hydronephrosis etc.)	*E. coli*, *Proteus*, *Pseudomonas aeruginosa*	Meropenem 1 g i.v. TID		• Definitive therapy based on culture and susceptibility report· Duration: 10 - 14 days

Condition	Most likely microbial etiology			See Comments *
Foley catheter associated UTI	*E. coli*, *Proteus*, *Pseudomonas aeruginosa*, *Acinetobacter* spp.	No empiric treatment		

* Do not send urine culture from an asymptomatic patient with indwelling urinary catheter

- Urinalysis for **pyuria NOT useful** in diagnosing CAUTI
- **Treat only when patient has symptoms attributable to UTI**
- Urine sample for culture should be obtained either through

✓ A new catheter (after removing the indwelling catheter), or

✓ Through sample port near junction of drainage tubing and Foley catheter

✓ Do not send samples from the drainage bag· Remove urinary catheter

- Replace urinary catheter only if essential; consider alternatives (e.g., condom catheter, intermittent catheterization etc.)
- Duration of antimicrobials: 7 – 14 days

A8. Sepsis

1. Sepsis is a life-threatening organ dysfunction caused by host response to infection. Septic shock is a subset of sepsis with shock, cellular, and metabolic abnormalities which is associated with an increased risk of mortality.
2. **Suspect sepsis** when some of the following are present:
   a. General: fever (>38°C), hypothermia (< 36°C), tachycardia (HR>90), tachypnea (RR>20), altered mental status.
   b. Inflammatory: leukocytosis, leukopenia, >10% band forms, thrombocytopenia (consumption), elevated plasma C-reactive protein, elevated procalcitonin.
   c. Hemodynamic: arterial hypotension (SBP< 90 mm Hg, MAP< 70 mm Hg, or SBP decrease >40mm Hg)
   d. Organ dysfunction: arterial hypoxemia, acute oliguria, creatinine increase >0.5 mg/dL, coagulation abnormalities (INR >1.5 or aPTT >60 sec), ileus, platelets <1 lakh, hyperbilirubinemia (bilirubin >4 mg/dL)
   e. Decreased tissue perfusion: elevated lactate >1 mmol/L, decreased capillary refill or mottling
3. **Prompt management of hypotension and hypoxia as per the emergency and critical care management protocol**
4. Look for common **source of sepsis**: urinary tract infections, intra-abdominal sources, pneumonia, skin and soft tissue infection and vascular line.
5. Assess possibility of hospital acquired infection
6. **Obtain cultures:**
   a. Blood cultures (10ml) x 2 sets before initiating antibiotics (one drawn percutaneously and the other through central line if present)
   b. Other relevant cultures based on the suspected source (eg. urine, sputum, pus etc.)

c. Imaging studies to evaluate the source and to determine need for source control.

7. **Common pathogens causing sepsis:**

   a. Gram-negative bacteria: *E. coli, Klebsiella, Enterobacter, Pseudomonas, Acinetobacter*

   b. Gram-positive bacteria: *Staphylococcus aureus, S. pneumoniae, Streptococcus spp.*

   c. Toxin mediated: Streptococcal or Staphylococcal toxic shock syndrome

8. **Antimicrobial management**:

   a. **All patients should receive the first dose of antimicrobials as soon as possible, preferably within 1 hour of presentation.**

   b. **Empiric antibiotic selection should be based on the source of infection and the local susceptibility profile of the suspected organism causing the infection.**

   c. **Initial empiric antimicrobials for sepsis when the source is unclear:**

      i. **Community acquired:** Meropenem 1-2 g i.v. TID

      ii. **Hospital acquired infection with septic shock:** Meropenem 2 g i.v. TID + Colistin 9 million units i.v. loading, followed by 4.5 million units i.v. BID

   d. Add clindamycin when toxic shock is suspected and vancomycin when MRSA is likely

   e. Modify antimicrobial regimen in 48-72 hours based on results of culture & susceptibility reports, the site of infection and the clinical status of the patient.

Chapter 4: **Targeted (Definitive) Therapy of Common Infections**

1. Infective endocarditis

Condition	Etiology	First choice	Alternative	Comments
Infective endocarditis (native valve)	a. Penicillin susceptible (MIC <0.12 µgm/ml) *Strep viridans*	1. Penicillin G 2 - 3 million units i.v. Q4H x 4 weeks 2. Ceftriaxone 2 g i.v. OD x 4 weeks	1. Penicillin G 2 million units i.v. Q4H + Gentamicin 3 mg/kg i.v. OD x 2 weeks (see comments) 2. Ceftriaxone 2 g i.v. OD + Gentamicin 3 mg/kg i.v. OD x 2 weeks (see comments)	2-week regimen **only for uncomplicated cases (no cardiac / extra-cardiac abscess, eGFR >250 ml/min and age <65 years)** of native valve IE due to highly penicillin-susceptible *Strep viridans* (MIC <0.12 µgm/ml). For patients with beta-lactam allergy, use Vancomycin 15 mg/kg i.v. BID *Ceftriaxone MIC <0.5
	b. *Strep viridans* with Penicillin MIC >0.12 and <0.5 µgm/ml	Penicillin G 2 million units i.v. Q2H x 4 weeks +Gentamicin 3 mg/kg i.v. OD x 2 weeks	Ceftriaxone 2 g i.v. OD + Gentamicin 3 mg/kg i.v. OD x 2 weeks (if isolate susceptible to ceftriaxone)	For patients with beta-lactam allergy, use Vancomycin 15 mg/kg i.v. BID
	c. Enterococcus and Streptococci with Pen MIC >0.5 µgm/ml	Penicillin G 2 million units i.v. Q2H + Gentamicin 3mg/kg i.v. OD x 4 weeks	Ampicillin 2g i.v. Q4H + Ceftriaxone 2g i.v. Q 12H x 4 weeks	Increase the treatment to 6 weeks if symptom duration is > 3 months VRE: request for ID consultation
	d. MSSA	Cloxacillin 2 g i.v. Q4H x 6 weeks	Cefazolin 2 g i.v. TID x 6 weeks	For patients with beta-lactam allergy, use Vancomycin 15 - 30 mg/kg i.v. BID
	e. MRSA	Vancomycin 15 - 30 mg/kg i.v. Q12H x 6 weeks (Adjust dose to obtain vancomycin trough level 15 – 20 µg/ml)		
	d. HACEK	Ceftriaxone 2 g i.v. OD x 4 weeks	Ampicillin 2 g i.v. Q4H x 4 weeks	

