A POCKET GUIDE TO ANTIBIOTIC PRESCRIBING
FOR ADULTS IN SOUTH AFRICA, 2014

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ON BEHALF OF THE SOUTH AFRICAN ANTIBIOTIC STEWARDSHIP
PROGRAMME (SAASP)
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<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Antibiogram</td>
<td>A list of antibiotics to which a cultured bacterium is susceptible, intermediate or resistant</td>
</tr>
<tr>
<td>BC</td>
<td>Blood culture</td>
</tr>
<tr>
<td>BD</td>
<td>Twice daily</td>
</tr>
<tr>
<td>Beta-lactam antibiotic</td>
<td>Antibiotic class containing a beta-lactam ring that inhibits bacterial cell wall synthesis. Includes penicillins, cephalosporins and carbapenems</td>
</tr>
<tr>
<td>CA</td>
<td>Community-acquired</td>
</tr>
<tr>
<td>CAP</td>
<td>Community acquired pneumonia</td>
</tr>
<tr>
<td>Cleaning solution</td>
<td>Antiseptic for hand hygiene, including 0.5% chlorhexidine in 70% alcohol and iodine-based solutions</td>
</tr>
<tr>
<td>Community-acquired (CA) infection</td>
<td>Illness starts prior to, or within 48 hours of admission</td>
</tr>
</tbody>
</table>
| CRB-65 score                  | A clinical prediction rule for mortality in community-acquired pneumonia. The score is an acronym for individual risk factors as follows: Confusion of new onset  
Respiratory rate ≥ 30 breaths per minute  
Blood pressure < 90 mmHg systolic or < 60 diastolic  
65 years or older  
A single point is assigned to each risk factor. |
| CRE                           | Carbapenem resistant Enterobacteriaceae                                                                                                          |
| CXR                           | Chest X-ray                                                                                                                                    |
| eGFR                          | Estimated glomerular filtration rate                                                                                                           |
| ESBL                          | Extended spectrum beta lactamase producing organism                                                                                             |
| Health care associated infection (HCAI) | Any patient with a new infection starting ≥ 48 hours after admission and was not apparent at the time of admission, or any catheter or line-associated infection irrespective of time of insertion. The following factors increase risk:  
• Admission to an acute care hospital within 90 days of the current presentation  
• Resident of a nursing home or long-term care facility  
• Recent intravenous antibiotic therapy, chemotherapy or wound care within the past 30 days of the current presentation  
• Patients attending a haemodialysis clinic |
| HCAP                          | Health care associated pneumonia                                                                                                                |
| IPC                           | Infection prevention and control                                                                                                                |
| im                            | Intramuscular injection                                                                                                                        |
| iv                            | Intravenous                                                                                                                                    |
| MRSA                          | Methicillin resistant *Staphylococcus aureus*                                                                                                   |
| MSSA                          | Methicillin sensitive *Staphylococcus aureus*                                                                                                  |
| po                            | Per os (oral)                                                                                                                                  |
| Rx                            | Treatment/therapy                                                                                                                              |
| TOE                           | Trans-oesophageal echocardiogram                                                                                                                |
| TTE                           | Trans-thoracic echocardiogram                                                                                                                  |
| VRE                           | Vancomycin resistant enterococci                                                                                                                |
Disclaimer

This document is provided as an information resource for all health care workers to assist in the appropriate prescribing of antibiotics. It attempts to summarise relevant information for clinicians from South African and International guidelines as well as reference to textbooks, key publications and expert opinion.

Recommendations change rapidly and opinion can be controversial. The authors do not warrant that the information contained in this booklet is complete and shall not be liable for any damages incurred as a result of its use.

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Chapter 1
Why do we need this guide?

The international community sits at the tipping point of a post-antibiotic era, where common bacterial infections are no longer treatable with the antibiotic armamentarium that exists. In South Africa, the identification of the first case of pan-resistant *Klebsiella pneumoniae* (Brink et al, J Clin Microbiol. 2013;51(1):369-72) marks a watershed moment and highlights our tip of the antibiotic resistance ‘iceberg’ in this country. Multi-drug resistant (MDR)-bacterial infections, predominantly in Gram-negative bacteria such as *Klebsiella pneumoniae*, *Escherichia coli*, *Pseudomonas aeruginosa* and *Acinetobacter baumannii* are now commonplace in South African hospitals. Whilst a number of expensive new antibiotics for Gram-positive bacterial infections have been manufactured recently (some of which are licenced for use in South Africa), no new antibiotics active against Gram-negative infections are expected in the next 10-15 years. Hence what we have now, needs conserving.

The development of antibiotic resistance is a natural phenomenon. Drug-resistance mutations have been found in 30,000-year old ice blocks. In addition, bacteria may acquire antibiotic resistance mechanisms by horizontal gene transfer. There are over 1000 different naturally occurring enzymes that are produced by different bacteria, which inactivate antibiotics. The overuse of antibiotics is driving the selection of antibiotic resistance. Given the right circumstances, the resistant bacteria that are selected out can either colonize a patient (be present, potentially transmissible, but not cause clinical disease i.e. infection) or cause infection. It follows that the more antibiotics are used, the greater the likelihood of selecting out antibiotic resistance, and the broader the spectrum of antibiotic that is used, the greater the number of different types of resistant bacteria will be selected out. The fact that it is estimated that half of all antibiotics prescribed in human health are unnecessary e.g. for viral upper respiratory tract infections, demands our renewed efforts to make antibiotic prescribing appropriate. When it is indicated, an antibiotic must be the right choice at the right dose, dosing interval and route, and for the right duration, and when it is not indicated, that antibiotic must not prescribed.

