REPUBLIC OF KENYA

MINISTRY OF HEALTH

NATIONAL ANTIBIOTIC USE GUIDELINES

EMPIRIC TREATMENT AND SURGICAL PROPHYLAXIS

2024 Edition

National Antibiotic Use Guidelines

Empiric Treatment and Surgical Prophylaxis

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MINISTRY OF HEALTH

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The National Antibiotics Use Guidelines on Empiric Treatment and Surgical Prophylaxis, 2024 edition, contain local evidence-based information for clinical care use in Kenya. All reasonable precautions have been taken by Ministry of Health to verify the information contained in this guideline document.

For clarifications contact Ministry of Health at P. O. Box, 30016 – 00100, Nairobi Kenya, Email: dhsqar@health.go.ke or Website: https://www.health.go.ke/

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FOREWORD

Antimicrobial resistance (AMR) is a threat to public health. The impact of AMR is significantly higher in Low- and Middle-Income Countries (LMICs) where health systems are weaker with inadequate microbiological diagnostic capacities as well as limited availability of alternative antimicrobials agents.

The rapid spread of AMR has necessitated standard treatment guidelines with considerations of local resistance patterns, to be regionally customized. Local guidelines would help with clinical decision making through a consensus development method that focuses on locally available evidence on AMR and evidence-based treatment recommendations on antibiotics use. However, this is only effective when these guidelines are developed based on common pathogen resistance data and clinical experience.

This guideline is intended to guide clinicians and other medical staff on the choice of appropriate antibiotics for treatment of infections and surgical prophylaxis. Empiric antibiotic therapy and surgical antibiotic prophylaxis are the cornerstones for the management and prevention of infectious diseases. Specifically, empiric therapy remains important especially in situations where a definitive diagnosis is delayed or unavailable, as it considers clinical presentation, epidemiological data, and local pathogen resistance patterns.

These guidelines were developed by a team of experts in Infectious Disease, Clinicians, Clinical Pharmacists and Clinical Microbiologists as a guide in management of infectious diseases. These guidelines are intended to assist with clinical decision-making for common situations but cannot replace clinical judgement based on individual patient factors. Clinicians should always consider patient-specific information (e.g., prior culture results, recent antimicrobial therapy and immune status) when selecting therapy. They should also reassess their initial treatment choice (continue, modify, de-escalate, discontinue) once cultures are available.

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These guidelines were developed with reference to the national basic pediatric protocol and the WHO Aware (Access, Watch, Reserve) antibiotic book, and other international guidelines.

The Ministry of Health (MOH) wishes to thank the NASIC Secretariat for their leadership and the following contributing stakeholders for their expertise and time given to development and validation of these guidelines: Infectious disease experts and health care practitioners from various public and private health care institutions; faith-based organizations; professional and regulatory bodies and implementing partners.

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ANTIBIOTICS FOR SURGICAL PROPHYLAXIS

LIST OF ABBREVIATIONS

AVPU	Alert, Voice, Pain, Unresponsive
ASP	Antimicrobial Stewardship Programs
AMS	Antimicrobial Stewardship
AWaRe	Access Watch Reserve
BGA	Blood Gas Analysis
CFU	Colony Forming Unit
CNS	Central Nervous System
CoNS	Coagulase negative staphylococci
CRP	C-reactive Protein
CSF	Cerebral Spinal Fluid
CT	Computed Tomography
CVS	Cardiovascular System
DFAT	Direct Fluorescent Antibody Testing
ESR	Erythrocyte Sedimentation Rate
EVD	External Ventricular Drain
GI	Gastrointestinal
HIV	Human Immuno-deficiency Virus
HPF	High Power Field
IDS	Infectious Disease Specialist
IPC	Infection Prevention and Control
IV	Intravenous
KEML	Kenya Essential Medicines List

KNH	Kenyatta National Hospital
LAM	Lipoarabinomannan
LP	Lumbar Puncture
MDRO	Multidrug-resistant Organism
MIC	Minimum Inhibitory Concentration
MOH	Ministry of Health
MRI	Magnetic Resonance Imaging
MRSA	Methicillin Resistant Staphylococcus Aureus
PJP	Pneumocystis Jirovecii pneumonia
PCT	Procalcitonin
PMN	Polymorphonuclear cells
PO	Per Oral
RBS	Random Blood Sugar
RR	Respiratory Rate
RS	Respiratory System
Sp.	Species
TB	Tuberculosis
UEC	Urea, Electrolytes and Creatinine
UTI	Urinary Tract Infection
UON	University of Nairobi
WBC	White blood cells
WHO	World Health Organization

INTRODUCTION

Antimicrobial stewardship programs (ASPs) play a crucial role in developing multidisciplinary, evidence-based guidelines that incorporate local data, ensuring standardized, high-quality care for common infections and the use of antibiotics for surgical prophylaxis. These National Antibiotic Use Guidelines on Empiric Treatment and Surgical Antibiotic Prophylaxis provide direction for the initial therapy choices, offering first-line and alternative recommendations for infections like pneumonia, intra-abdominal infections, urinary tract infections (UTIs), meningitis, and skin infections, as well as the choice of antibiotics to be used for surgical prophylaxis.

Therapy choices suggested within the guidelines consider:

- Infection site and common pathogens
- Local epidemiology and resistance patterns
- Evidence and clinician consensus
- Stewardship principles
- Antibiotic availability and costs

Clinicians should reassess initial treatment choices once cultures are available, deciding whether to continue, modify, de-escalate, or discontinue therapy.

To develop effective local empiric antibiotic regimens, institutions should adapt these national guidelines, ensuring they are tailored to local needs. Regular updates are essential as new information emerges.

Strategies proposed to enhance the implementation and adoption of these guidelines include:

- Educating prescribers during formal rounds and informal settings
- Distributing guidelines via pocket cards, hospital intranet sites, or computerized physician order entry systems to facilitate compliance.
- Collaboration with the infection prevention and control (IPC) Committee
- Inclusion on official Ministry of Health Apps

HAND HYGIENE TECHNIQUE

Source: The above poster has been adapted from the World Health Organization (WHO)

GOOD PRACTICE ON ANTIMICROBIAL USE

1. Not all admitted patients require antibiotics, fever does not necessarily mean presence of a bacterial infection.
2. Appropriate investigations are recommended for all infections. These are necessary for diagnosis, treatment and follow up.
3. Microbiological specimens should be collected before initiating antimicrobial therapy.
4. Prescribe antimicrobials contained in the hospital formulary/Kenya essential medicines list (KEML).
5. For community acquired infections in children under the age of five not covered in this guideline, use the updated Basic Paediatric Protocols from the Ministry of Health.
6. Check for factors that will affect drug choice and dose such as age, renal and hepatic dysfunction, drug interactions, hypersensitivity reactions, pregnancy and lactation.
7. Ensure that an appropriate dose is prescribed; if uncertain consult the clinical pharmacist or check in the hospital formulary.
8. The need for antimicrobial therapy should be reviewed at 48 hours and regularly thereafter. If investigations **do not** suggest an infection, antibiotics should be stopped and other appropriate management instituted.
9. For most infections 5 days of antimicrobial therapy is sufficient. Exceptions include: meningitis, neonatal sepsis, deep seated abscesses, infective endocarditis, osteomyelitis, pyelonephritis, blood stream infections secondary to staphylococcus aureus and pseudomonas aeruginosa, and skin and soft tissue infections.
10. Once culture and sensitivity reports are available, de-escalate to the narrowest spectrum, most efficacious and most cost-effective option. Narrowest spectrum is not the drug with the lowest MIC. Select the antibiotics in the WHO AWaRe classification 'ACCESS' wherever possible.
11. Switch from IV to oral antibiotic once the patient is clinically stable.
12. Prescription of a reserve antibiotic (e.g., carbapenem (meropenem or imipenem) in the general wards will need to be supported by a culture and sensitivity report.
13. In case of multidrug resistant (MDR) infections, observe strict contact precautions (this will include gowns and gloves) notify the infection prevention and control committee (IPC) and consult the antimicrobial stewardship (AMS) committee.

GOOD PRACTICE ON MICROBIOLOGY SAMPLE COLLECTION

(Also refer to the National Diagnostic Stewardship Guidelines)

Collecting Specimens for Bacteriology

1. Sterile technique should be observed. Appropriate sterile containers should be used.
2. Samples should be collected at time of patient presentation/onset of illness and before administration of any antibiotics.
3. Samples should be collected only when clinically indicated. Avoid routine screening cultures such as routine tracheal aspirates or routine urine cultures.

Adequate specimen collection

1. Blood - should be taken from 2 sites e.g., from a central line and a peripheral site or 2 peripheral sites. When taking a blood culture sample from a peripheral site, clean the site with an alcohol swab or 2% chlorhexidine and allow 30 seconds to dry before puncture, **do not** palpate the vessel before puncture unless sterile gloves are worn. Central venous catheter tip cultures must be accompanied by blood for culture. For adults draw 10-15 mls of blood from each site, for children under 5 years, collect 1-5mls of blood for culture.
2. When taking multiple samples, take blood culture sample first.
3. Urine - should be a clean catch midstream sample, or from a freshly inserted catheter.

   Patient to wash hands with soap and water before sample collection. Females to hold edges of labia apart and males to retract foreskin if not circumcised to minimize contact of the urinary stream with the mucosa. Without touching the inside of the container and the lid, cover the container with the lid and tighten it.

   Do not collect urine from a urine bag or an indwelling catheter. Urine catheter tip cultures **should not** be sent for culture.
4. Abdominal fluid - should be taken straight from the abdomen or from a newly placed drain. **Do not** collect specimens from existing drains.
5. Wound swabs are often not useful due to contamination. To collect a swab, first clean the wound with normal saline and attempt to get a swab from the base or alternatively, get a tissue specimen for culture. **Do not** collect a superficial sample from the surface of a wound.
6. A sterile procedure should always be used for collection of cerebrospinal fluid (CSF), a mask should be worn to avoid respiratory contamination.
7. For abscesses, bullae, blisters, aspirate pus directly from the abscess with a sterile needle and syringe and immediately transfer to a sterile container.

Interpreting bacteriology results

1. The clinical context must be taken into account when interpreting cultures as this will help in differentiating true infection from colonization or contamination.
2. Coagulase negative Staphylococci in blood will only be considered relevant if grown in more than 1 bottle in an appropriate clinical scenario (site of infection).
3. True infection is almost always present if the blood culture is positive for one of the following:
    - Aerobic and facultative gram-negative rods e.g., *Escherichia coli, Klebsiella pneumoniae, Enterobacter, Pseudomonas*
    - Anaerobic cocci e.g., Peptococcus, Peptostreptococcus
    - Anaerobic gram-negative rods e.g., Bacteroides, Prevotella, Fusobacterium
    - Staphylococcus aureus
    - Streptococci (non-viridans)
    - Yeast e.g., Candida species.
4. Suspect contamination if detection of bacterial growth is delayed (≥5 days), or if multiple organisms are isolated from one culture (if unsure about interpretation, discuss with the lab).
5. Tracheal aspirates should only be collected if clinically indicated, avoid taking routine tracheal aspirates for culture. Consider the organism cultured as the possible cause of infection if the chest radiograph shows infiltrates consistent with pneumonia.
6. Once culture and sensitivity reports are available, de-escalate to the narrowest spectrum, most efficacious and most cost-effective option. Narrowest spectrum is not the drug with the lowest MIC. Select the antibiotics in the 'access' section of the WHO AWARE classification.

If you are unsure of how to interpret culture and sensitivity results, consult the AMS team and/or physician or call an ID specialist in urgent cases.

Interpretation of inflammatory markers

C-Reactive Protein (CRP)

CRP is the most widely studied and used acute-phase protein. It increases between 4 and 6 hours after exposure to an infectious process or tissue damage, with a half-life of 19 hours, peaks at between 36 and 50 hours, and then decreases with time as the inflammatory process decreases. It is important to remember that several inflammatory conditions can elevate CRP.

The actual normal or clinically innocuous range for CRP is uncertain, and there is a lack of consistency in the units used to convey CRP levels (mg/dL or mg/L).

In a newborn, for example, in addition to infection, CRP can be increased by surgery, tissue necrosis, and intracranial hemorrhage. For the pediatric age group in general, values above 75 mg/l have been suggested to identify children at higher risk of serious bacterial infection, in some cases, a 26.8% risk of infection.

CRP level	Interpretation
< 0.3 mg/dL	Normal (level seen in most healthy adults)
0.3 to 1.0 mg/dL	Normal or minor elevation (can be seen in obesity, pregnancy, diabetes, common cold, gingivitis, periodontitis, sedentary lifestyle, cigarette smoking etc.)
1.0 to 10.0 mg/dL	Moderate elevation (Systemic inflammation such as lupus, or other autoimmune diseases, malignancies, myocardial infarction, pancreatitis, bronchitis)
> 10.0 mg/dL	Marked elevation (Acute bacterial infections, viral infections, systemic vasculitis, major trauma)
> 50.0 mg/dL	Severe elevation (Acute bacterial infections)

Procalcitonin (PCT)

PCT measurement aids in the diagnosis of sepsis and to guide and monitor antibiotic therapy. PCT is used in pediatrics to support the diagnosis of sepsis in newborns, infants, and children. A cutoff value of 0.5 ng/ml showed high sensitivity, low specificity, and acceptable negative predictive value. The reference value for procalcitonin in adults is less than 0.1 ng/mL. Levels greater than 0.5 ng/mL may indicate the presence of an infection.