Condition	Etiology	First choice	Alternative	Comments
Infective endocarditis (prosthetic valve)	MSSA	Cloxacillin 2 g i.v. Q4H x 6 weeks + Rifampicin 600 mg p.o. BID x 6 weeks + Gentamicin 1 mg/kg i.v. Q8H x 2 weeks		• Start rifampicin 3 – 5 days after cloxacillin and gentamicin • Cardiothoracic surgery consultation
	MRSA	Vancomycin 15 mg/kg i.v. Q12H x 6 weeks + Rifampicin 600 mg p.o. BID x 6 weeks + Gentamicin 1 mg/kg i.v. Q8H x 2 weeks		• Start rifampicin 3 – 5 days after vancomycin and gentamicin • Teicoplanin may be used instead of vancomycin (12 mg/kg/12 h x 3 days, followed by 12 mg/kg/day). Request Vancomycin MIC; if vanco mic >1 ID consult should be obtained

2. Bloodstream infections

a. Candidemia (Candida isolated from a single peripheral or central-line blood culture):

i. Start treatment with Caspofungin 70 mg i.v. x one dose, followed by 50 mg i.v. OD

Fluconazole 400 mg i.v. OD is appropriate for patient with no features of sepsis or septic shock

ii. Obtain blood cultures on alternate days until negative to document clearance of candidemia

iii. Ophthalmology evaluation (fundoscopic examination) to r/o retinal involvement

iv. Echocardiography for patients with persistently positive (>96 hours after antifungal therapy) or clinical features suggestive of IE

v. Central venous catheters should be removed as early as possible when presumed to be the source and the catheter can be removed safely; decision should be individualized for each patient

vi. Duration of treatment: 14 days from end of candidemia (for patients without obvious metastatic complications); change to Fluconazole 400 mg p.o. OD after 5 to 7 days if isolate susceptible and patient clinically stable

b. *Staphylococcus aureus* bacteremia (SAB)

i. Detailed history and physical examination to:

1. Determine source of bacteremia
2. Ascertain presence of prosthetic devices
3. Evidence of metastatic infection (e.g., endocarditis, bone and joint infection, splenic abscess, renal abscess etc.)

ii. Echocardiography required for all patients with SAB

to r/o endocarditis. TTE may be adequate for patients without identified risk factors for IE

1. Indications for TEE: persistently positive (>96 hours after appropriate antimicrobials) blood cultures, presence of prosthetic heart valve, peripheral stigmata of IE, cardiac valvular abnormalities, metastatic infections.

iii. Obtain blood cultures on alternate days to document clearance of bacteremia

iv. Antimicrobials:

1. MRSA: Vancomycin 15 mg/kg i.v. BID
2. MSSA: Cloxacillin 2 g i.v. Q4H (alternative Cefazolin 2 g i.v. Q8H)

v. Duration: 14 days from end of bacteremia for uncomplicated illness; longer duration for IE, metastatic infections, delayed clearance of bacteremia

3. Other infections

Condition	Etiology	Preferred	Alternative	Comments
3.1 Bacterial infections				
1. Enteric fever	• *S.* Typhi • *S.*Paratyphi A	1. Azithromycin 20 mg/kg/day x 7 days (for MDR & cipro resistant isolates)	1. Ceftriaxone 2 g i.v. OD x 14 days 2. Cotrimoxazole DS 1 tablet p.o. BID x 14 days if susceptible	
2. Melioidosis	• *B. Pseudomallai*	**Intensive phase:** • Ceftazidime 2 g i.v. Q6H x 14 days **Eradication phase:** • Co-trimoxazole Trimethoprim 15mg/kg/day in two dived doses for 5 months (longer if there is chronic osteomyelitis	**Intensive phase:** • Meropenem 1 g i.v. TID x 14 days (for patients in ICU) • Meropenem 2 g i.v. TID x 14 days (for neurological melioidosis)	• Prolonged i.v. therapy (4 - 8 weeks or longer) for o Complicated pneumonia, o Deep-seated infection including prostatic abscesses, o Neurological melioidosis, o Osteomyelitis o Septic arthritis • Abscess drainage
3. Brucellosis	*Brucella abortus, B. melitensis*	1. Uncomplicated brucellosis: Doxycycline 100 mg p.o. BID + Rifampicin 600 mg p.o. OD x 6 weeks 2. Complicated brucellosis: Doxycycline 100 mg p.o. BID x 6 wks +Rifampicin 600 mg p.o. OD+Gentamicin 5 mg/kg/day x 2 weeks		Obtain ID consult for patients with focal disease (spondylitis, endocarditis, neurobrucellosis)