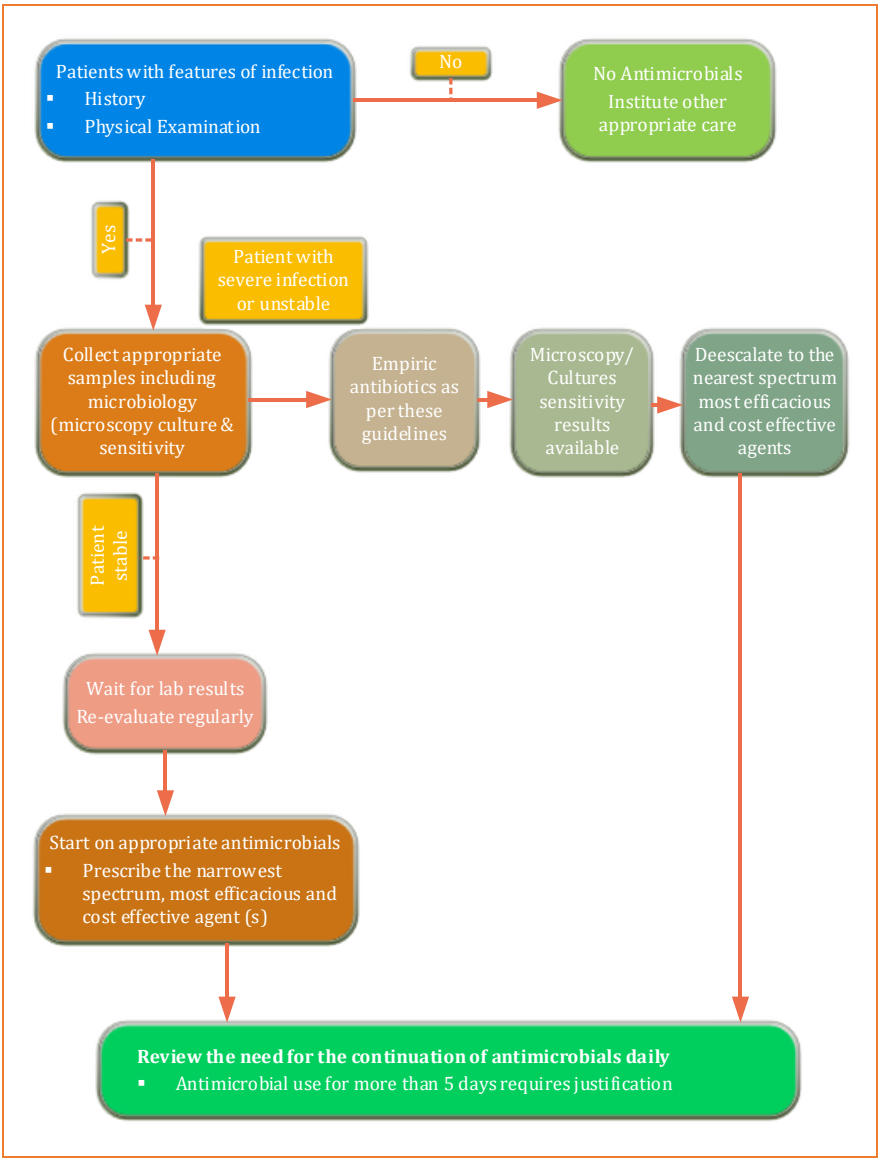
AWARE CLASSIFICATION OF ANTIBIOTICS

Access Group	KEML 2023 Access group antibacterial
This group includes antibiotics and antibiotic classes that have activity against a wide range of commonly encountered susceptible pathogens while showing lower resistance potential than antibiotics in Watch and Reserve groups. Access antibiotics should be widely available, affordable and quality-assured to improve access and promote appropriate use. Selected Access group antibiotics are included on the WHO EML as essential first-choice or second- choice empirical treatment options for specific infectious syndromes.	Amikacin Amoxicillin Amoxicillin + Clavulanic acid Ampicillin Benzathine Benzylpenicillin Benzylpenicillin Cefalexin Cefazolin Cefixime Doxycycline Flucloxacillin Gentamicin Metronidazole Nitrofurantoin Phenoxymethylpenicillin (Penicillin V) Tinidazole
Watch Group	**KEML 2023 Watch group antibacterial**
This group includes antibiotics and antibiotic classes that have higher resistance potential and includes most of the highest priority agents among the critically important antimicrobials for human medicine and/or antibiotics that are at relatively high risk of selection of bacterial resistance. Watch group antibiotics should be prioritized as key targets of national and local stewardship programme and monitoring. Selected Watch group antibiotics are included on the WHO EML as essential first-choice or second-choice empirical treatment options for a limited number of specific infectious syndromes.	Azithromycin Cefixime Cefotaxime Ceftazidime Ceftriaxone Cefuroxime Ciprofloxacin Clarithromycin Clindamycin Co-trimoxazole (Sulfamethoxazole + Trimethoprim) Erythromycin Piperacillin + Tazobactam

Reserve Group	KEML 2023 Reserve group antibacterial
This group includes antibiotics and antibiotic classes that should be reserved for treatment of confirmed or suspected infections due to multidrug-resistant organisms and treated as “last-resort” options. Their use should be tailored to highly specific patients and settings, when all alternatives have failed or are not suitable. They could be protected and prioritized as key targets of national and international stewardship programme, involving monitoring and utilization reporting, to preserve their effectiveness. Selected Reserve group antibiotics (shown here) are included on the WHO EML when they have a favourable risk-benefit profile and proven activity against “Critical Priority” or “High Priority” pathogens identified by the WHO Priority Pathogens List, notably Carbapenem- resistant Enterobacterales.	Ceftazidime + Avibactam Colistin Fosfomycin Linezolid Meropenem Polymyxin B Teicoplanin Tigecycline Vancomycin

Source: The above table has been adapted from the 1st Edition 2023, Kenya National Medicine Formulary

ANTIBIOTIC PRESCRIBING ALGORITHM



Note: Use of reserved antibiotics in general wards requires approval from the antimicrobial stewardship committee

INFECTION PREVENTION MEASURES FOR INVASIVE PROCEDURES

Central line insertion	Peripheral cannula insertion	Urinary catheter insertion
• Perform hand hygiene and hand scrubbing • Put on sterile personal protective equipment • Prepare skin with 2% chlorhexidine gluconate solution in alcohol • Ensure full draping then insert the central line avoiding the femoral site • Secure line with sterile gauze or transparent dressing. • Gauze should be changed after 48hrs and transparent dressing after 7 days or when visibly soiled. • Indicate date of insertion and document procedure • Use aseptic technique while flushing the line • Remove central venous lines when no longer required and no longer than 2 weeks • Note that the femoral site should only be used in patients in whom accessing an alternative site would be dangerous and these should be replaced within 48-72 hours	• Perform hand hygiene • Use non-touch technique using clean gloves • Prepare skin with 2% chlorhexidine gluconate /alcohol swab/surgical spirit • Secure line with transparent dressing • Change dressing when visibly soiled • Use aseptic technique while flushing the line • Remove when no longer required	• Perform hand hygiene • Use aseptic technique • Prepare skin with 2% chlorhexidine gluconate solution • Insert catheter after applying sterile lubricating gel. Use the appropriate size catheter to minimize bladder neck and urethral trauma • Secure catheter to prevent movement and urethral traction • Maintain a closed drainage system • Drain the urine bags observing standard precautions always • Clean the meatal surface during daily routine bathing - don't use antiseptic baths

NB: Insertion of central line catheters, dialysis catheters, and chemotherapy ports DON'T require antibiotic prophylaxis

EMPIRIC ANTIBIOTIC USE

1. BACTERIAL MENINGITIS IN CHILDREN > 2 MONTHS

Definition: Acute infectious syndrome characterized by signs of meningeal inflammation.

Diagnosis:

1. Clinical:

Symptoms: Fever, lethargy, irritability, altered level of consciousness, coma, nausea, vomiting, inability to feed, convulsions – generalized or partial.

Older children: headache and photophobia.

These symptoms can be preceded by symptoms of respiratory tract infection with rapid evolution of symptoms.

Signs: AVPU < A, stiff neck, bulging anterior fontanelle, sutural diastasis, unequal pupils, focal neurologic signs, hypotonia or hypertonia, non-blanching hemorrhagic/ purpuric rash.

Consider tuberculous meningitis when there are gradually progressing signs of meningeal inflammation (subacute presentation)/ non-response to standard meningitis treatment.

Refer to Current Integrated Guidelines for Tuberculosis, Leprosy and Lung Disease

Encephalitis: Consider encephalitis when there are behavioral changes, confusion, seizures

2. Laboratory investigation:

Note: CSF analysis is mandatory in the diagnosis of meningitis and should be done prior to antibiotic initiation

- CSF studies: observe the following:
  - CSF under pressure
  - Cloudy appearance
  - Cell count: Pleocytosis (WBC count >5 cells/Ul with predominant neutrophils)
  - Elevated CSF protein
  - Decreased CSF glucose
  - Positive gram stain
  - Do culture and sensitivity
  - Gene Xpert for suspected tuberculous meningitis
- Blood culture indicated for all patients with suspected meningitis
- Complete blood count
- ESR, CRP

- Malaria blood slide
- Urea, creatinine and electrolytes including calcium and magnesium
- Random blood sugar
- HIV test

Contraindications of lumbar puncture:

1. Child requires CPR
2. Pupils respond poorly to light
3. Skin infection at LP site
4. Bleeding diasthesis
5. Lateralising signs

3. Imaging:

Brain CT scan or MRI

Indications for imaging:

- Focal neurological signs
- Signs of raised intracranial pressure
- Encephalitis
- Seizures occurring after 48 hours of antimicrobial therapy/prolonged seizures
- Abnormal increase in head circumference for age
- Deterioration in AVPU status after 48 hours of antimicrobial therapy
- Evidence of continued infection

	Community Acquired	Hospital Acquired
Common pathogens	*Streptococcus pneumoniae, Haemophilus influenzae, Neisseria meningitidis*	High risk population: children with spina bifida, myelomeningocele, ventriculo-peritoneal (VP) shunt, external ventricular drain (EVD), ventriculitis • *Coagulase negative staphylococci* • *Staphylococcus aureus* • *Escherichia coli* • *Klebsiella pneumoniae* • *Pseudomonas aeruginosa*
Empiric therapy	WATCH **High dose Ceftriaxone 100 mg/kg IV/day** in two divided doses	WATCH **High dose Cefepime. 50mg/kg IV** 8 hourly **PLUS** RESERVE **Vancomycin 15mg/kg/dose IV 6** hourly (slow IV infusion for at least 1 hour). Adjust treatment based on culture results. Where feasible, remove shunt/device
Comments	**Duration of therapy: 10-14 days** • Treat for 10-14 days • 21 days for gram negative organisms **Adjuvant treatment** 1. Corticosteroids to be used in patients > 3 months of age with a diagnosis of probable meningitis (frankly purulent CSF, CSF white cell count> 1000 cells/µl, raised CSF white cells with protein more than 1mg/dl, bacteria on gram stain). • Dexamethasone – 0.15mg/ kg administered before the 1st dose of the antibiotics. To be given every 6 hours for the 1st 48 hours. 2. Fluids and electrolytes: Give appropriate maintenance fluids and correct any electrolyte abnormalities. 3. If there is high suspicion of HSV encephalitis, add acyclovir IV 10-15mg/kg 8 hourly for 21 days If there is no improvement after 48 -72 hours, re-evaluate patient	

2. BACTERIAL MENINGITIS IN ADULTS

Definition: Meningitis is an inflammatory disease of the leptomeninges
Diagnosis:
1. Clinical features:
Symptoms: Acute onset< 48 hours. The patient should have at least 2 or more of the following: severe headache, fever, change in mental status, convulsions, skin rash
Signs: nuchal rigidity, positive Kernigs' and Brudzinski sign, cranial nerve palsies, papilledema
2. Lab investigations:
Note: CSF analysis is mandatory in the diagnosis of meningitis and should be done prior to antibiotic initiation

- CSF studies: observe the following:
  - CSF under pressure
  - Cloudy appearance
  - Cell count: Pleocytosis (WBC count >5 cells/Ul with predominant neutrophils) or Elevated WBC >1000/microL
  - Elevated CSF protein (elevated protein >2000mg/l)
  - Decreased CSF glucose (<2.22mmol/l with a CSF to serum glucose ratio of ≤0.4)
  - Positive gram stain
  - Do culture and sensitivity
  - Gene Xpert for suspected tuberculous meningitis
- Blood culture indicated for all patients with suspected meningitis
- Complete blood count
- ESR, CRP
- Malaria blood slide
- Urea, creatinine and electrolytes including calcium and magnesium
- Random blood sugar
- HIV test

3. Imaging:
A head CT scan should be performed before lumbar puncture (LP) in adults with one or more of the following risk factors: history of central nervous system (CNS) disease (mass lesion, stroke, or focal infection), new onset seizure (within one week of presentation), papilledema, abnormal level of consciousness, focal neurologic deficit

Notes:
Antibiotic de-escalation should always be part of the plan guided by antimicrobial susceptibility results and the patient's clinical status.

	Community Acquired	Hospital Acquired
Common pathogens	*Streptococcus pneumoniae, Neisseria meningitidis*	*Staphylococci and aerobic gram-negative bacilli*
Empiric therapy	WATCH **Ceftriaxone 2g IV** 12 hourly for 10 days	WATCH **Cefepime 2g IV** every 8 hours for 21 days
Comments	• Antibiotics should be initiated within an hour of presentation. • In case of allergy to beta lactams: **Vancomycin** and **Levofloxacin** can be used. • For patients with a device e.g., ventriculoperitoneal (VP) shunt, LP and CSF analysis should be done prior to initiation of antibiotics, culture and sensitivity results should guide subsequent therapy. Where feasible, the device should be removed	

3. PNEUMONIA IN CHILDREN 2 – 59 MONTHS

Definition: Inflammation of lung tissue due to bacterial or viral infection

Diagnosis:

1. Clinical features:

Symptoms: cough and/or difficulty breathing associated with fever

Signs: oxygen saturations <90%, increased work of breathing, tachypnoea (RR ≥ 50/min 2-11 mo; RR ≥ 40/min 12-59 mo) flaring alae nasi, lower chest wall indrawing, reduced breath sounds, crepitations

Grading severity:

- Severe pneumonia: Above symptoms plus one of: oxygen saturation <90%, central cyanosis, inability to drink/breastfeed, AVPU < A, grunting
- Non-severe pneumonia: Above symptoms plus one of: lower chest wall in-drawing or RR ≥ 50/min (age 2-11mo) RR ≥ 40/min (age 12-59 mo)
- No pneumonia: None of the above; likely upper respiratory tract infection
- Recurrent pneumonia: At least 2 episodes in a year or more than 3 episodes ever, separated by an asymptomatic period of over a month or radiographic clearance between episodes

2. Lab investigations:

- Full blood count
- ESR, CRP or PCT where available
- Blood culture
- Nasopharyngeal swab for PCR testing for influenza, respiratory syncytial virus (RSV) and other respiratory viruses
- Bronchoalveolar lavage for pneumocystis jiroveci pneumonia testing if HIV positive or severely malnourished where available.
- TB diagnosis: refer to current Integrated Guidelines for Tuberculosis, Leprosy and Lung Disease. Collect specimens for microbiological diagnosis. Negative tests **do not** rule out tuberculosis in children

3. Imaging:

- Chest radiograph: indications - treatment failure, progression/worsening of pneumonia, non-response after 48 hours, recurrent pneumonia
- Upper GI studies: indications - children with cerebral palsy, GastroEsophageal Reflux Disease (GERD), Tracheo-esophageal fistula, aspiration pneumonia

Note: Viral aetiologies are the predominant causes of pneumonia in early childhood.

	Community Acquired	Hospital Acquired
Common Pathogens	*Streptococcus pneumoniae, Haemophilus influenzae, Staphylococcus aureus, Pneumocystis jirovecii pneumoniae, Mycoplasma pneumoniae, Mycobacterium tuberculosis*	*Streptococcus pneumoniae, Staphylococcus aureus, Pseudomonas spp., Klebsiella pneumoniae, Escherichia coli*
Empiric Therapy	**<u>NON-SEVERE PNEUMONIA</u>:** ACCESS **Oral high dose Amoxicillin 40-45mg/kg** 12 hourly. Counsel on danger signs, review after 48 hours. **<u>SEVERE PNEUMONIA:</u>** **First line:** ACCESS **Benzylpenicillin 50,000 iu/kg/dose IV** 6 hourly **PLUS** ACCESS **Gentamicin 7.5 mg/kg IV** once daily **OR** Staphylococcus aureus suspected: ACCESS **Flucloxacillin 50mg/kg IV** 8 hourly **PLUS** ACCESS **Gentamicin 7.5 mg/kg IV** once daily **Second line:** ACCESS **Amoxicillin+Clavulanic acid IV 30mg/kg** 8 hourly **OR**	WATCH **Piperacillin-Tazobactam IV 100mg/kg** Piperacillin component 8 hourly

	 **Amoxicillin+Clavulanic acid 45mg/kg PO** 12 hourly For a child not improving, consider addition of:  **Erythromycin 30-50mg/kg/day PO** in 3-4 divided doses **OR**  **Azithromycin 10mg/kg PO** once daily	
Comments	• Duration of therapy: 7 days • Do IV to oral switch after 48 hours if there is clinical improvement • If culture is positive for only Staphylococcus aureus, stop the gentamicin • For suspected Pneumocystis Jirovecii Pneumonia (PJP) **ADD**  **Co-trimoxazole at 30mg/kg/dose for 21 days** • Tuberculosis can present as acute pneumonia • Consider high dose oral steroids in severe pulmonary TB and PJP • **Recurrent/ non-responsive pneumonia:** ○ Differential diagnosis: Pulmonary TB, PJP, Aspiration pneumonia, GERD, Asthma, Inhaled foreign body, Congestive Cardiac Failure, Congenital heart disease ○ Consider underlying conditions like rickets, malnutrition and immunosuppression • **Complicated pneumonia:** ○ Empyema: drainage of the infected pleural fluid ○ Lung abscess: drainage plus additional coverage for anaerobic organisms and staphylococcus aureus. Consider adding clindamycin	

4. BACTERIAL PNEUMONIA IN ADULTS

Definition

An acute illness (less than two weeks) affecting the lung parenchyma and associated with a new or worsening infiltrate on chest radiograph

Clinical manifestations

Symptoms: cough/sputum production, fever, pleuritic chest pain, difficulty in breathing, confusion

Signs: respiratory distress, tachycardia, tachypnea, crepitations, reduced oxygen saturation, bronchial breathing

Classification

Community acquired pneumonia (CAP): an infection acquired outside the hospital

Hospital acquired pneumonia (HAP): an infection acquired ≥48 hours after hospital admission

Ventilation acquired pneumonia (VAP): a type of hap that develops ≥48 hours after endotracheal intubation

Risk stratification

Determine each patient CURB*-65 or CRB**-65 score and classify as follows:

- Mild/low risk - CURB/CRB-65 score = 0-1
- Moderate/intermediate risk - CURB/CRB-65 score = 2
- Severe/high risk - CURB/CRB-65 score ≥ 3 or patient with a lower score but with significant co-morbidities

Diagnostic workup

- Blood culture and sputum culture for patients who are severely ill, prior antibiotic use or hospitalization
- Sputum for pneumocystic jiroveci pneumonia testing if HIV positive
- Nasopharyngeal swab for influenza PCR if flu season
- Lower respiratory tract samples especially for intubated patients
- C reactive protein/ESR and procalcitonin if available to help guide treatment
- Full hemogram
- U/E/Cs
- Test for TB using preferably a gene Xpert test on sputum

Imaging

Chest radiography

	Community Acquired (CAP)	Hospital Acquired (HAP)	Ventilator Acquired (VAP)
Common pathogen	*Streptococcus pneumoniae, Staphylococci spp.*	*Escherichia coli, Klebsiella pneumoniae*	*Acinetobacter baumanii, Klebsiella pneumoniae, Pseudomonas sp.*
Empiric therapy	For low severity illness, treated as out-patient: ACCESS **Amoxicillin 1g PO** 8 hourly for 5 days For patients who require admission or with co-morbidities: ACCESS **Amoxicillin +Clavulanic acid 1g PO** 12 hourly **OR** ACCESS **Amoxicillin +Clavulanic acid 1.2g IV** 8 hourly for 5 days For severe pneumonia, **ADD** WATCH **Azithromycin 500mg PO** once a day for 3 days **OR** WATCH **Clarithromycin 500mg PO** 12 hourly for 5 days	**PREFERRED:** ACCESS **Amoxicillin + Clavulanic acid 1.2g IV** 8 hourly for 5 days (Consider if low-risk of multidrug-resistant infections (e.g., short hospitalization before symptom onset and no prior antibiotic exposure) **ALTERNATIVE:** WATCH **Piperacillin+ Tazobactam 4.5g IV** 6 hourly	WATCH **Piperacillin+ Tazobactam 4.5g IV** 6 hourly **PLUS** ACCESS **Amikacin 15mg/kg/day IV** *For patients with significant antibiotic exposure or known to be colonised with MDRO, consult Infectious Disease team.* *Where there is high risk of MRSA e.g., in patients known to be colonized with MRSA and awaiting culture results, consider the addition of;* RESERVE **Linezolid 600mg IV BD** **OR** RESERVE **Vancomycin**

Comments

- The most common causes of pneumonia are viral pathogens
- Tests not required in mild pneumonia
- Microbiological samples should be obtained prior to administration of antibiotics
- Duration of treatment is 5 days for community acquired pneumonia and 7 days for hospital acquired pneumonia
- In case of penicillin allergy use;

Doxycycline 100mg twice a day for CAP.

- For patients not improving evaluate for complications e.g., empyema

Monitor patients closely and if not improving, consult IDS.

***The CURB-65 scoring** can be used to assess for severity of illness:

C – confusion (1 point), U- urea >7mmol/l (1 point), R- respiratory rate >30bpm (1 point), B-blood pressure <90mmhg systolic or <60mmhg diastolic (1 point)65 – age > 65 (1 point)

****The CRB-65 score**, which does not require laboratory values for its calculation, can also be used, the score value interpretation is the same as for CURB-65.

Clinical judgement should be used for all patients when determining the appropriate site of care. Prediction scores such as CURB-65 or PSI are useful but should not be the only determinant of location of care of the patient.

5. NEONATAL SEPSIS IN INFANTS < 60 DAYS

Definition: Acute life-threatening infection characterized by organ dysfunction in new born infants < 60 days

Early onset neonatal sepsis (EONNS): < 72 hours

Late onset neonatal sepsis (LONNS): > 72 hour after birth

Diagnosis:

1. **Clinical Features**

   Symptoms:

   One of: Temperature instability (temp > 38.0°C or lower than 35.5°C), convulsions, apnoea, inability to feed, central cyanosis or SPO^2 <90%, bulging anterior fontanelle, persistent vomiting, movement only when stimulated, irritability, lethargy

   Signs:
   General: Temperature instability (temp > 38.0°C or lower than 35.5°C), irritability, drowsiness, lethargy, jaundice, pallor, petechiae, purpura, bleeding, mottling, sclerema

   Abdominal: abdominal distention, hepatomegaly, splenomegaly

   Respiratory: apnoea, tachypnoea, retractions, grunting, cyanosis,

   Cardiovascular: tachycardia, bradycardia, hypotension

   Central nervous system: tremors, seizures, hypotonia, abnormal reflexes, bulging anterior fontanelle, high pitched cry

   Categorization:
   Neonate at risk of sepsis: Neonate with risk factors for sepsis including prolonged rupture of membranes (PROM) > 18 hours, maternal fever > 38°C, suspected or confirmed chorioamnionitis, mother treated for infection during labour or 24 hours before or after delivery; and no clinical features of sepsis

   Neonatal sepsis: Signs of infection plus one of the following: not feeding well on observation, temp ≥ 38°C or ≤35.5°C, severe chest wall in-drawing, movement only when stimulated

   Severe neonatal sepsis: Signs of infection plus one of the following: Unconscious, history of convulsions, unable to feed/poor feeding, apnoea, unable to cry/high pitched cry, central cyanosis/SPO2 < 90%, bulging anterior fontanelle, persistent vomiting

   Neonatal meningitis: signs of sepsis plus irritability, unable to cry/high pitched cry, bulging anterior fontanelle, convulsions

Necrotising enterocolitis: presence of abdominal distension, bloody stool, coffee ground vomitus/aspirates

Staphylococcal septicemia: presence of extensive skin pustules, abscess, omphalitis

If the neonate has none of the above symptoms and signs, systemic bacterial infection is unlikely. Assess for other illness and treat appropriately. Advise mother on danger signs and arrange for early review within 24 hours if no improvement.

2. **Lab investigations:** Full blood count, Blood culture, LP for CSF studies, Urine MCS, UECs, LFTs and CRP/ procalcitonin (if available)
3. **Imaging:** Chest radiograph, Cranial ultrasound, Abdominal Xray as indicated based on presentation

Neonatal Sepsis		
Common Pathogens	**Early onset sepsis** *Group B streptococcus, Gram negative enteric bacilli (Escherichia coli, Klebsiella pneumoniae)* **Late onset sepsis** *CoNS, Staphylococcus aureus, Candida, Escherichia coli, Group B Streptococcus, Klebsiella pneumoniae, Pseudomonas aeruginosa*	
Empiric Therapy	**First line:** ACCESS **Benzylpenicillin 50,000 IU/kg IV** 6 hourly **PLUS** ACCESS **Gentamicin 7.5mg/kg IV** 24 hourly If Staphylococcus is suspected: ACCESS **Flucloxacillin 50mg/kg IV** 8 hourly **PLUS** ACCESS **Gentamicin 7.5 mg/kg IV** 24 hourly If necrotizing enterocolitis is suspected: **ADD**	**Second line:** WATCH **Cefepime 50mg/kg** 8 hourly **OR** WATCH **Piperacillin/Tazobactam** Postmenstrual age up to 30 weeks: **100 mg/kg (piperacillin component) IV** every 8 hours Postmenstrual age over 30 weeks: **80 mg/kg (piperacillin component) IV** every 6 hours

	ACCESS **Metronidazole 7.5 mg/kg:** < 1month 12 hourly; 1 month 8 hourly WATCH **Ceftazidime 50mg/kg IV** 8 hourly (alternative 1st line in case of acute kidney injury)	
Comments	**Duration of therapy:** **Neonate at risk of sepsis:** stop IV antibiotics after 48 hours if all signs of possible sepsis have resolved, neonate is feeding well, and LP if done is normal. Discharge without antibiotics. Follow-up at 48 hours at nearest facility. **Neonatal sepsis:** 48 hours of IV antibiotics Reassess at 48-72 hours: clinical and lab results If breastfeeding well and clinically stable, discharge on oral treatment: ACCESS **Dispersible high dose Amoxicillin 50 mg/kg 12** hourly to complete 5 days. ***Severe sepsis: complete 7 days of IV antibiotics*** Reassess at 48-72 hours: clinical and lab results If improving: complete antibiotics and discharge ***Confirmed sepsis (culture positive): complete 7-10 days of IV antibiotics*** Reassess at 48-72 hours: clinical and lab results **Neonatal meningitis:** IV treatment for 14 days for suspected meningitis/gram positive organisms isolated and 21 days for gram negative organisms. **Treatment failure:** If baby is not improving, or is deteriorating having been on antibiotics for at least 48-72 hours, do complete clinical re-evaluation, repeat hemogram, blood culture, CRP and appropriate investigations before switching antibiotics.	

6. BACTERIAL BLOOD STREAM INFECTIONS (BSI)

Definition: bacterial invasion of the blood stream resulting in fever and other features of infection with no clear focus of infection.

NB: Diagnostic stewardship should guide sample collection and empiric antibiotic use. Common sources of infection include upper and lower respiratory tract infections, abdominal and pelvic infections, urinary tract infections, and skin and soft tissue infections. Ensure a thorough head-to-toe examination is conducted. The goal is to identify any potential infection sites comprehensively and assess the necessity for antibiotics.

Diagnosis:

1. **Clinical features:**

   Fever, rigors, altered mental status, hypotension, chills, malaise, nausea, vomiting, diarrhea, confusion

   The presence of two or more of the following is suggestive of a blood stream infection:

   Hyperthermia (>38 ℃) or hypothermia of (<36℃)

   Respiratory rate > or = 20 breaths per minute

   Heart rate of greater than 90beats per minute

2. **Lab investigations:**

   Blood cultures: take 1 set of cultures through the central line and another set of cultures from a peripheral site or 2 sets of cultures from a peripheral site.

   Other investigations: complete blood count, urea electrolytes and creatinine, (CRP or procalcitonin where available), LFTS, blood gas analysis

	Community Acquired BSI	Hospital Acquired BSI	Central Line Associated BSI
Common Pathogens	*Staphylococcus aureus, Escherichia coli*	*Enterobacterales Escherichia coli, Klebsiella,*	*Staphylococcus aureus, Escherichia coli, Klebsiella, Methicillin resistant staphylococcus aureus (MRSA), Coagulase negative Staphylococci*

Empiric Therapy	ACCESS **Amoxicillin +Clavulanic acid 1.2g IV** 8 hourly	WATCH **Piperacillin+ Tazobactam 4.5g IV** 6 hourly	WATCH **Piperacillin+ Tazobactam 4.5g IV** 6 hourly **PLUS** RESERVE **Vancomycin 1g IV** 12 hourly. Where there is no improvement consult AMS team/physician.
Comments	**Duration of treatment:** • **No catheter or catheter removed** (preferred option) treat for 7 days. If Staphylococcus aureus is isolated, treat according to susceptibility results for 14 days following the first negative culture. • **Catheter retained:** treat for 14 days. If Staphylococcus aureus is isolated but the catheter cannot be removed (e.g., when alternative access isn't possible), treat based on susceptibility results for 28 days after the first negative culture. For patients with staphylococcal bacteremia screen for complications of hematogenous spread such as infective endocarditis (ideally by transesophageal echocardiogram), vertebral osteomyelitis and septic arthritis. If Staphylococcus aureus is isolated, treat according to susceptibility results for 14 days if uncomplicated or 4-6 weeks if complicated following the first negative culture. Staphylococcus aureus bacteremia is classified as complicated when any of the following characteristics are present: Endocarditis or metastatic infection, presence of a permanently implanted prosthetic material, skin findings that suggest a systemic infection, positive blood cultures after 48 hours, or persistent fever after 72 hours. If the culture is still positive consult id team. The CVC should be removed if there is central line associated blood stream infection and especially if the following organisms are cultured: **Acinetobacter baumanii, Staphylococcus aureus, Pseudomonas aeruginosa, drug resistant gram-negative bacilli and Candida species.**		

When to repeat cultures:

This will depend on the organism isolated. For Staphylococcal bacteremia repeat blood cultures after 72 hours. If the culture is still positive, re-evaluate patient treatment (review susceptibility of Staphylococcus aureus, remove invasive devices, review drug dosing). A repeat blood culture is not required from gram negative bacteraemia if the patient is improving.