Condition	Etiology	Preferred	Alternative	Comments
4. *C. difficile* colitis	*C. difficile*	• Non-severe disease: Metronidazole 500 mg p.o. TID x 10 days • Severe disease: Vancomycin 125 mg p.o. QID Metronidazole 500mg i.v. TID x 10 days		• Testing for *C. difficile* or its toxins should be performed only on diarrheal (unformed) stool, unless ileus or toxic megacolon due to *C. difficile* is suspected • Discontinue unnecessary antimicrobials • Fluid and electrolytes replacement • Avoid anti-motility drugs • Review proton pump inhibitor use Wash hands with soap and water after patient contact as spore will not be cleared by alcohol based hand rub • Surgery for ✓ Colonic perforation ✓ Severe disease not responding to antimicrobials
5. Carbapenem resistant Gram negative bacilli (CR GNB)causing BSI, pneumonia	• CR *K. pneumoniae* • CR *A. baumannii*	• Colistin 9 million units i.v. loading dose, followed by 4.5 million units i.v. BID + Meropenem 2 g i.v. TID given as 3 hr. infusion	If isolate sensitive to Amikacin: Amikacin 15 mg/kg i.v. OD + Meropenem 2 g i.v. TID given as 3 hr, infusion	• Obtain ID consult • Antimicrobials only for invasive infection • Don't treat colonization and contamination • Follow infection control precautions

Condition	Etiology	Preferred	Alternative	Comments
3.2 Parasitic infections				
6. Malaria	*Plasmodium vivax*	Chloroquine phosphate Day 1: 1000 mg (=600 mg base=4 tablets) p.o. x 1 doseDay 2: 4 tablets p.o. x 1 doseDay 3: 2 tablets p.o. x 1 dose + Primaquine 15 mg p.o. OD x 14 days		Primaquin contraindicated for patients with G6PD deficiency
	Plasmodium falciparum	• Artesunate 2.4 mg/kg body weight i.v. at admission, then at 12, 24 and 48 hours (4 doses), followed by Coartem 4 tablets p.o. BID x 3 days		• Primaquin 45 mg p.o. x 1 dose after completion of artesunate treatment .
	Severe malaria	• Artesunate 2.4 mg/kg body weight i.v. at admission, then at 12 h and 24 h, then once a day x 7 days + Doxycycline 100 mg p.o. BID x 7 days		
7. Visceral leishmaniasis	*Leishmania donovani*	Ambisome 10 mg/ kg i.v. x 1 dose	Amphotericin B deoxycholate 1 mg/kg i.v. on alternate days x 15 doses	
8. Amoebic liver abscess	Entameba histolytica	Metronidazole 500 mg i.v. / 800 mg p.o. TID, followed		Ultrasound guided drainage indicated in:

Condition	Etiology	Preferred	Alternative	Comments
		by: Diloxanide furoate 500 mg p.o. TID x 10 days, **or** Paromomycin 25 mg/kg/day p.o.in 3 divided doses x 7 days		• Large abscesses (diameter >10 cm) • Signs of imminent rupture No response to medical treatment
9. Neurocysticercosis	*Taenia solium*	Albendazole 400 mg p.o. BID + Praziquantel 100mg/kg/day in 3 divided doses on day 1 followed by 50mg/kg/day in 3 divided doses + Dexamethasone 2 mg TID x 15 days		• Antiepileptic therapy • Patients with multiple cysts with significant cerebral edema, only corticosteroid therapy + antiepileptic should be given.
3.3 Viralinfections				
10. Influenza	Influenza A and B viruses	Oseltamivir 75 mg p.o. BID x 5 days		Indications for antiviral treatment: 1. Persons with suspected or confirmed influenza who are at higher risk for influenza complications 2. Severe influenza (suspected or confirmed influenza who require hospitalization)
3.4 Mycobacterial infections				
11. Tuberculosis	*Mycobacterium tuberculosis*	Rifampicin 10 mg/kg/dayp.o. (max. 600 mg OD) + Isoniazid 5 mg/kg/day p.o. (max. 300 mg OD) + Pyridoxine 10 mg p.o. OD + Ethambutol		If GeneXpert shows rifampicin resistance, obtain ID consult

Condition	Etiology	Preferred	Alternative	Comments
		20 mg/kg/day p.o. (max. 1600 mg OD) + Pyrazinamide 25 mg/kg/day p.o. (max. 2000 mg OD) x 2 months, followed by Rifampicin + Isoniazid + Pyridoxine + Ethambutol x 4 months (total duration: 9 months)		
12. Surgical site infection caused by rapidly growing mycobacteria	*M. cheloniei* *M. abscessus* *M. fortuitum*	Clarithromycin 500 mg p.o. BID + Levofloxacin 750 mg OD + Amikacin 750 mg i.v. OD x 3 months		Surgical debridement
3.5 Fungal infections				
13. Pneumocystis pneumonia	*Pneumocystis jiroveci*	Cotrimoxazole (p.o. or i.v.) • Dose: Trimethoprim 15 mg/kg/day given in 3 or 4 divided doses • Duration: 21 days		Adjunctive therapy for severe PCP (PaO2 <70 mm Hg on room air) • Day 1 to 5: Prednisolone 40 mg p.o. BID • Day 6 to 10: Prednisolone 40 mg p.o. OD • Day 11 to 21: Prednisolone 20 mg p.o. OD
14. Invasive aspegillosis	*Aspergillus fumigatus*	Voriconazole 6 mg/kg i.v. or p.o. x 2 days, followed by 4 mg/kg BID till resolution of symptoms, signs and radiologic changes		