Once culture and antibiotic susceptibility results are available, antibiotics should be de-escalated to the narrowest spectrum, most appropriate antibiotic to which the organism is susceptible.

Institute appropriate supportive care e.g., fluid replacement, treatment of hypoglycaemia to prevent organ failure or further deterioration.

7. URINARY TRACT INFECTIONS

Definition
An infection of any part of the urinary tract including the bladder, ureters or kidneys.

Classification:
Uncomplicated UTI – acute infection that is confined to the urinary bladder with symptoms suggestive of cystitis (dysuria, urinary frequency and urgency, suprapubic pain without fever, chills, or flank pain).

Complicated UTI - acute infection accompanied by features suggestive of extension beyond the bladder with symptoms suggestive of systemic illness (loin pain, flank tenderness, fever, rigors, or other evidence of systemic inflammatory response).

Asymptomatic bacteriuria - presence of bacteriuria in urine revealed by quantitative culture or microscopy in a sample taken from a patient without any typical symptoms of lower or upper urinary tract infection. In contrast with symptomatic bacteriuria, the presence of asymptomatic bacteriuria should be confirmed by two consecutive urine samples.

Pyuria - occurrence of ≥10 white blood cells per high power field in a freshly voided specimen of urine. Higher numbers of WBC are often found in healthy asymptomatic women. Pyuria is present in 96% of symptomatic patients with bacteriuria of $>10^5$ colony forming units (CFU)/ml, but only in <1% of asymptomatic, abacteriuric patients. Pyuria in the absence of bacteriuria may be caused by the presence of a foreign body, for example, a urinary catheter, urinary stones or neoplasms, lower genital tract infection or, rarely, renal tuberculosis.

Diagnosis

1. Clinical features:

Dysuria, frequency of urination, suprapubic tenderness, urgency, polyuria, hematuria

2. Lab investigations:

- Urinalysis and urine microscopy
- Urine culture in patients at risk for complications, complicated UTI, or recurrent uncomplicated UTI

NB: Risks for complicated UTI include individuals with structural anomalies of the urinary tract, patients who are immunocompromised, and pregnant women.

- Blood tests are usually not needed for uncomplicated UTIs
- Consider pelvic examination and screening for STIs for women with symptoms of vaginal itch or discharge.
- In males with urethritis or urinary tract infections, consider evaluating for a sexually transmitted infection.

3. Imaging

Kidney ureter bladder ultrasound (KUB) for males after 1st episode UTI or anyone with suspected anatomic abnormality.

Proper collection of a urine sample

Refer to the section on - adequate specimen collection

The urine sample should be;

- A clean catch midstream sample
- Collected from a freshly inserted catheter, or
- In and out urethral catheterization

Do not collect urine from a urine bag or an indwelling catheter.

Urine catheter tip cultures **should not** be sent for culture

	Community Acquired	Hospital Acquired
Common Pathogens	*Escherichia coli, Klebsiella Pneumoniae, Proteus species*	*Escherichia coli, Klebsiella Pneumoniae, Pseudomonas spp.*
Empiric Therapy	**UNCOMPLICATED UTI: PREFERRED** ACCESS **Nitrofurantoin 100mg PO** 12 hourly for 5 days in females and 7 days in males (Pediatrics) ACCESS **Nitrofurantoin 2mg/kg/dose 12** hourly or **1 mg/kg/dose** 6 hourly (immediate-release formulation) for 5 days)	**UNCOMPLICATED UTI:** ACCESS **Nitrofurantoin 100mg PO** 12 hourly for 5-7 days OR ACCESS **Amikacin 15mg/kg IV** once a day if unable to take orally for 3 days in females and 7 days in males

	ALTERNATIVE  **Amoxicillin+ Clavulanic acid 1g PO** 12 hourly for 3 days in females and 7 days in males (Pediatrics)  **Amoxicillin + Clavulanic acid 80-90 mg/kg/day** of amoxicillin component oral for 3-5 days) **COMPLICATED UTI:**  **Amoxicillin + Clavulanic acid 1g PO** 12 hourly or **1.2 g IV** 8 hourly for 10-14 days **OR**  **Amikacin 15mg/kg IV** once a day for 7 days in females and 14 days in males if unable to take orally	**COMPLICATED UTI:**  **Amikacin 15mg/kg IV** once a day for 10-14 days **OR**  **Piperacillin/Tazobactam 4.5g IV** every 6 hours IV for 10-14 days
Comments	• Treatment is not indicated for asymptomatic bacteriuria except in pregnancy or in patients who will undergo procedures involving mucosal disruption. • With recurrent infections, previous culture results could guide empiric therapy pending urine culture and sensitivity results. • Antibiotic therapy should be tailored once urine culture and sensitivity results are available at which point, the narrowest spectrum, most efficacious and appropriate antibiotic should be prescribed • For cystitis caused by **MDR E. coli, Fosfomycin** may be an oral option given as **3g sachet STAT**	

8. INTRA-ABDOMINAL INFECTIONS

Definition: Intra-abdominal infections are usually classified into uncomplicated and complicated.

Classification

Uncomplicated infection involves a single organ and does not proceed to peritoneum. Patients with such infections can be managed with either surgical source control or with antibiotics alone. e.g., acute appendicitis, acute cholecystitis

Complicated infection infections that originate in an organ but extend to form an abscess called peritonitis. It extends beyond a single organ and causes either localized peritonitis or diffuse peritonitis. e.g., ruptured appendicitis

They can be community acquired or hospital acquired.

- **Primary peritonitis –** is diffuse bacterial peritonitis without organ perforation. e.g spontaneous bacteria peritonitis in children & liver cirrhosis, tuberculous /granulomatous peritonitis – monomicrobial especially E.coli
- **Secondary peritonitis–** local (often abscesses) or diffused peritonitis originating from a defect in the wall of abdominal organs. e.g. a perforated viscus, perforated gall bladder, anastomotic leaks,
- **Tertiary peritonitis –** persistent/recurrent secondary bacterial peritonitis that does not resolve with treatment, usually associated with nosocomial organisms and MDR organisms. e.g., patients in ICU

Risk classification

Low risk - mild to moderate community acquired intra-abdominal infections with no risk factors for antibiotic resistance or treatment failure. e.g., acute appendicitis

High risk - severe intra-abdominal infections or in patients at high risk for adverse outcomes or resistance e.g.,

- Patients referred from another facility and were receiving antibiotics
- Patients who have been admitted in the hospital for ≥ 48 hours
- Recent hospitalization within the last 3 months
- Patients known to be colonized with MDR organisms

Diagnosis:

1. **Clinical features:**
   Abdominal pain, signs of peritonitis, hypotension or low mean arterial pressure (<65mmHg), PR 100bpm, RR>22 beats per min, urine output <0.5-1.5ml/kg/hour, altered mentation
2. **Lab investigations:**
   White cell count>12,000/uL, lactate >2 mmols/L, deranged BGA, elevated CRP/procalcitonin. Intra-abdominal sample (pus aspirate/tissue) should be taken for microscopy, culture, and sensitivity.
   Avoid collecting samples from indwelling drains.
3. **Imaging:**
   X-ray/ultrasound/CT scan abdomen

	Community Acquired	Hospital Acquired
Common Pathogens	*Escherichia coli, Bacteroides, Klebsiella spp., Proteus, Enterobacter spp*	*Enterococcus, Pseudomonas spp., resistant Enterobacterales, Streptococci and Anaerobes*
Empiric Therapy	Source control is key in management of complicated intra-abdominal infections **<u>LOW RISK:</u>** ACCESS **Amoxicillin+ Clavulanic acid 1.2 g IV** 8 hourly **OR** ACCESS **Amikacin 15mg/kg/day IV** **PLUS** ACCESS **Metronidazole 500mg IV** 8 hourly **<u>HIGH RISK:</u>** WATCH **Piperacillin+ Tazobactam 4.5 g IV** 6 hourly	Source control is key in management of complicated intra-abdominal infections WATCH **Piperacillin + Tazobactam 4.5g IV** 6 hourly **OR** WATCH **Cefepime 2g IV** 8 hourly **PLUS** ACCESS **Metronidazole 500mg IV** 8 hourly AMS team/physician if patient not improving

	OR ACCESS **Amikacin 15mg/kg/day IV** PLUS ACCESS **Metronidazole 500mg IV** 8 hourly	
Comments	• Source control is key in management of complicated intra-abdominal infections • Duration of treatment is **5 days** after adequate source control • With multiple abdominal surgeries consider candida infections and take appropriate samples for fungal cultures. **Consult AMS team/Physician** • Amoxicillin+ Clavulanic acid and Piperacillin+Tazobactam provide adequate anaerobic cover, **DO NOT add Metronidazole or Clindamycin when using these agents** • Ensure adequate patient monitoring and fluid management	

9. SKIN AND SOFT TISSUE INFECTIONS

Definition: encompass a variety of pathological conditions that involve the skin and underlying subcutaneous tissue, fascia, or muscle, ranging from simple superficial infections to severe necrotizing infections.

Diagnosis:

1. **Clinical features:** skin erythema, edema, and warmth, extremity swelling, pain, fever-38°c, hypotension, sustained tachycardia, purulent drainage or exudate, crepitus
2. **Lab investigations:** leukocytosis with neutrophilia, (CRP/procalcitonin if available).
   Laboratory risk indicator for necrotizing fasciitis **(*LRINEC)** score based on laboratory indicators including white cell count, hemoglobin, sodium, glucose, creatinine, and CRP. Blood culture and tissue biopsy for necrotizing fasciitis.
3. **Imaging**
   - Xray rule out osteomyelitis or if pyomyositis and gas gangrene is suspected
   - Ultrasound if pyomyositis is suspected or to rule out an abscess
   - CT scan or MRI (necrotizing fasciitis, gas gangrene, rule out osteomyelitis)

***LRINEC**

The laboratory risk indicator for necrotizing fasciitis score (LRINEC) is a simple tool used to support early diagnosis of necrotizing fasciitis (NF)

Variable	Value	Score
C-reactive protein (mg/l)	≤150	0
	>150	4
Total white blood cell count (1000 cells/µl)	<15	0
	15–25	1
	>25	2
Hemoglobin (g/dl)	>13.5	0
	11–13.5	1
	<11	2
Sodium (mmol/l)	≥135	0
	<135	2
Creatinine (mg/dl)	≤1.6 (≤ 141 µmol/L)	0
	>1.6 (>141 µmol/L)	2
Glucose (mg/dl)	≤180 (≤10mmol/L)	0
	>180 (>10mmol/L)	1

LRINEC risk assessment

Risk category	LRINEC points	Probability for presence of NF
Low	≤5	<50%
Medium	6–7	50–75%
High	≥8	>75%

NB: If high suspicion for necrotizing fasciitis through clinical history and physical exam, DO NOT calculate a LRINEC score and go straight to operative debridement.

Common Pathogens	*Staphylococcus aureus, Streptococcus spp.* *Necrotizing fasciitis -Additionally Pseudomonas, Enterobacterales and is often polymicrobial* *Polymyositis - Additionally, Escherichia coli*	
Condition	**Description**	**Empiric Therapy**
Abscesses & Carbuncles	Simple abscesses /carbuncles <5cm	Incision and drainage is the mainstay of treatment
Cellulitis **(If there is a concern for necrotizing fasciitis, admit the patient to hospital)**	Antibiotics are required if any of the following are present: • Severe, extensive, rapidly progressive cellulitis • Abscess >5cm • Signs or symptoms of systemic illness • Elderly, immunosuppressed, malignancy or diabetes mellitus • Circumstances where an abscess is difficult to drain • Associated septic phlebitis • Inadequate response to incision and drainage alone Patients with mild cellulitis can receive treatment as outpatient	Incision and drainage (if there is an abscess) plus: ACCESS **Flucloxacillin 500mg-1g 1000mg PO 6** hourly/**2g IV** 6 hourly **OR** WATCH **Clindamycin 600mg PO** 8 hourly **/900mg IV** 8 hourly **OR** ACCESS **Doxycycline 100mg PO** 12 hourly Switch to oral medication once patient can tolerate it
Pyomyositis	Pyomyositis is an infection of a skeletal muscle caused by bacteria usually accompanied by abscess formation.	Drainage of the abscess is the mainstay of treatment **PLUS** ACCESS **Amoxicillin+ Clavulanic acid 1.2g IV** 8 hourly OR

		ACCESS **Amoxicillin+ Clavulanic acid 1g PO** 8 hourly **OR** ACCESS **Cefalexin 500 mg PO** 8 hourly **OR** ACCESS **Flucloxacillin 500mg-1000mg PO** 6 hourly/ **2g IV** 6 hourly Treat for 2-3 weeks: 2 weeks in otherwise healthy patients and adequate. Source control 3 weeks if source control is not optimal or underlying significant comorbidities
Necrotizing fasciitis including fourniere's gangrene & meleney's gangrene. **Gas gangrene**	Early and aggressive surgical exploration and debridement is critical Emergent surgical consultation is recommended	WATCH **Piperacillin+ Tazobactam 4.5 g IV** 6 hourly **PLUS** WATCH **Clindamycin 900mg IV** 8 hourly. For penicillin allergy use: ACCESS **Amikacin 15mg/kg/day IV** **PLUS** WATCH **Clindamycin 900mg IV** 8 hourly
Diabetic foot infections	Most **do not** require antibiotic therapy	Surgical debridement is an important

Decubitus or sacral wound infection without osteomyelitis	Start empiric antibiotic treatment only if there are local features of inflammation (surrounding cellulitis or abscess) and systemic features of infection Obtain a tissue culture for infected wounds. Avoid pus swabs.	component in management  **Amoxicillin+ Clavulanic acid 1g PO** 12 hourly **OR**  **Amoxicillin+ Clavulanic acid 1.2g IV** 8 hourly **OR** In patients with penicillin allergy,  **Doxycycline 100mg PO** 12 hourly **PLUS**  **Clindamycin 600mg PO** 8 hourly **/900mg IV** 8 hourly
Wounds	Usually, polymicrobial from environmental contamination. Evaluate need to provide adequate post-exposure prophylaxis and vaccinations in traumatic and bite wounds as appropriate.	
Traumatic wounds	Traumatic wounds without evidence of local infection or systemic signs of infection	Debridement of devitalized tissues and source control is critical to successful healing **Do not** need antimicrobial therapy
	In the presence of systemic features of infection →	Debridement of devitalized tissues and source control is critical to successful healing **PLUS**