Condition	Etiology	Preferred	Alternative	Comments
15. Invasive mucormycosis	Mucorales	Ambisome 5 mg/kg/day i.v. till resolution of symptom, signs and radiologic changes	Amphotericin B deoxycholate 1 mg/kg/day till resolution of symptom, signs and radiologic changes	• Surgical debridement· Consider changing to Posaconazole 400 mg p.o. BID after 2 weeks of Amphotericin in patients with good clinical response
16. Candiduria: Treatment is required **only in specific situations such as** • Neutropenic **or** • Undergoing urologic manipulation	*Candida* spp.			• **Most patients need no antifungals** • Remove urinary catheter Neutropenic patients treated when indicated

Chapter 5 : Infective Endocarditis Prophylaxis

High risk conditions requiring IE prophylaxis:

1. Prosthetic heart valves and prosthetic material used for cardiac valve repair, such as annuloplasty rings and chords
2. Prior history of IE
3. Unrepaired cyanotic congenital heart disease
4. Repaired congenital heart disease with residual shunts or valvular regurgitation at the site or adjacent to the site of the prosthetic patch or prosthetic device
5. Repaired congenital heart defects with catheter-based intervention involving an occlusion device or stent during the first six months after the procedure
6. Valve regurgitation due to a structurally abnormal valve in a transplanted heart

Procedures requiring IE prophylaxis:

a. Dental or oral procedures that involve manipulation of gingival tissue or the periapical region of teeth or perforation of the oral mucosa.

b. Invasive respiratory tract procedures that involve incision or biopsy of the respiratory mucosa (eg, tonsillectomy, adenoidectomy, bronchoscopy with biopsy).

The following antibiotic regime is recommended for standard prophylaxis:

- Amoxycillin 2g orally 1 hr before procedure **OR**
- Cefazolin 1g IV/IM 30-60 min before the procedure

For patients allergic to penicillin:

- Clindamycin 600mg orally 1 hr or IV just before (dental and respiratory) procedure

1. A single preoperative dose of antibiotic is sufficient; there is no evidence for post-operative prophylactic antibiotic.
2. Antibiotics are repeated if the duration of operation is > 4 hours or if blood loss is > 1 liter (except vancomycin, aminoglycoside, fluoroquinolone).
3. Prophylactic antibiotics should be administered within 1 hour prior to incision.
4. Prophylactic antibiotics should not be used in perianal procedures (lay open fistula, hemorrhoidectomy, lateral anal sphincterotomy)
5. Avoid hypothermia as it increases incidence of surgical site infection.
6. No role for prophylactic antibiotic in routine cathertization

1a. Clean operation without use of prosthetic implant (thyroglossal cyst excision, thyroidectomy, parotidectomy, radical neck dissection, mastectomy, adrenalectomy, hepatectomy, hydatid cyst liver without biliary communication, splenectomy, porto-systemic shunt operation)

The evidence for use of antibiotic is thin. However if an antibiotic is deemed necessary:

Recommendation: Inj Cefazolin 1 gm IV

1b. Clean operation with use of prosthetic implant(inguinal hernioplasty, incisional hernia mesh repair, aortic aneurysm repair, aorto femoral bypass). Recommendation: Inj Cefazolin 1 gm IV

2a. Clean contaminated operation (cholecystectomy laparoscopic and open, gastrojejunostomy, gastrectomy, jejunal resection anastomosis, distal pancreatectomy, pseudocyst gastrostomy, pseudocystjejunostomy, low risk perforated peptic ulcer)

Recommendation: Inj Cefazolin 1 gm IV (evidence for prophylactic antibiotic in low risk laparoscopic cholecystectomy is thin)

2b. **Clean contaminated operation** (head & neck operation where oral cavity / upper aerodigestive tract is open, including esophageal operations). Recommendation: Inj Cefazolin 1 gm IV + Inj Metronidazole 500 mg IV (alternative: clindamycin)

3. **Contaminated operation** (colectomy, obstructed biliary tract, choledocholithiasis). Recommendation: InjCefazolin 1 gm IV + Inj Metronidazole 500 mg IV (alternative: clindamycin + metronidazole). Surgeries on obstructed Bilary system should also add Inj. Amikacin15mg /Kg.

4. **Dirty** (fecal peritonitis, anastomotic leakage)

Antibiotics are not "prophylactic" here. Choice of antibiotics will depend on whether organ dysfunction is present or not. Specimens for culture and sensitivity should be taken at operation. If organ dysfunction is present broad-spectrum antibiotics will be chosen initially and de-escalate once culture / sensitivity results are available.

Esophago-gastroduodenal surgery

Nature of Operation	Etiology	Recommended antimicrobials	Usual adult dose	Redose Interval
Procedure involving entry into lumen of gastrointestinal tract	Enteric gram negative bacilli, gram-positive cocci.	Cefazolin.	<120 Kg: 1 g IV >120 Kg: 2 g IV	4 hours
Procedures not involving entry into lumen of gastrointestinal tract (selective vagotomy, antireflux)	Enteric gram-negative bacilli, gram-positive cocci	*High risk only: Cefazolin	<120 kg: 1 g IV >120 kg: 2 g IV	4 hours

*HIGH RISK - Morbid obesity, gastrointestinal obstruction, decreased gastric acidity or GI motility, gastric bleeding, malignancy or perforation, or immunosuppression.

Biliary tract surgery (including pancreatic)

Nature of Operation	Etiology	Recommended antimicrobials	Usual adult dose	Redose Interval
Laparoscopic procedure (low risk)	N/A	NA	NA	NA
Open procedure or laparoscopic procedure (high risk)[§]	Enteric gram-negative bacilli, enterococci, clostridia	Cefazolin	<120 kg: 1 g IV >120 kg: 2 g IV	4 hours
Obstructed biliary system	Enteric gram negative bacteria	Cefazolin PLUS Amikacin	<120 kg: 1 g IV >120 kg: 2 g IV 15mg/kg	4 hours NA

$High risk laparoscopic -Age >70 years, acute cholecystitis, non-functioning gall bladder, or common bile duct stones

Small intestine surgery

Nature of Operation	Etiology	Recommended antimicrobials	Usual adult dose	Redose Interval
Nonobstructed	Enteric gram-negative bacilli, gram-positive cocci	Cefazolin	<120 kg: 1 g IV >120 kg: 2 g IV	4 hours
Obstructed	Enteric gram-negative bacilli, anaerobes, enterococci	Cefazolin PLUS Metronidazole	<120 kg: 1 g IV >120 kg: 2 g IV 500 mg IV	4 hours N/A

Colorectal Surgery

Nature of Operation	Etiology	Recommended antimicrobials	Usual adult dose	Redose Interval
Colorectal surgery	Enteric gram-negative bacilli, anaerobes, enterococci	Cefazolin PLUS Metronidazole	<120 kg: 1 g IV >120 kg: 2 g IV 500 mg IV	4 hours N/A

Hernia Surgery

Nature of Operation	Etiology	Recommended antimicrobials	Usual adult dose	Redose Interval
Hernia	Aerobic gram-positive organisms	Cefazolin	<120 kg: 1 g IV >120 kg: 2 g IV	4 hours

Head & Neck surgery

Nature of Operation	Etiology	Recommended antimicrobials	Usual adult dose	Redose Interval
Clean Including thyroidectomy	_	None	N/A	N/A
Clean-contaminated	Anaerobes, enteric gram-negative bacilli, *S. aureus*	Cefazolin PLUS Metronidazole	<120 kg: 1 g IV >120 kg: 2 g IV 500 mg IV	4 hours N/A

Vascular Surgery

Nature of Operation	Etiology	Recommended antimicrobials	Usual adult dose	Redose Interval
Arterial surgery involving prosthesis, abdominal aorta or groin incision	*S.aureus, S.epidermidis*	Cefazolin	<120 kg: 1 g IV >120 kg: 2 g IV	4 hours
Superficial venous system surgery	*S.aureus, S.epidermidis*	NA	NA	NA

Mastectomy

Nature of Operation	Etiology	Recommended antimicrobials	Usual adult dose	Redose Interval
Clean	Aerobic gram-positive organisms	Cefazolin	<120 kg: 1 g IV >120 kg: 2 g IV	4 hours

Orthopedic Surgery

Nature of Operation	Etiology	Recommended antimicrobials	Usual adult dose	Redose Interval
Clean surgeries including fracture repair, arthroplasty, iimplantation of foreign material and joint replacement	Aerobic gram-positive organisms	Cefazolin	<120 kg: 1 g IV >120 kg: 2 g IV	4 hours

Chapter 7: **Dosing of antimicrobial agents in renal insufficiency**

Cockcroft-Gault equation to calculate creatinine clearance (CrCl) for drug dosing in renal impairment:

CrCl (ml/min) = (140-age) x weight (kg) (x 0.85 if female)

72 x serum creatinine (mg/dl)

NB If anuric, morbidly obese or in acute renal failure, this equation will NOT give a true reflection of the creatinine clearance. **Anuric and oliguric** (<500ml/day) patients assumed to have CrCl < 10ml/min.

If **morbidly obese**, use ideal body weight (IBW):

IBW (in kg) for males = 50kg + 2.3kg for each inch over 5 feet (Devine formula –Average BMI of 23.0)

IBW (in kg) for women = 49kg + 1.7kg for each inch over 5 feet (Robinson formula—average BMI of 21.1)