		ACCESS **Amoxicillin+ Clavulanic acid 1.2g IV** 8 hourly **OR** WATCH **Clindamycin 600mg PO** 8 hourly /**900mg IV** 8 hourly
Bite-related wounds	In the absence of systemic signs of infection →	Debridement of devitalized tissues and source control is critical to successful healing **Do not** need antimicrobial therapy
	Any traumatic skin injury characterized by damage and exposure of deeper skin tissue with systemic symptoms Consider in selected cases (e.g., severely immunocompromised patients) and/or high-risk clinical areas (face, hands, near joints)	Debridement of devitalized tissues and source control is critical to successful healing **PLUS** ACCESS **Amoxicillin+ Clavulanic acid 1.2g IV 8** hourly **OR** WATCH **Clindamycin 900mg IV** 8 hourly
Surgical site infections	Infections involving the subcutaneous tissue within 30 days of surgery with no systemic response	Adjunctive systemic antimicrobial therapy is not routinely recommended unless there is systemic response.
	Presence of more than one local and systemic features e.g., erythema and induration extending >5 cm from wound edge, fever >38.5°c, HR >110 beats/minute, WBC >12,000/µl and Infections involving the deep	Suture removal plus incision and drainage should be performed. ACCESS **Amoxicillin+ Clavulanic acid 1g PO** 12 hourly

	fascia, muscle and organ space involvement within 30 days of surgery	**OR** ACCESS **Amoxicillin+ Clavulanic acid 1.2g IV** 8 hourly **OR** (in patients with long hospital stay, extensive antibiotic exposure) WATCH **Piperacillin+ Tazobactam 4.5 g IV** 8 hourly **PLUS** WATCH **Clindamycin 900mg IV** 8 hourly
Burn wound-related infections	Mostly polymicrobial.	Only infected wounds should be treated. Treat for 5 days ACCESS **Amoxicillin + Clavulanic acid 1.2g IV** 8 hourly / **1g PO** 12 hourly **OR** ACCESS **Cefalexin 500 mg PO** 8 hourly **OR** ACCESS **Flucloxacillin 500mg-1g PO** 6 hourly/2g IV 6 hourly Topical antibiotics could be considered based on local protocols (silver sulfadiazine)

Comments	• Incision & drainage and debridement remain the cornerstone of management; avoid using antibiotics for chronic wounds except where there are features of cellulitis, systemic response or positive blood cultures. • Incision and drainage without antibiotics are adequate for small abscesses (<5cm) • For necrotising infections, aggressive debridement of necrotic tissue until healthy, viable (bleeding) tissue is reached. Inspection and debridement in the operating room should be continued every one to two days until necrotic tissue is no longer present. For severe necrotizing infection involving the extremities, amputation may be needed to control the infection e.g., wet gangrene of a diabetic foot. • Duration of treatment should be **7-10 days.** Antibiotics should be continued until no further debridement is needed and the patient is hemodynamically stable in the setting of septic shock.

10. BONE AND JOINT INFECTIONS

1. Definition:

Osteomyelitis is a bone infection involving part or whole of a bone characterized by progressive inflammatory bony destruction and apposition of new bone.

Septic arthritis is an inflammation of a joint secondary to an infectious etiology. Both are initially painful, but can be painless in chronicity.

Risk factors are: fracture, wound/injury, having a prosthesis or implant, recent surgery to bone or joint, weakened immune system, previous osteomyelitis, diabetes (foot ulcer), sickle cell, advanced age, pressure sores. Osteomyelitis may cause septic arthritis and vice versa.

Spread: Haematogenous, contiguous, direct inoculation.

Septic arthritis in a native joint is a **MEDICAL EMERGENCY** and should have a washout within 6 hours.

Septic arthritis in a joint with a prosthesis should have an open debridement and washout within 12 hours (Debridement, Antibiotics, Irrigation & Retention - DAIR).

2. Clinical Presentation:

Osteomyelitis

Acute: within 2 weeks. Subacute: 1 month to several months. Chronic: Several months.

Pain, fever, reduced joint movement, avoidance of weight-bearing, joint swelling, erythema, local increase in temperature, discharging sinus, compromised vascularity, and sepsis.

If there is an implant on the bone, the surgical scar overlying the implant may become red, erythematous and dehisce.

Septic Arthritis

In a native joint, the main symptoms are pain, fever, joint swelling, reduced joint movement, avoidance of weight-bearing, sepsis.

In a joint with a prosthesis, the symptoms may not be as clear cut.

3. Diagnosis:

Osteomyelitis

Plain radiograph, MRI for early infection.

WBC count, CRP.

Bone sample (gold standard)

Bone scan may be considered in difficult to diagnose case after a consultant review.

Septic Arthritis

Native Joint:

Plain radiograph, Ultrasound, MRI.

WBC count, CRP.

Joint aspirate (gold standard): Gross analysis (cloudy, string sign), gram stain, cell count with differentials (WBC >50,000/ul), crystals, glucose levels (glucose < 60% of plasma level), Culture & sensitivity plus extended culture.

Prosthetic Joint:

Plain Radiographs.

Joint aspirate/tissue samples from at least 6 sites.

Criteria for diagnosis of Prosthetic joint Infection (PJI):

1. On clinical examination a sinus tract or purulence around prosthesis during surgery
2. On microscopy of joint aspirate WBC >2000/ul or >70% Polymorphonucleocytes (PMNs)
3. On culture, positive growth in the synovial fluid or positive growth ≥2 periprosthetic cultures with the same organism
4. On histopathology >23 PMNs per 10 high power fields
5. In explanted prosthesis, Sonication fluid culture >50 CFU/ml.

When not to use antibiotics	Before samples for culture have been taken
When to treat	It is very important to identify the offending organism prior to antibiotic therapy. Hence get relevant samples prior to antibiotic therapy.

	Consider removal of implant or prosthesis: 1. Implant for a fracture: If fracture has not healed consider retaining implant until fracture callus has formed. If not, remove implant and use alternative stabilization techniques. 2. Prosthesis: Establish if the infection needs DAIR OR STAGED REVISION. Essentially, establish if the biofilm is immature or not. Acute inflammation-immature biofilm: DAIR. Chronic inflammation-mature: Staged As a general guide: <4 weeks from surgery-immature. >4 weeks from surgery - mature. <3 weeks symptoms-immature. >3 weeks symptoms mature. Infections caused by high virulence organisms e.g., Staph aureus and gram-negative bacteria like E. coli, Pseudomonas, Klebsiella are more likely to present acutely and may have immature biofilms at time of presentation. Low virulence organisms e.g., coagulase negative Staphylococci cause slow infections and are likely to have mature biofilms at presentation.
Most likely organisms:	**Osteomyelitis** Most common organism is Staphylococcus aureus in all age groups. **New born:** *Enterobacter, Group A and B Streptococcus* **Children:** *Enterobacter, Group A Streptococcus* **Adolescents:** *Haemophilus influenza, Enterobacter, Group A Streptococcus* **Unusual Pathogens:** *Salmonella (Sickle Cell Disease), Pseudomonas (IV drug abusers), Bartonella (cat bite/HIV),* Fungal (immunosuppression, parenteral feeding), TB (immunosuppression).

	Septic Arthritis *Staphylococcus aureus* is the most common organism. Other organisms to consider: Other *Staph spp.* *Neisseria gonorrhoea:* in adolescents and young adults. Gram negative bacilli *(E.coli, Proteus, Klebsiella, Enterobacter).* *Strep spp.* (Group A more common). *Salmonella, Bartonella, Pseudomonas, Eikenella, Pasteurella, Fungal.*
Treatment options	
Septic Arthritis in native joint WASHOUT	1. No Risk Factors: ACCESS **PO/IV Flucloxacillin 2g QDS** 2. Penetrating Trauma: ACCESS **PO/IV Flucloxacillin 2g QDS** **PLUS** WATCH **Ceftazidime 1g TDS IV** **PLUS** ACCESS **Metronidazole 500 mg PO TDS**
Septic arthritis in prosthetic joint following DAIR:	A sample should be collected for microscopy, culture and sensitivity prior to initiation of empiric treatment. Empiric choices prior to pathogen identification include RESERVE **IV Vancomycin** **PLUS** WATCH **Ciprofloxacin.** Subsequent treatment should be guided by culture.
Septic arthritis in prosthetic joint following single stage procedure:	1. Change liner. 2. 4 weeks of IV treatment together with oral rifampicin. 3. Then 8 weeks of oral antibiotics.

	Empiric choices prior to pathogen identification include:  **IV Vancomycin** **PLUS**  **Ciprofloxacin** Subsequent treatment should be guided by culture
Septic arthritis in prosthetic joint following 2 stage procedure:	1. 4 weeks of IV treatment 2. Then 8 weeks of oral antibiotics. Empiric choices prior to pathogen identification include  **IV Vancomycin** **PLUS**  **Ciprofloxacin** Subsequent treatment should be guided by culture
Revision Cement Composition in Septic arthritis in joint following 1st stage revision.	Cement spacer. Revision cement PMMA (40g) 1. For Unknown Organisms:  **IV Gentamicin 1g** **PLUS**  **Clindamycin 1g** 2. For Staph Spp (Including Methicillin and Oxacillin-Resistant Staph Spp) And Enterococcus Spp:  **IV Gentamicin 0.5g** **PLUS**  **Vancomycin 2g** 3. For Resistant Gram Negative Spp:  **IV Gentamicin 0.5g** **PLUS**  **Ciprofloxacin 2g**

	4. For Fungi: ACCESS **IV Gentamicin 0.5g** **PLUS** **Amphotericin B 0.1g** **DURATION:** a) 4-6 weeks for osteomyelitis. b) 2 weeks for septic arthritis in a native joint. c) 4-6 weeks for septic arthritis with DAIR. d) 4-6 weeks for septic arthritis with single-stage revision. e) 6-12 weeks for septic arthritis with staged procedure.

Other notes:

- Antibiotic is tailored to the specific organism.
- Extended cultures including fungal & difficult to isolate bacteria in joint replacement are important.
- Fracture stabilization by external fixation or casting to allow tissues to revitalize.
- Extensive debridement and all devitalized tissue removed.
- Sequestrum must be removed.
- Early consult to an arthroplasty surgeon; presence of a biofilm means an infected prosthesis will not heal.
- Suspicion of an infected joint necessitates an urgent orthopedic consult with urgent washout of the joint.
- Hardware removal from infected joint or bone may be necessary; consult an orthopedic surgeon immediately.
- Consider gonococcal arthritis or reactive arthritis in patients with a history of urethral discharge or diarrhoea.

SURGICAL ANTIBIOTIC PROPHYLAXIS

INTRODUCTION

Surgical site infections (SSIs) are defined as infections that occur up to 30 days after surgery (up to one year after surgery in patients receiving implants). They affect either the incision or deep tissue at the operation sites. SSIs remain a significant clinical problem associated with substantial mortality and morbidity despite improvements in their prevention, the incidence may be as high as 20% depending on the procedure.

Most SSIs are caused by organisms that are endogenous to the patient, with the commonly isolated organisms being Staphylococcus aureus, coagulase -negative Staphylococci, Enterococcus spp., and Escherichia coli. It is imperative that we follow guidelines for prevention of SSIs including good patient preparation, aseptic practice and attention to surgical techniques; antimicrobial prophylaxis is indicated in specific circumstances.

The goal of antimicrobial prophylaxis is to reduce the incidence of post-operative wound infection by reducing the numbers of viable bacteria to levels which are unlikely to overwhelm the host defense and prevent infection from occurring.

Table 1: Surgical wound classification and subsequent risk of infection (prophylaxis not recommended)

Classification	Description	Infective Risk (%)
Clean (Class I)	Uninfected operative wound No acute inflammation Closed primarily Respiratory, gastrointestinal, biliary, and urinary tracts not entered No break in aseptic technique Closed drainage used if necessary	< 2
Clean-contaminated (Class II)	Elective entry into respiratory, biliary, gastrointestinal, urinary tracts and with minimal spillage No evidence of infection or major break in aseptic technique. Example: appendectomy	< 10
Contaminated (Class III)	Non- purulent inflammation present Gross spillage from gastrointestinal tract Penetrating traumatic wounds < 4 hours Major break in aseptic technique	About 20
Dirty-infected (Class IV)	Purulent inflammation present Preoperative perforation of viscera Penetrating traumatic wounds >4 hours	About 40

RECOMMENDATIONS

- Antimicrobial prophylaxis should be considered where there is a clear indication, a risk of postoperative infection, or if postoperative infection will have serious consequences.
- Commonly used prophylaxis antibiotics should be in the Operating Room (OR) stock
- The recommended antimicrobial prophylaxis regimens are for specific surgical procedures, and include alternative regimes for patients with a high risk of penicillin/ cephalosporin allergy.
- If pre-existing infections at surgical site (known or suspected) are present, use an appropriate treatment regimen instead of prophylactic regimen for procedure.
- Consider individual risk factors for every patient – need for prophylaxis, drug

choice or dose may need to be altered (e.g., immune suppression, presence of prostheses, allergies, obesity, malnutrition, diabetes, infection at another site, available pathology or malignancy).

- Antibiotic prophylaxis does not substitute for good surgical technique.
- **Local epidemiology:** Modify antibiotic prophylaxis if there is a high local incidence of specific infections.
- **Obese patients**: Consider increased dose of cefazolin (3g) if patient is obese (>120kg). Consult Infectious Disease specialist for advice.

Drug administration

- IV bolus – should be timed ≤ 60 minutes before skin incision (optimal 15-30 minutes). Administration after skin incision or > 60 minutes before incision reduces effectiveness.
- IV infusion – should be commenced 30-60 minutes prior to skin incision (e.g., metronidazole).

See appendix 1 for dose adjustment in renal insufficiency.

Repeat intra-operative doses

A single pre-operative dose is sufficient for most procedures; however,repeat intra-operative doses are advisable:

- For prolonged surgery (> 4 hours from the time of the first pre-operative dose) when a short-acting agent is used (e.g., cefazolin); or if the procedure exceeds two half-lives of the drug

  Or

- If major/rapid blood loss occurs (over 1.5litres), and/or following fluid resuscitation.