Antimicrobial agent	CrCl (ml/min)			Comments
	Normal dose	Mild 20-50	Moderate 10-20	Severe <10	AD = After haemodialysis
Aciclovir IV	10 mg/kg q8h	10 mg/kg q12h	10mg/kg q24h	5mg/kg q24h	AD
Aciclovir po	Simplex: 200-400 mg q6h Zoster: 800 mg 5 times a day	Normal dose	Simplex: 200-400mg q6h Zoster: 800mg q8h	Simplex: 200-400mg q12h Zoster: 800mg q12h	AD
Amikacin IV	15 mg/kg q24h	7.5mg/kg q24h	7.5mg/kg q24-48h	7.5mg/kg q48-72h	Supplement HD: 7.5mg/kg AD
Amoxicillin po	500 mg - 1g q8h	Normal	500mg - 1g q12h	500mg - 1g q24h	AD
Amphotericin IV	1 mg/kg q24h	Normal	Consider lipid formulations	Consider lipid formulations	No supplementation after HD
			Amphotericin is highly NEPHROTOXIC. Consider using Liposomal Amphotericin. Monitor CrCl daily.		
Liposomal Amphotericin IV	3–5 mg/kg q24h	Normal	Normal	Normal	
Ampicillin IV	2g q4-6h	Normal	2gm q6-8h	2gm q8-12h	AD
Anidulafungin IV	200 mg for 1 day then 100 mg q24h	Normal	Normal	Normal	
Artemether with lumefantrine po	20 mg/120mg tabs: 4 tabs q12h for 3 days	Normal	Normal	Normal	**<10** Monitor ECG & potassium
Artesunate IV	2.4 mg/kg at 0, 12 and 24 h then q24h	Normal	Normal	Normal	
Azithromycin IV + po	IV: 500 mg q24h po: 500 mg – 1g q24h	Normal	Normal	Normal	
Benzylpenicillin (CP) IV	20-40L units q4h	Normal	10-20L q4h	5 - 10 L q4h	AD
Caspofungin IV	70 mg for 1 day then 50 mg q24h [If >80 kg 70 mg q24h]	Normal	Normal	Normal	
Cefazolin IV	1–2g q8h	Normal	1-2g q12h	1g q24h	AD
Cefoperazone + sulbactam IV (1.5g = 1g + 500 mg, 3g = 2g + 1g)	**3g** q12hbut severe / less sensitive/ neutropenia **3g** q8h tomax **6g** q12h	Normal	**3g** q12hplus if severe extracefoperazone **2g** q24h to max **2g** q12h	**1.5g** q12hplus extra cefoperazone**1g** q12h; if severe **2g** q12h tomax **3g** q12h	AD

ANTIBIOTICS, ANTIFUNGALS, ANTIVIRALS	Normal Dose	CrCl (ml/min) Mild 20-50	Moderate 10-20	Severe <10	Comments AD = After haemodialysis
Ceftazidime IV	1-2 g q8h	**CrCl-31-50**:1-2g 12h	**CrCl-10-30**: 1-2g q24h	500 mg – 1g q24h	AD
Ceftriaxone IV	1-2g q12-24h	Normal	Normal	Normal	
Ciprofloxacin IV + po	IV 400 mg q8h PO 750 mg q12h	Normal	IV 200-400 mg q12h PO 250–500 mg q12h	IV 200-400 mg q12h PO 250–500 mg q12h	
Clarithromycin IV + po	IV 500 mg q12h PO 500 mg q12h	Normal	250–500 mg q12h	250-500mg q24h	AD
Clindamycin IV + po	IV 600mg q6-8h PO 300–450 mg q6h	Normal	Normal	Normal	
Cloxacillin IV + po	IV 1-2g q4-6h PO 500 mg-1g q6h	Normal		Normal (Max 6g/day)	
Co-amoxiclav IV + po (Augmentin® etc)	IV-1.2gm q8h PO 1000 mg q12h	Normal	Normal	IV 1.2 g q24h PO 625 mg q8-12h	AD
Colistimethate sodium IV	9MU Loading dose (LD) [If <60kg 0.15MU/kg] THEN after 12 hours 3MU q8h [If <60kg 0.05MU/kg q8h]	**CrCl-60-80**: Normal **CrCl-50-59:** Normal LD then 4MU q12h [If <60kg 0.044MU/kg q8h] **CrCl-20-49:** Normal LD then 2MU q8h (If >60kg)[If <60kg 0.038MU/kg q8h]	IV 1.2g q12h PO 625 mg q8-12h Normal LD then 2 MU q12h [If <60kg .038MU/kg q12h]	Normal LD then 1.5 MU q12h [If <60kg 0.023MU/kg q12h]	2MU q12h on dialysis days [If <60kg 0.038MU/kg q12h]**NB** If < 60kg round to nearest 0.5g
Colistimethate sodium NEB	1-2MU q12h	1 MU q12h		1 MU q24h	AD
Co-trimoxazole IV + po [DS = 960 mg = 800mg sulfamethoxazole and 160 mg trimethoprim]	**PCP:** (TMP 15mg/kg/day) **or** 1 DS (960mg) tab per 10 kg/ day in 2-4 divided doses. **Melioidosis:** 1920mg (2 DS (960mg) tabs) q12h **Nocardiosis:** (TMP 10-15 mg/kg/ day) in 2-4 divided doses **Toxoplasmosis:** (TMP 5mg/kg) q12h **Prophylaxis:** 960mg q24h **or** 960mg q12-24h 3 days a week	**CrCl-30-50:** Normal	1 MU q12h CrCl-15-30 **PCP**: Normal for first 3days followed by 50% of usual dose	**CrCl<15** **All infections**: 50% of usual doses **Prophylaxis:** Normal	AD