Surgical care bundles

The surgical care bundle comprises interventions aimed at preventing surgical site infections. The key components of the surgical care bundle are:

1. Perform surgical site skin antisepsis using an alcohol-based solution of 2% chlorhexidine gluconate.
2. Appropriate selection, timing (30-60 minutes before incision), and re-dosing of surgical antibiotic prophylaxis.
3. No hair removal, but if absolutely necessary, using a clipper is strongly recommended shortly before surgery.
4. Adequate surgical hand scrubbing using an antiseptic solution or alcohol-based hand sanitizer before gloving
5. Blood glucose control for both diabetic and non-diabetic patients
6. Maintain normal body temperature during surgery and recovery: Normothermia with temperature >36^0C
7. Administer 80% fraction of inspired oxygen (FiO_2) in adult patients undergoing general anesthesia with endotracheal intubation, and 2-6 hours postoperatively.
8. Preoperative bathing or showering using a plain or antibacterial soap on the day of surgery.

MRSA Risk

Definition: history of methicillin-resistant S. aureus (MRSA) colonization or infection or inpatient of high-risk hospital or unit (where MRSA is endemic) for more than the last 5 days.

Prophylaxis regimen:

Give **Vancomycin 1g** (1.5g for patients >80kg actual body weight) by IV infusion started 30-120 minutes before surgical incision and given at a recommended rate of 1g per hour (1.5g over 90 minutes).

High risk penicillin/cephalosporin allergy

Careful history taking about antimicrobial allergies should be carried out to determine whether a true allergy exists before selection of an agent for prophylaxis. History should include exact details of the reaction, including description of reaction e.g., rash, timing of reaction, reason for antibiotic prescription, other antibiotics received since then.

Types of Penicillin allergy

Severe penicillin allergy includes;

- **Immediate:** Type Ig-E mediated hypersensitivity reactions such as hives, angioedema, wheezing, anaphylaxis
- **Late reactions:** Hemolytic anemia, thrombocytopenia, serum sickness, drug reaction with eosinophilia, Steven Johnson syndrome (SJS)/ Toxic epidermal necrolysis (TEN)
- **Do not re-challenge**
- Alternative prophylactic regimes (e.g., with Vancomycin, Clindamycin, Erythromycin) are provided in the guidance tables as per the specific indications.
- **Non-severe penicillin allergy includes:**
- Rash and other non-allergic reactions such as gastrointestinal intolerance.
- **Re-challenge or use alternative beta lactam**

General guidance when prophylaxis is not recommended:

- Bronchoscopy unless incision or biopsy of respiratory mucosa
- Gastrointestinal and genitourinary procedures unless indicated for surgical reasons.

A. CARDIOTHORACIC AND VASCULAR PROCEDURES

Table 2: Cardiac Surgery

Procedure	Common organisms	Recommended Prophylaxis
Valve Replacement Surgery	*Staphylococcus aureus, Coagulase-negative Staphylococci, Corynebacteria*	ACCESS **Cefazolin 2g** for patients > 80kg and 1g for < 80kg, initiated 30 to 60 minutes before skin incision Repeat dose of 1 g in patients with normal renal function every 3-4 hours if surgical incision still open or with massive blood loss. If apparent that cardiopulmonary bypass will be discontinued in 4hrs can delay until off bypass/ pump to maximize effective blood levels ACCESS **Cefazolin dose** for children: **25-50mg/kg** initiated 30 to 60 minutes before skin incision then intra-operatively, **30mg/kg** every 4hours and post-operatively **30mg/kg/dose** 8 hourly for 24 hours Addition of adjuvant Vancomycin ONLY IF: • Setting of presumed or known staphylococcal colonization **OR** • Institutional presence of high incidence of MRSA **OR** • Patients susceptible to colonization e.g., Hospitalized more than 3 days, transfer in from another in-patient facility or already on antibiotics **OR** • Re-do surgery in patients with prosthetic valves RESERVE **Vancomycin dose of 1 to 1.5 g** or weight adjusted 15mg/kg administered slowly over 1 hour and completion within 1hour of

Procedure	Common organisms	Recommended Prophylaxis
		the skin incision. May repeat a dose of 7.5mg/kg during cardiopulmonary bypass although usefulness not well established.
Coronary Artery Bypass Surgery (CABG)	*Staphylococcus aureus, Coagulase-negative Staphylococci, Corynebacteria*	ACCESS **Cefazolin 2g** for patients > 80kg and 1g for < 80kg, initiated 30 to 60 minutes before skin incision Repeat dose of 1g every 3-4 hours for patients with normal renal function, if incision is still open or there is massive blood loss (this can be given as a continuous infusion).

Post-operative antibiotics (>24 hours from first dose) are NOT indicated unless infection is confirmed or suspected, regardless of the presence of surgical drains. If infection is suspected, consider modification of antibiotic regimen according to clinical condition and microbiology results.

Table 3: Thoracic Surgery

Procedure	Common organisms	Recommended Prophylaxis
Pneumonectomy / Lobectomy	*Staphylococcus aureus* *Coagulase negative staphylococci, Coliforms* *Streptococcus species*	ACCESS **Cefazolin 2g IV** for patients > 80kg and 1g for < 80kg, initiated 30 to 60 minutes before skin incision **THEN** ACCESS **Cefazolin 2g IV** (child: 30mg/kg up to 2g) 8- hourly for 2 more doses commencing 4 hours after the initial dose If anaerobic cover required (empyema or abscess) then **ADD**: ACCESS **Metronidazole 500mg IV** infusion commenced 30-60 minutes prior to skin incision (child: 12.5mg/kg), repeated 12 hourly for 2 more doses commencing 6 hours after initial dose
Decortication / Pleurectomy	*Staphylococcus aureus* *Coagulase negative staphylococci* *Coliforms*	Peri-operative antibiotics for empyema should be based on culture and sensitivity. If culture and sensitivity results not available: 1. For community acquired: WATCH **Cefuroxime 1.5g** with ACCESS **Metronidazole 500mg** **OR** WATCH **Clindamycin 600mg** alone 2. For hospital acquired empyema: WATCH **Ceftazidime 2g**

Video-assisted thoracoscopic surgery (VATS)	*Staphylococcus aureus* *Coagulase negative staphylococci, Coliforms*	 **Cefazolin 2g IV** commenced 30-60 minutes prior to skin incision **(child: 30mg/kg up to 2g)**
Tube thoracostomy (in setting of trauma) **No prophylaxis needed for tube thoracostomies done in non-traumatic settings**	*Staphylococcus aureus or Streptococcus species*	 **Cefazolin 1 - 2g** for a maximum of three doses. In penicillin allergy cases:  **Clindamycin 600-900mg** are appropriate alternative choices. **OR**  **Vancomycin 1g** (1.5g for >80kg) as infusion
Esophageal surgery	*Enteric gram-negative bacilli* *Streptococci* *Oropharyngeal anaerobes*	 **Cefazolin 2g** for patients > 80kg and 1g for < 80kg, initiated 30 to 60 minutes before skin incision Repeat dose of 1g in patients with normal renal function then 1g 8 hourly for 24 hours In penicillin allergy:  **Vancomycin 1g** (1.5g for >80kg) as infusion then 12 hourly for 24 hours If high anaerobic burden e.g., with perforation: **ADD**  **Clindamycin 600mg** 8 hourly for 3 doses.

Table 4: Vascular Surgery

Procedure	Common organisms	Recommended Prophylaxis
Vascular reconstruction (e.g., abdominal aorta, graft/stent insertion, groin incision)	*Staphylococcus aureus* *Coagulase negative staphylococci* *Corynebacteria* *Coliforms in groin incisions*	ACCESS **Cefazolin 2g IV** initiated 30 to 60 minutes before skin incision (child: 30mg/kg up to 2g), repeated 8-hourly for 2 further doses post-operatively
Amputation of ischaemic limb	*Staphylococcus aureus* *Coagulase negative staphylococci* *Corynebacteria*	ACCESS **Cefazolin 2g IV** initiated 30 to 60 minutes before skin incision (child: 30mg/kg up to 2g) repeated 8-hourly for 2 further doses post-operatively PLUS ACCESS **Metronidazole 500mg IV** infusion (child: 12.5mg/kg up to 500mg), repeated 12 hours after initial dose)
Primary autogenous arteriovenous fistula (AVF) formation	**Prophylaxis NOT recommended**	
AVF revision or AVF with insertion of prosthetic material (e.g Dacron graft)	*Staphylococcus aureus* *Coagulase negative staphylococci* *Corynebacteria*	ACCESS **Cefazolin 2g IV** initiated 30 to 60 minutes before skin incision (child: 30mg/kg up to 2g)
Venous insufficiency surgery	**Prophylaxis NOT recommended**	

B. GASTROINTESTINAL PROCEDURES

Table 5: Endoscopic Gastrointestinal Procedure

Procedure	Common organisms	Recommended Prophylaxis
Percutaneous Endoscopic Gastrostomy/Jejunostomy (PEG/PEJ) insertion/revision	*Coliforms* *Peptostreptococci*	 **Cefazolin 2g IV** initiated 30 to 60 minutes before skin incision (Child: 30mg/ kg up to 2g) **PLUS** consider adding  **Metronidazole 500mg IV** infusion (child: 12.5mg/kg up to 500mg) in complicated cases
Endoscopic Retrograde Cholangiopancreatography (ERCP) (For patients with a high risk of infection, e.g. known or suspected biliary obstruction, biliary sepsis, pancreatic pseudocyst)	*Coliforms* *Anaerobes* *Enterococci*	 **Cefazolin 2g IV** initiated 30 to 60 minutes before skin incision (Child: 30mg/ kg up to 2g) **OR**  **Gentamicin 2mg/kg IV** **PLUS** consider adding  **Metronidazole 500mg IV** infusion (child: 12.5mg/kg up to 500mg)
Endoscopic ultrasound- guided fine-needle aspiration	*Coliforms* *Anaerobes* *Enterococci*	 **Cefazolin 2g IV** initiated 30 to 60 minutes before skin incision (child: 30mg/ kg up to 2g) **PLUS**  **Metronidazole 500mg IV** infusion (child: 12.5mg/kg up to 500mg)
Sclerotherapy	*Coliforms* *Anaerobes* *Enterococci*	 **Cefazolin 2g IV** initiated 30 to 60 minutes before skin incision (child: 30mg/ kg up to 2g)
All other procedures (with or without biopsy), e.g., endoscopy, colonoscopy, sigmoidoscopy, oesophageal dilatation	**Prophylaxis NOT recommended**	

Table 6 : Gastrointestinal Surgery

Procedure	Common organisms	Recommended Prophylaxis
Gastric / duodenal / Oesophageal (bypass, resection, ulcer oversew, esophagectomy etc.)	*Coliforms (e.g., Escherichia coli, Klebsiella, Citrobacter, Enterobacter)*	ACCESS **Cefazolin 2g IV** initiated 30 to 60 minutes before skin incision (child: **30mg/kg up to 2g**) **PLUS** ACCESS **Metronidazole 500mg IV** (Child: **12.5mg/kg up to 500mg**)
Biliary procedures (including laparoscopic procedures)	*Escherichia coli Anaerobes*	OMIT metronidazole if low risk as defined by: • Upper GI surgery: normal gastric acidity/mobility; no obstruction, bleeding, or malignancy; no previous gastric surgery • Biliary tract surgery: patient < 60yrs of age; no diabetes; elective cholecystectomy with low risk of exploration of common bile duct
Colorectal (Colon/small bowel resection, revision of anastomosis/stoma, appendectomy etc.) **Pancreatic (Whipple's etc.)** **Liver resection Exploratory laparotomy/ division of adhesions**	*Coliforms, Anaerobes, Enterococci*	ACCESS **Cefazolin 2g IV** initiated 30 to 60 minutes before skin incision (Child: **30mg/ kg up to 2g**) **PLUS** ACCESS **Metronidazole 500mg IV** infusion (child: **12.5mg/kg up to 500mg)** **PLUS** ACCESS **Gentamicin 2mg/kg IV**
Hernia repair	**Prophylaxis NOT recommended when mesh is not inserted**	
Hernia repair with mesh insertion	*Staphylococcus aureus, Coagulase negative staphylococci*	ACCESS **Cefazolin 2g IV** initiated 30 to 60 minutes before skin incision (child: **30mg/ kg up to 2g**)

Post-Operative Care

Except where included above, post-operative antibiotics are NOT indicated unless infection is confirmed or suspected, regardless of the presence of surgical drains.

If infection is suspected, consider modification of antibiotic regimen according to the clinical condition and microbiological results.

C. Neurosurgery

Table 7 : Neurosurgery

Procedure	Common organisms	Recommended Prophylaxis
Elective Craniotomy procedures	*Coagulase negative staphylococci* *Staphylococcus aureus* *Corynebacteria*	 ACCESS **Cefazolin 2g IV** initiated 30 to 60 minutes before skin incision (child: **30mg/kg up to 2g**) Penicillin allergy:  RESERVE **Vancomycin 1g IV** infusion (1.5g for patients > 80kg actual body weight)
Emergency Craniotomy Procedures	*Coagulase negative staphylococci* *Staphylococcus aureus* *Corynebacteria*	 ACCESS **Cefazolin 2g IV** STAT (Child 30mg/ kg) Penicillin allergy:  RESERVE **Vancomycin 1g IV** **OR**  WATCH **Clindamycin (600mg IV if <70kg, 900mg if>70kg)**
Procedure with involvement of Paranasal Sinuses (including Trans-sphenoidal and Skull base procedures)	*Streptococcus pneumoniae,* *Haemophilus influenzae,* *Moraxella catarrhalis*	 ACCESS **Cefazolin 2g IV** **PLUS**  WATCH **Clindamycin (600mg IV** initiated 30 to 60 minutes before skin incision if <70kg, **900gms if>70kg)** Penicillin allergy:  RESERVE **Vancomycin 1g IV** **OR**  WATCH **Clindamycin (600mg IV if <70kg, 900mg if>70kg)**

Elective spine surgery	*Gram positive staphylococci and Propionibacterium*	 **Cefazolin 2g IV** **OR**  **Amoxicillin+ Clavulanic acid 1.2g** at induction and a repeat 8 hours later Penicillin allergy:  **Vancomycin 1g IV** **OR**  **Clindamycin (600mg IV if <70kg, 900mg if>70kg)**
Insertion of Implants	*Coagulase negative staphylococci* *Staphylococcus aureus* *Corynebacteria*	 **Vancomycin 1g IV infusion** (1.5g for patients > 80kg actual body weight) **PLUS**  **Ceftazidime 2g IV** Penicillin allergy:  **Vancomycin 1g IV** **OR**  **Clindamycin (600mg IV if <70kg, 900mg if>70kg)**
Ventriculo-peritoneal Shunting and insertion of External ventricular Drains	*Coagulase negative staphylococci.* *Staphylococcus aureus* *Corynebacteria*	 **Cefazolin 2g IV** initiated 30 to 60 minutes before skin incision (child: 30mg/kg up to 2g) Penicillin allergy:  **Vancomycin 1g IV** infusion (1.5g for patients > 80kg actual body weight)
Other minor clean procedures	**Prophylaxis NOT recommended**	

D. OBSTETRIC AND GYNECOLOGY

Table 8: Gynecologic Surgery

Procedure	Common organisms	Recommended prophylaxis
Dilation & Curettage / Uterine evacuation	*Coliforms Enterococci* *Group B streptococci*	ACCESS **Amoxicillin+ Clavulanic acid 1.2g STAT** For penicillin allergy: WATCH **Clindamycin 900mg IV** **PLUS** ACCESS **Gentamicin 5mg/kg IV**
Total abdominal hysterectomy, radical hysterectomy and laparoscopic hysterectomy	*Staphylococcus aureus* *Coliforms Enterococci* *Group B Streptococci*	ACCESS **Cefazolin 2g IV (3g if patient is >120kg)** Repeat dose after 3 hours if surgery prolonged
Vaginal Hysterectomy	*Coliforms Enterococci* *Group B Streptococci*	ACCESS **Cefazolin 2g IV** **PLUS** ACCESS **Metronidazole 500mg IV**
Diagnostic Laparoscopy without breach of bowel, uterine or vaginal cavity	**Prophylaxis NOT recommended**	
Operative Laparoscopy	*Coliforms, Enterococci* *Group B Streptococci*	ACCESS **Cefazolin 2g IV** STAT
Diagnostic and Operative hysteroscopy	*Prophylaxis NOT recommended*	
Open myomectomy	*Coliforms, Enterococci* *Group B Streptococci*	ACCESS **Cefazolin 2g IV** STAT

Laparatomy for ectopic pregnancy	*Coliforms, Enterococci* *Group B Streptococci*	 **Cefazolin 2g IV** STAT
Insertion of IUD, contraceptive implants	**Prophylaxis NOT recommended**	
Vesico-vaginal fistula (VVF)	*Coliforms, Enterococci*	 **Amoxicillin+ Clavulanic acid 1.2g IV** STAT **OR**  **Gentamicin 80 mg IV** STAT given immediately pre-op or intra-op
Recto-vaginal Fistula (RVF)	*Coliforms, Enterococci*	 **Amoxicillin+ Clavulanic acid 1.2g IV** STAT **OR**  **Gentamicin 80 mg** **PLUS**  **Metronidazole 1g** STAT given intraoperatively
Vulvectomy	*Coliforms, Enterococci* *Group B Streptococci* *Staphylococcus aureus*	 **Cefazolin 2g IV** STAT
Antibiotic prophylaxis not recommended	Cervical biopsy, endometrial biopsy	

Table 9: Obstetrics Surgery

Procedure	Common organisms	Recommended prophylaxis
Postpartum Bilateral Tube Ligation (BTL)	**Prophylaxis NOT recommended**	
Cervical Cerclage	**Prophylaxis NOT recommended**	
Emergency or elective Caesarean Section (no labor, no rupture of membranes)	*Staphylococcus aureus, Coliforms Enterococci, Group B Streptococci*	ACCESS **Cefazolin 2g IV** Penicillin allergy: RESERVE **Vancomycin 1g IV** infusion (1.5g for patients > 80kg actual body weight)
Emergency or elective Caesarean Section where there is need for broader spectrum antibiotics: • **Prolonged labour (>24hrs)** • **Prolonged rupture of membranes (>24hrs)** • **multiple number of vaginal examinations (>5 examinations)** • **post-partum** • **hemorrhage (PPH) or anemia** **Difficult or prolonged surgery due to adherence of placenta or numerous adhesions**	*Staphylococcus aureus, Coliforms Enterococci, Group B Streptococci*	ACCESS **Cefazolin 2 g IV** **PLUS** WATCH **Azithromycin 500mg IV**
Emergency caesarean or vaginal delivery with chorioamnionitis	*Staphylococcus aureus, Coliforms, Enterococci,* *Group B Streptococci*	ACCESS **Amoxicillin+ Clavulanic acid 1.2g IV** 8 hourly **PLUS** ACCESS **Metronidazole 500mg** 8 hourly

		Treat for 5 days Samples for bacteriology should be taken before initiating antibiotics
Normal vaginal delivery	**Prophylaxis NOT recommended except** in case of 3rd or 4th degree tears	
Perineal Tear **1st or 2nd degree perineal tear**	**Prophylaxis NOT recommended**	
3rd and 4th degree perineal tear	*Coliforms, Enterococci,* *Group B Streptococci*	ACCESS **Cefazolin 2g** STAT
Assisted Vaginal Delivery (vacuum delivery and forceps delivery)	*Coliforms, Enterococci* *Group B Streptococci*	ACCESS **Amoxicillin+ Clavulanic acid 1.2g** STAT before the procedure
Cervical tears	ACCESS **Cefazolin 2g** STAT	
Manual removal of placenta	**Prophylaxis NOT recommended**	
Labour, epidural analgesia	**Prophylaxis NOT recommended**	

Table 10: Prevention of Early Onset Group B Streptococcal Infections

Prevention of early onset neonatal Group B Streptococci (GBS)

Intrapartum antibiotic prophylaxis to reduce the risk of GBS early onset disease is based on:

1. Decreasing the incidence of GBS colonization which requires adequate maternal drug levels
2. Reducing the risk of neonatal sepsis which requires adequate antibiotic levels in the fetus and newborn

Universal bacteriology screening is not recommended.

Clinical Risk factors of having baby with early onset of neonatal GBS will determine bacteriological screening

For those at risk there is a 50% chance of GBS in current pregnancy. The management options include:

Option 1: Intrapartum antibiotic prophylaxis to the at-risk woman

Option 2: Perform bacteriological testing at 35-37 weeks gestation

OR

3-5 weeks prior to anticipated delivery date

Option 3: Women with previous baby affected by GBS, intra-partum antibiotic prophylaxis is given

NB: Maternal request is not an indication for bacteriological screening

Option 4: For women with GBS bacteriuria treat when detected and offer intrapartum antibiotic prophylaxis.

Membrane sweeping is not contraindicated in women who are carriers of GBS

Antibiotic prophylaxis specific for GBS is not required for women undergoing planned caesarian section in absence of labor and with intact membranes

Offer intrapartum antibiotic prophylaxis for GBS carriers undergoing induction of labor

Women with fever in labor (38 degrees C or more) should be offered a broad-spectrum antibiotic with GBS cover intra-partum

Intrapartum antibiotic prophylaxis for women with confirmed preterm labor and premature rupture of membranes

For patients with Preterm premature rupture of membranes, obtain vaginal-rectal swab for GBS culture and start antibiotics which include coverage for GBS prophylaxis.

Not allergic to penicillin	 ACCESS **Penicillin G 5million units IV** load then 2.5- 3 Million Units IV every 4 Hours until delivery. **OR**  ACCESS **Ampicillin 2g IV** Load then **1g** Every 4 Hours until delivery
Allergic to Penicillin	**<u>Low Risk penicillin allergy</u>**  ACCESS **Cefazolin 2gm IV** load then **1g IV** every 8 hours until delivery **<u>High risk penicillin allergy</u>** Request Clindamycin susceptibility on lab sample. Clindamycin susceptible GBS give;  WATCH **Clindamycin 900mg IV** every 8 hours until delivery Clindamycin resistant GBS give  RESERVE **Vancomycin 20mg/kg** every 8 hours (max single dose 2g) minimum infusion time is 1 hour or **500mg** for 30min for a dose more than 1g. **<u>Unknown Risk</u>** Penicillin allergy testing administer;  ACCESS **Cefazolin 2g IV** load then **1g IV** every 8 Hours until delivery **OR**  WATCH **Clindamycin** if isolate susceptible **OR**  RESERVE **Vancomycin** if GBS not susceptible to clindamycin

<u>Notes:</u>

This section will be updated as evidence from laboratory data is generated.

Low Risk Penicillin Allergy: Individuals with a history of any of the following non-specific symptoms: Gastrointestinal distress, headaches, yeast vaginitis, non -urticarial maculopapular rash without systemic symptoms, pruritis without a rash, family history of penicillin allergy but no personal history, patient reports history but has no recollection of symptoms

High Risk Penicillin Allergy: Individuals with a history of any of the following after administration of penicillin; pruritic rash, urticaria, immediate flashing, hypotension, angioedema, respiratory distress or anaphylaxis, recurrent reactions, SJS syndrome.

Unknown Risk: No information available to direct which antibiotic choice is best in this scenario

E. ORTHOPEDIC PROCEDURES

Table 11: Orthopaedic Surgery

Procedure	Common organisms	Recommended Prophylaxis
Internal fixation of large bones	*Skin commensals e.g., Staphylococcus aureus, Coagulase negative staphylococci, Coliforms*	ACCESS **Cefazolin 2g IV** initiated 30 to 60 minutes before skin incision (child <12 years: 30mg/ kg up to 2g) **THEN** Repeat 8-hourly for 2 further doses. (Max 3 doses irrespective of the presence of surgical drains)
Other (closed) internal fixation	*Skin commensals e.g., Staphylococcus aureus, Coagulase negative staphylococci, Coliforms*	ACCESS **Cefazolin 2g IV** (child < 12 years: 30mg/ kg up to 2g)
Open fractures	The commencement of broad-spectrum antibiotics should be within 3 hours of injury and should continue until first debridement1. Farm injuries, heavy contamination, or possible bowel contamination - add high dose penicillin for anaerobic coverage (clostridium)	
Gustilo type Iand II	*Staphylococcus aureus*	ACCESS **Amoxicillin + Clavulanic acid 1.2g,** 8 hourly **OR** WATCH **Cefazolin 1g,** 8 hourly Penicillin allergy: WATCH **Clindamycin 600 mg IV,** 6 hourly preoperatively Duration - 24 hours post-surgery
Gustilo type III	*Staphylococcus aureus*	ACCESS **Amoxicillin + Clavulanic acid 1.2g,** 8 hourly **OR** ACCESS **Cefazolin 1g,** 8 hourly

		PLUS ACCESS **Gentamicin (1.5 mg/kg),** 8 hourly **PLUS,** ACCESS **Metronidazole 500mg,** 8 hourly Duration of treatment- 72 hours after surgery or within 24 hours after skin closure. Please justify need for on-going antibiotic use (Note that longer duration of antibiotic therapy has not been shown to reduce the incidence of infection)
Type III fractures and potential water or sewage exposure	*Pseudomonas spp.*	WATCH **Ceftazidime 2 g IV** 8 hourly **OR** WATCH **Cefepime 2 g IV** 6 hourly for 72 hours after surgery
Arthroscopic and other clean procedures not involving foreign material (e.g., pins, plates)	**Prophylaxis NOT recommended**	
Lower limb amputation	Risk of anaerobic infection e.g., gas gangrene	ACCESS **Cefazolin 2g IV** initiated 30 to 60 minutes before skin incision (child < 12 years: 30mg/ kg up to 2g) **THEN** Repeat 8hourly for up to 2 further doses If limb is ischemic **ADD** to above ACCESS **Metronidazole 500mg IV** infusion (child < 12 years: 12.5mg/kg up to 500mg), may be repeated after 12 hours
Spinal procedures	Skin commensals e.g., *Staphylococcus aureus, Coagulase negative staphylococci, Coliforms*	ACCESS **Cefazolin 2g IV** initiated 30 to 60 minutes before skin incision (child < 12 years: 30mg/ kg up to 2g)

Table 12: Orthopaedic Surgery (Joint Replacement)

Procedure	Common organisms	Recommended Prophylaxis
Primary Total Hip Replacement (THR) OR Total Knee Replacement (TKR)	Skin commensals *e.g., Staphylococcus aureus, Coagulase negative staphylococci, Coliforms*	 **Cefazolin 2g IV** initiated 30 to 60 minutes before skin incision (child: 30mg/kg up to 2g), then 8-hourly for 2 more doses
Patients requiring revision / re-operation	Skin commensals *e.g., Staphylococcus aureus, Coagulase negative staphylococci, Coliforms*	 **Cefazolin 2g IV** initiated 30 to 60 minutes before skin incision (child: 30mg/kg up to 2g), then 8-hourly for 2 more doses **PLUS**  **Vancomycin 1g IV** infusion (1.5g for patients > 80kg actual body weight) Note: Pre-existing infections (known or suspected) – if present, use appropriate treatment regimen instead of prophylactic regimen for procedure. Doses should be scheduled to allow for re-dosing just prior to skin incision.
Routine arthroscopic procedures	Skin commensals e.g., *Staphylococcus aureus, Coagulase negative staphylococci, Coliforms*	**NO PROPHYLAXIS REQUIRED** (Unless prosthesis is being inserted or patient is immunocompromised)

- Tropical antibiotics should not be applied to the wound during or after surgery
- If a tourniquet is to be used, the full dose of the antibiotic should be infused prior to application of the tourniquet
- There is no role for routine diagnosis or treatment of asymptomatic bacteriuria among patients undergoing joint arthroplasty or other orthopedic hardware placement
- A dental evaluation should be undertaken to assess and manage for the presence of gingivitis, occult dental abscess, or decay prior to joint replacement

F. PLASTIC AND RECONSTRUCTIVE SURGERY

Table 13: Plastic and Reconstructive Surgery

Procedure	Common organisms	Recommended Prophylaxis
Groin/axilla/neck dissections **Open reduction and internal fixation of fractures** **Insertion of implants, mesh, prostheses, screws, plates etc.**	*Skin commensals e.g., Staphylococcus aureus, Coagulase negative staphylococci, Coliforms*	ACCESS **Cefazolin 2g IV** initiated 30 to 60 minutes before skin incision (child: 30mg/kg up to 2g)
Clean bone or soft tissue injury **Hand surgery (without implants)** **Non-infected lesions & minor excisions**	**Prophylaxis NOT recommended**	

Unless otherwise stated, antibiotic prophylaxis is NOT required for the following plastic surgery indications:

- Clean elective surgery with no implants
- Clean trauma with no fracture and less than 24 hours since injury

Topical antibiotics should NOT be applied to the wound during or after surgery

G. PREVENTION OF ENDOCARDITIS OR INFECTION OF PROSTHETIC IMPLANTS OR GRAFTS

Cardiac conditions for which antibiotic prophylaxis to prevent endocarditis is recommended. **(These are high cardiac risk conditions)**

- Prosthetic cardiac valve or prosthetic material used for cardiac valve repair
- Previous infective endocarditis
- Congenital heart disease, only if it involves:

  i. Unrepaired cyanotic defects, including palliative shunts and conduits;

  OR

  ii. Completely repaired defects with prosthetic material or devices, whether placed by surgery or catheter intervention, during the first six months after the procedure (after which the prosthetic material is likely to have endothelialised);

  OR

  iii. Repaired defects with residual defects at, or adjacent to the site of a prosthetic patch or device (which inhibit endothelialisation)

Prophylaxis always required for patients with high-risk lesions for infective endocarditis.