ANTIBIOTICS, ANTIFUNGALS, ANTIVIRALS	Normal Dose	Mild 20-50	CrCl (ml/min) Moderate 10-20	Severe <10	Comments AD = After haemodialysis
Daptomycin IV	Soft tissue infections 4-6mg/kg q24hBacteremia and Endocarditis: 8-10mg/kg q24h	Normal	Soft tissue infections 4-6mg/kg q48h Bacteremia and Endocarditis: 8-10mg/kg q48h		AD Monitor creatine kinase initially and at least weekly
Dicloxacillin IV + po	IV 1-2g q4-6h PO 500 mg-1g q6h	Normal	Normal	Normal (Max 6g/day)	
Doxycycline IV + po	100 mg q12h	Normal	Normal	Normal	
Ertapenem IV	1g q24h	Normal	Normal	500 mg q24h	AD
Ethambutol po	20 mg/kg q24h	Normal	20mg/kg q24-36h	20mg/kg q48h	AD
Fluconazole IV + po	50-800 mg daily	Start normal dose then 50%	Start normal dose then 50%	Start normal dose then 50% **HD**: 100% after each dialysis [on non-dialysis days dose according to CrCl)	AD **Single dose**: Normal **CRRT**: Normal
Ganciclovir IV (Induction)	5 mg/kg q12h	**CrCl-50-69** 2.5 mg/kg q12h **CrCl-25-49** 2.5 mg/kg q24h	**CrCl-10-24** 1.25 mg/kg q24h	1.25 mg/kg 3 times a week	AD
Gentamicin IV	**Once daily**: 5-7 mg/kg q24h **Infective endocarditis:** 3mg/kg q24h	**Once daily**: **60-79** 4mg/kg q24h **40-59** 3.5mg/kg q24h **30-39** 2.5mg/kg q24h **IE:** 2mg/kg q24h	**'Once daily'**: 3mg/kg **q48h** **IE:** 1mg/kg q24h	**'Once daily'**: 2mg/kg **q48-72h** **IE:** 1mg/kg q48h	AD
Imipenem IV	500 mg–1g q6h	**CrCl-41-70** 500-750 mg q8h **CrCl-21-40** 250-500 mg q6h	250-500 mg q12h	Risk of seizures – use Meropenem	AD
Isoniazid po	5 mg/kg q24h	Normal	Normal	150-300 mg q24h	AD
Itraconazole po	200 mg q12h	Normal	Normal	100mg q12h	

ANTIBIOTICS, ANTIFUNGALS, ANTIVIRALS	Normal Dose	CrCl (ml/min) Mild 20-50	Moderate 10-20	Severe <10	Comments AD = After haemodialysis
Levofloxacin IV + po	750 mg q24h	750 mg q48h	500 mg q48h	250-500 mg q24-48h	
Linezolid IV + po	600 mg q12h	Normal	Normal	Normal	AD **<10** Monitor platelets
Meropenem IV	1-2g q8h	1-2g q12h	500-1g q12h	500 mg -1g q24h	AD **CRO**: Infuse each dose over 3 hours
Metronidazole IV + po	IV 500 mg q8h PO 400-800 mg q8h	Normal	Normal	Normal CrCl (ml/min)	AD
Moxifloxacin po	400-600 mg q24h	Normal	Normal	Normal	600 mg q24h for MDR-TB
Nitrofurantoin po	50-100 mg q6h **Prophylaxis:** 50-100 mg at night	**>45** Normal **30-45** Normal - ONLY if no option, 3-7 days ONLY	**<30 Contraindicated** as ineffective due to inadequate urine concentrations.		Unsuitable for pyelonephritis or urinary sepsis
Oseltamivir po (Treatment dose)	75 mg q12h	**30-60** 30 mg q12h	**10-30** 30 mg q24h	30 mg stat then every 5 days if required	AD 30 mg after each dialysis
Piperacillin / Tazobactam IV	4.5g q6-8h	4.5g q8h	4.5g q12h **or** 2.25 mg q8h	4.5g q12h **or** 2.25 mg q8h	AD
Posaconazole po (Suspension)	**Treatment:** 400 mg q12h, with food, **or** 200 mg q6h **Prophylaxis:** 200 mg q8h	Normal	Normal	Normal	
Pyrazinamide po	25 mg/kg q24h	Normal	Normal	15 mg/kg q24h	AD
Rifabutin po	300 mg q24h	Normal	**<30** 150-300 mg q24h		150mg q24h when co-administered PIs in HIV infection
Rifampicin po	10 mg/kg q24h	Normal	Normal	Normal	
Streptomycin IM	15 mg/kg q24h	**30-50** 15 mg/kg q48h**<30** 12-15 mg/kg q48-72h	12-15 mg/kg q72h	12-15 mg/kg q72h-96h	AD (+extra 7.5 mg/kg AD)
Teicoplanin IV	Loading dose (LD) 6mg/kg q12 h for 3 doses then 6mg/kg q24h. **Bone and joint infection / endocarditis**: LD 12 mg/kg q12h for 3 doses then 12 mg/kg (max. 800 mg) q24h	**CrCl-30-50**Loading dose: NormalDay 3 and 4 NormalAfter day 4- 400mg q48h	**CrCl<30**Loading dose: NormalDay 3 and 4 NormalAfter day 4- 400mg q72h	**CrCl<30**Loading dose: NormalDay 3 and 4 NormalAfter day 4- 400mg q72h	
Tigecycline IV	Loading dose (LD) 100 mg then 50 mg q12h	Normal	Normal	Normal	For CRO use 200mg as loading dose followed by 100mg q12

ANTIBIOTICS, ANTIFUNGALS, ANTIVIRALS	Normal Dose	CrCl (ml/min) Mild 20-50	Moderate 10-20	Severe <10	Comments AD = After haemodialysis
Valganciclovir IV	**Induction** 900 mg q12h **Maintenance** 900 mg q24h	**CrCl-40-59** **I-**450 mg q12h **M** 450 mg 24h **25-39** **I** 450 mg q24h **M** 450 mg q48h	**CrCl-10-24 I** 450 mg q48h**M** 450 mg twice weekly	Not recommendedLimited data: **I** 450 mg 2-3 times a week**M** 450 mg 1-2 times a week	AD
Vancomycin IV	20-30mg/kg loading (max 1.5gm) Followed by 15mg/kg q12h	15mg/kg q24h	15mg/kg q48h	15mg/kg once followed by redosing based on trough levels	monitor trough levels before 5th dose to achieve 15—20mcg/ml
Voriconazole IV and PO	IV 6mg/kg q12h x 2 doses, then 4 mg/kg q12hPO 400 mg q12 h x 2 doses then 200-300 mg q12h		Normal but **PO** preferred, ideally AVOID **IV** as solubilising agent may lead to renal damage. If IV essential monitor creatinine.		AD