The procedures that require prophylaxis for prevention of infective endocarditis are indicated below (table 14).

Table 14: Prevention of Infective Endocarditis

Procedure	Common organisms	Recommended Prophylaxis
Dental procedure **That involve manipulation of gingival tissue or the periapical region of teeth or perforation of the oral mucosa including:** • **Extractions** • **Periodontal procedures including surgery, subgingival scaling, and root planning** • **Replanting avulsed teeth** **Other surgical procedures (e.g. implant placement, apicoectomy)**	*Viridans Streptococcus (Alpha- hemolytic streptococci)*	**Single dose** ACCESS **Amoxicillin 2g PO** 30-60 minutes prior to procedure Child: **50 mg/kg PO**; not to exceed 2 g/ dose If unable to take oral medication: ACCESS **Amoxicillin + Clavulanic acid 1.2g IV** (Child: 25mg/kg) **OR** ACCESS **Cefazolin 1g IM or IV** (child: 50mg/kg IM or IV)
Infected Skin, Skin Structures, or Musculoskel etal Tissue Procedures	*Staphylococci and beta- hemolytic streptococci*	ACCESS **Amoxicillin + Clavulanic acid 1.2g IV** **OR** ACCESS **Cefazolin 1g IV**

PROPHYLAXIS NOT RECOMMENDED

Bronchoscopy unless incision or biopsy of respiratory mucosa

Gastrointestinal and genitourinary procedures unless indicate for surgical reasons

The following dental procedures **DO NOT** require endocarditis prophylaxis:

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

H. SPECIAL SURGERY

Table 15: Ophthalmologic Surgery

Procedure	Common organisms	Recommended Prophylaxis
All procedures	*Cutibacterium acnes* *Coagulase negative Staphylococcus* *Corynebacterium* *Streptococcus spp.* *Enterococcus spp.*	Pre-operatively: Immediately prior to surgical incision, apply sterile povidone-iodine 5% swab to conjunctival cul de sac, lid margins and periorbital skin and dry for 2 minutes. In patients with a povidone iodine allergy, use a sterile product containing chlorhexidine acetate 0.05% for 5 minutes
Extra-ocular procedures • Conjunctival procedures • Rectus / oblique muscle Procedures where infection may be present (e.g., Dacryocystorhinostomy)	*Cutibacterium acnes* *Coagulase negative Staphylococcus* *Corynebacterium* *Streptococcus spp.* *Enterococcus spp.*	ACCESS **Cefazolin 2g IV** (child: 30mg/kg up to 2g) High risk of MRSA infection: **REPLACE** ACCESS **Cefazolin** with WATCH **Clindamycin 600mg IV** infusion No strong evidence for IV prophylaxis (Follow pre-operative procedure as above) **Chloramphenicol 0.5%** eye drops 4 times a day post-operatively for 7 days.
Intra-ocular procedures **Anterior procedures** • Phacoemulsification / lens implant	*Cutibacterium acnes,* *coagulase-negative Staphylococcus,* *Corynebacterium*	ACCESS **Cefazolin 1mg/0.1ml** of balanced salt solution intracameral injection at the end of the procedure **PLUS**

• Keratoplasty • Trabeculectomy/ tube implant **Corneal graft**	*Streptococcus spp.* *Enterococcus spp.*		**Chloramphenicol 0.5% eye drops** four times a day post-operatively for one week **OR**, if chloramphenicol contraindicated then: **Tobramycin 0.3% eye drops** four times a day post-operatively for one week
Vitreous procedures • Retinal detachment repair • Scleral buckle Cryotherapy	*Cutibacterium acnes* *Coagulase-negative Staphylococcus* *Corynebacterium* *Streptococcus spp.* *Enterococcus spp.*		**Ceftazidime 2.25 mg/0.1 mL** of balanced salt solution subconjunctival injection at the end of the procedure **PLUS** **Chloramphenicol 0.5% eye drops** four times a day post-operatively for one week **OR** if chloramphenicol contraindicated then: **Tobramycin 0.3% eye drops** four times a day post-operatively for one week

Post-Operative Care

There is a lack of strong evidence to support the use of post-operative topical antibiotics. Prolonged treatment with antibiotic ointment or drops is not indicated unless there is confirmed or suspected infection.

For patients who are treated with extended periods of topical steroids or who have been treated with systemic steroids preoperatively, immunological defenses may be reduced and the risk of infection may be increased. If post-operative topical antibiotics are considered necessary due to higher risk of infection, Chloramphenicol 0.5% eye drops can be used four times daily for 7 days. Tobramycin eye drops should only be used in patients hypersensitive to chloramphenicol due to an increased risk of resistance.

If infection is suspected, consider modification of antibiotic regimen according to clinical condition and microbiology results

Table 16: Oral and Maxillofacial Surgery

Procedure	Common organisms	Recommended Prophylaxis
Minor Oral & Maxillofacial Surgical Procedures	Routine minor oral and maxillofacial surgical procedures under local anesthesia **do not** routinely require prophylactic antibiotics. Where there is no pre-existing infection and no risks as discussed below, no antibiotics should be administered and this includes surgical extractions in otherwise healthy persons, unless the surgery is prolonged and contaminated. Where there are clinical signs of infection such as abscess or pericoronitis, then full treatment dose of the applicable antibiotic should be administered.	
Antibiotic prophylaxis during dental treatment of patients with prosthetic joint implants	**Prophylactic antibiotics are NOT RECOMMENDED** prior to dental procedures to prevent prosthetic joint infection. The practitioner and patient should consider possible clinical circumstances that may suggest the presence of a significant medical risk in providing care without antibiotic prophylaxis against the known risks of frequent or widespread antibiotic use.	
Orthognathic surgery	*Oropharyngeal flora Streptococci spp.* *Staphylococcus aureus* *Anaerobes* *Corynebacteria*	ACCESS **Benzylpenicillin 1.2g IV** initiated 30 to 60 minutes before skin incision (child < 12 years: 30mg/kg up to 1.2g) **THEN** (for procedures greater than 2 hours duration) **Repeat** dose 2- hourly intra-operatively Penicillin allergy: WATCH **Clindamycin 600mg IV infusion** (child: 15mg/kg up to 600mg)

Skin approach procedures (oral cavity not involved)	*Streptococci spp.* *Staphylococcus aureus* *Anaerobes* *Corynebacteria*	ACCESS **Cefazolin 2g IV** initiated 30 to 60 minutes before skin incision (child < 12 years: 30mg/kg up to 2g) Penicillin allergy: WATCH **Clindamycin 600mg** (child: 15mg/kg up to 600mg) by IV infusion, then 8-hourly for 24 hours
Skin approach procedures (with concurrent oral cavity involvement)	*Oropharyngeal flora Streptococci spp.* *Staphylococcus aureus* *Anaerobes* *Corynebacteria*	ACCESS **Cefazolin 2g IV** initiated 30 to 60 minutes before skin incision (child < 12 years: 30mg/kg up to 2g) **PLUS** ACCESS **Metronidazole 500mg IV** infusion (child < 12 years: 12.5mg/kg up to 500mg) before incision, THEN 12-hourly for 24 hours Penicillin allergy: WATCH **Clindamycin 600mg** (child: 15mg/kg up to 600mg) by IV infusion, THEN 8-hourly for 24 hours
Implants (1st stage)	*Streptococci spp.* *Staphylococcus aureus* *Anaerobes* *Corynebacteria*	ACCESS **Benzylpenicillin 1.2g IV** initiated 30 to 60 minutes before skin incision (child < 12 years: **30mg/kg** up to 1.2g) **THEN** 2-hourly intra- operatively (for procedures greater than 2 hours duration) Penicillin allergy: WATCH **Clindamycin 600mg** (child: 15mg/kg up to 600mg) by IV infusion

Trauma Intraoral compound operation (injury of any age, compound to nose/ skin/sinuses)	*Oropharyngeal flora Streptococci spp.* *Staphylococcus aureus* *Anaerobes* *Corynebacteria*	ACCESS **Benzylpenicillin 1.2g IV** infusion **(child < 12 years: 30mg/kg up to 1.2g)** at presentation, THEN 4-hourly for 48 hours **PLUS** ACCESS **Metronidazole 500mg IV** infusion **(child: 12.5mg/kg up to 500mg)** at presentation, then 12-hourly for 48 hours Penicillin allergy: WATCH **Clindamycin 600mg (child: 15mg/kg up to 600mg)** by IV infusion, **THEN** 8 hourly for 48 hours
Skin approach with concurrent oral cavity involvement (reconstructive surgery with ORIF or bone graft placement)	*Oropharyngeal flora Streptococci spp.* *Staphylococcus aureus* *Anaerobes* *Corynebacteria*	ACCESS **Cefazolin 2g IV** initiated 30 to 60 minutes before skin incision **(child < 12 years: 30mg/kg up to 1g),** then 8-hourly for 24 hours **PLUS** ACCESS **Metronidazole 500mg IV** infusion **(child: 12.5mg/kg up to 500mg),** then 12- hourly for 24 hours Penicillin allergy: WATCH **Clindamycin 600mg (child: 15mg/kg up to 600mg)** by **IV infusion**, then 8-hourly for 24 hours

Table 17: Otorhinolaryngology / Head & Neck Surgery

Procedure	Common organisms	Recommended Prophylaxis
No incision through mucosal (oral, nasal, pharyngeal) surface	*Oropharyngeal flora* *Streptococci spp.* *Staphylococcus aureus* *Anaerobes, Corynobacteria*	ACCESS **Cefazolin 2g IV** initiated 30 to 60 minutes before skin incision (child: 30mg/ kg up to 2g)
With incision through mucosal (oral, nasal, pharyngeal, oesophageal) surface	*Oropharyngeal flora* *Streptococci spp.* *Staphylococcus aureus,* *Anaerobes,* *Corynebacteria*	ACCESS **Cefazolin 2g IV** initiated 30 to 60 minutes before skin incision (child: 30mg/ kg up to 2g) **PLUS** ACCESS **Metronidazole 500mg IV** infusion (child: 12.5mg/kg up to 500mg)
Other uncomplicated or minor clean procedures (e.g., tonsillectomy, adenoidectomy, tympanostomy, nasal septoplasty, endoscopic sinus surgery, uncontaminated neck dissection)	**Prophylaxis NOT recommended**	

Prophylaxis is not indicated for intra-oral procedures: dentoalveolar surgery (extractions, impactions, exposures); minor pathology (soft tissue, cysts).

For patients with cardiac conditions refer to Antibiotic Prophylaxis Guidelines for Prevention of Endocarditis

High risk penicillin/cephalosporin allergy

Clindamycin 600mg IV infusion (child: 15mg/kg up to 600mg)

H. UROLOGY

Table 18: Urology

Procedure	Common organisms	Recommended Prophylaxis
Open/laparoscopicprocedures when: • urinary tract entered • urinary tract not entered but: • patient is at risk of post-operative infection (e.g. urinary tract obstruction/ abnormalities); • prosthetic material is inserted; OR bacteriuria cannot be excluded	*Coliforms, Enterococci, Staphylococcus aureus*	ACCESS **Cefazolin 2g IV** initiated 30 to 60 minutes before skin incision **(child: 30mg/kg up to 2g)** **PLUS** ACCESS **Gentamicin 2mg/kg IV (adults and children)** If risk of entry into bowel lumen, then **ADD**: ACCESS **Metronidazole 500mg IV** infusion (child: 12.5mg/kg up to 500mg)
Open/laparoscopic procedures when urinary tract not entered and urine is sterile (e.g. vasectomy, scrotal surgery, varicocele ligation)	**Prophylaxis NOT recommended**	
Open prostatectomy / Robotic prostatectomy	*Coliforms, Enterococci, Staphylococcus aureus*	ACCESS **Cefazolin 2g IV** initiated 30 to 60 minutes before skin incision (child: 30mg/kg up to 2g) **PLUS** ACCESS **Gentamicin 2mg/kg IV** If risk of entry into bowel lumen, then **ADD**: ACCESS **Metronidazole 500mg IV** infusion (child: 12.5mg/kg up to 500mg)

Endoscopic procedures • Removal of calculi • Extracorporeal Shock Wave Lithotripsy only if high risk of infection Specific risk for postoperative infection	*Coliforms* *Enterococci* *Staphylococcus aureus*	 **Cefazolin 2g IV** initiated 30 to 60 minutes before skin incision (child: 30mg/kg up to 2g) Known urinary MRSA colonization: **ADD**  **Vancomycin 1g IV** infusion (1.5g for patients > 80kg actual body weight)
Removal of calculi **Transurethral resection of prostate (TURP)** **Stent insertion** **Ureteroscopy/instrumentation of upper tract** (including retrograde pyelogram)	*Coliforms* *Enterococci* *Staphylococcus aureus*	 **Gentamicin 2mg/kg IV (adults and children)** initiated 30 to 60 minutes before skin incision **OR** (if gentamicin contraindicated)  **Cefazolin 2g IV** initiated 30 to 60 minutes before skin incision (child: 30mg/kg up to 2g) Known urinary MRSA colonization: **ADD**  **Vancomycin 1g IV** infusion (1.5g for patients > 80kg actual body weight)

Table 19: Dosing of antibiotics used for surgical antibiotic prophylaxis

The table below provides dosing and re-dosing intervals for patients with normal and reduced renal function.

Antimicrobial	Pre-op Dose	Half-life, h	Half-life in ESRD	Normal Renal function Re-dose after (hours)[1]	Reduced renal function Re-dose based on CrCl after (hours)[2]	Administration
ACCESS **Cefazolin**	2g, 3g if >120kg	1.1-2.2	40-70	468	CrCl>35:4 CrCl 10-35:6 CrCl <10:8	IV push over 3-5 min
WATCH **Ceftriaxone**	2g	5.4-10.9		12	N/A	IV push over 3-5 min
WATCH **Clindamycin**	900mg	2.0-4.0	3.0-5.0	6	6	Infusion
ACCESS **Gentamicin**	5mg/kg, max 400mg	2.0-3.0	50-70	No re-dose	No re-dose	Infusion
ACCESS **Metronidazole**	500mg	6.0-8.0	7.0-21	8	8	Infusion
RESERVE **Vancomycin**	15mg/kg	4.0-8.0	44.1-406.4	12	N/A	Infusion should not exceed 1g in 60min
WATCH **Cefuroxime**	1.5g	1.0-2.0	3.5	8	24	IV push over 3-5 min

1. For long procedures, the prophylactic dose should be repeated after the number of hours indicated on the table.
2. For long procedures in patients with renal insufficiency, the dose should be repeated after the duration indicated.

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