Antimicrobial susceptibility profile of Blood stream infections - 2017

Table 1 : AST Profile of BSI organisms - Susceptible percentage			
	Escherichia coli (n=753)	*K.pneumoniae* (n=405)	*#Enterobacter* spp (n=85)
Gentamicin	64%	53%	85%
Amikacin	86%	59%	94%
Netilmicin	87%	59%	
Ciprofloxacin	31%	48%	84%
Piperacillin/Tazobactam	63%	51%	81%
Cefaperazone/Sulbactam	74%	54%	88%
Imipenem	86%	59%	93%
Meropenem	87%	58%	93%
Cefepime	34%	46%	73%
Tigecycline	90%	63%	
Chloramphenicol	82%	57%	
Minocycline	75%	67%	
Colistin susceptibility among carbapenem resistant isolates (N=95)	92%	63%	
*Cefotaxime/Ceftazidime	29%	40%	
*Ceftriaxone			11%

*Surrogate marker of ESBL Production

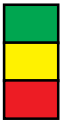
Table 2 : AST Profile of BSI organisms -Susceptible percentage		
	Pseudomonas aeruginosa (n=179)	*Acinetobacter baumanii* (n = 103)
Ceftazidime	73%	32%
Cefepime	73%	30%
Amikacin	73%	37%
Tobramycin	76%	45%
Gentamicin	78%	41%
Levofloxacin	70%	37%
Piperacillin / Tazobactam	69%	35%
Cefoperazone / Sulbactam	60%	37%
Imipenem	66%	31%
Meropenem	64%	31%
Colistin		96% (n=71)
Tigecycline		34%
Aztreonam	65%	
Co trimoxazole		48%
Minocycline		60%

Table 3 : AST Profile of BSI organisms -Susceptible percentage			
	Salmonella Typhi (n=213)	*Salmonella Paratyphi A (n=21)*	*Non Typhoidal Salmonella (n=26)*
Ampicillin	98%	100%	92%
Chloramphenicol	99%	100%	100%
Co- trimoxazole	99%	100%	100%
Ceftriaxone	100%	100%	92%
Ciprofloxacin	19%	29%	73%
Azithromicin	100%	100%	100%

Table 4 : AST Profile of BSI organisms -Susceptible percentage		
	Staphylococcus aureus	
	MRSA (n = 91)	MSSA (n=176)
Cefoxitin	0	100%
Clindamycin	45%	41%
Erythromycin	22%	64%
Co-trimoxazole	66%	83%
Gentamicin	55%	94%
Netilmicin	98%	93%
Rifampicin	90%	99%
Vancomycin	100%	
Linezolid	99%	100%
Chloramphenicol	90%	99%

Table 5: AST Profile of BSI organisms -Susceptible percentage		
	Streptococcus pneumoniae	
	Meningeal isolates (n=16)	Non-meningeal isolates (n=88)
Penicillin	38%	100%
Cefotaxime	75%	98%
Erythromycin	31%	49%
Co -trimoxazole	0	0
Vancomycin	100%	100%
Linezolid	100%	100%

Table 6 : AST Profile of BSI organisms- Susceptible percentage		
	Enterococcus spp	
	E.faecium (n=56)	*E.faecalis* (n = 24)
Ampicillin + High level Gentamicin	11%	63%
Levofloxacin	29%	46%
Vancomycin	75%	92%
Linezolid	100%	96%
Tigecycline	93%	92%
Chloramphenicol	91%	92%
Teicoplanin	84%	96%

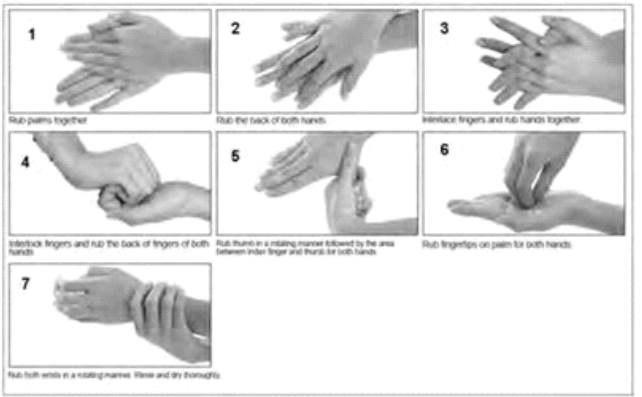


>80% Susceptible

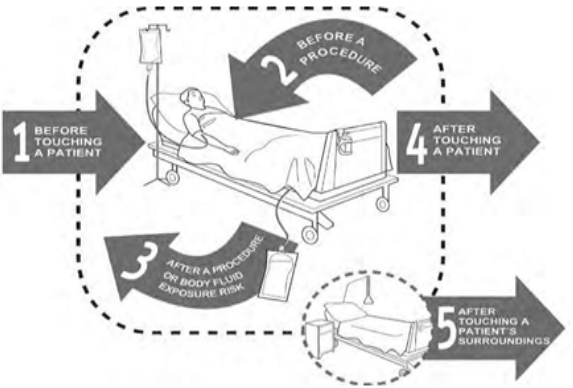
70 – 79% Susceptible

<69% Susceptible

Hand Hygiene Technique



5 Moments of Hand Hygiene



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