Rather than be an exhaustive text on infectious diseases, microbiology or clinical pharmacology, the aim of this guide is to give you the practical information you need to perform antibiotic stewardship in an algorithmic manner, which mimics the day-to-day experience of the prescriber.
Chapter 2
Principles for rational antibiotic prescribing

1. Decide if an antibiotic is indicated: does the patient have a bacterial infection?

   Is an antibiotic indicated?

   - Is there evidence of bacterial infection?
     - Fever
     - Leucocytosis with neutrophilia and left shift, toxic granulation
     - Raised inflammatory markers
     - Specific organ dysfunction (tachypnoea, dysuria, inflamed skin, etc)

   No

   Yes

   - Clear site of infection/disease?

     No

     Perform blood culture

     Rapid initiation of empiric antibiotics

     What is the most likely organism?
     - Respiratory tract: chapter 7 & 8
     - Intra-abdominal: chapter 9
     - Urinary tract: chapter 11
     - Meninges: chapter 13
     - Skin: chapter 16

     HCAI
     - Consult hospital/local guideline or contact specialist in infection

     CA
     - What is the narrowest spectrum antibiotic that will cover the most likely causes?

   Yes

   Send targeted specimen

   - Withhold antibiotics
     - Investigate for potential focus of infection
     - No antibiotics
     - Symptomatic Rx & look for other cause

   Targeted refers to specimen from site of infection e.g. urine for cystitis

2. Perform cultures before administering antibiotics in hospitalised patients or in outpatients with recurrent infections
This allows de-escalation to a narrow spectrum antibiotic once the 
antiibiogram is available & is a cornerstone of antibiotic stewardship

3. **Choose an appropriate empiric antibiotic:**
   a. **Target the most likely pathogen(s) for the site of infection**
      This can be predicted by understanding the broad groups of pathogens 
      that most commonly cause infections at various sites:
      - Skin and soft tissue: Gram positive cocci
      - Urinary tract: Gram negative bacilli
      - Intra-abdominal: Gram-negative, Gram-positive and anaerobic 
        organisms
      - See chapters on specific infections for more details

   An appropriate empiric antibiotic can then be selected by matching the 
   narrowest spectrum antibiotic with the likely pathogens. Spectrums of 
   activity of commonly used antibiotics are shown below
### Gram positive cocci

<table>
<thead>
<tr>
<th>Clusters</th>
<th>MSSA</th>
<th>MRSA</th>
<th>S. pneumoniae Most other streptococci</th>
<th>E. faecalis</th>
<th>E. faecium</th>
<th>VRE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amoxicillin/ampicillin</td>
<td>-</td>
<td>-</td>
<td>+</td>
<td>+</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Cloxacillin</td>
<td>+</td>
<td>-</td>
<td>+/</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Clindamycin</td>
<td>+</td>
<td>+/-</td>
<td>+</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Ceftriaxone</td>
<td>+</td>
<td>-</td>
<td>+</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Co-amoxiclavin</td>
<td>+</td>
<td>-</td>
<td>+</td>
<td>/</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Vancomycin</td>
<td>/</td>
<td>+</td>
<td>/</td>
<td>/</td>
<td>/</td>
<td>+</td>
</tr>
<tr>
<td>Ertapenem</td>
<td>/</td>
<td>-</td>
<td>/</td>
<td>/</td>
<td>/</td>
<td>-</td>
</tr>
<tr>
<td>Moxifloxacin</td>
<td>/</td>
<td>+/-</td>
<td>+</td>
<td>/</td>
<td>+/-</td>
<td>-</td>
</tr>
<tr>
<td>Linezolid</td>
<td>/</td>
<td>/</td>
<td>/</td>
<td>/</td>
<td>/</td>
<td>+</td>
</tr>
<tr>
<td>Daptomycin</td>
<td>/</td>
<td>/</td>
<td>/</td>
<td>/</td>
<td>/</td>
<td>/</td>
</tr>
</tbody>
</table>

### Gram negative

<table>
<thead>
<tr>
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<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td>Amoxicillin/ampicillin</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>/</td>
<td>-</td>
<td>+/-</td>
</tr>
<tr>
<td>Penicillin</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>/</td>
<td>-</td>
<td>+/-</td>
</tr>
<tr>
<td>Cotrimoxazole*</td>
<td>+/-</td>
<td>+/-</td>
<td>+/-</td>
<td>-</td>
<td>+/-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Ceftriaxone</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>-</td>
<td>-</td>
<td>+</td>
</tr>
<tr>
<td>Co-amoxiclavin</td>
<td>+</td>
<td>-</td>
<td>+</td>
<td>-</td>
<td>/</td>
<td>-</td>
<td>/</td>
</tr>
<tr>
<td>Ciprofloxacin</td>
<td>+</td>
<td>+</td>
<td>+/-</td>
<td>+/-</td>
<td>+</td>
<td>+</td>
<td>/</td>
</tr>
<tr>
<td>Aminoglycosides</td>
<td>+</td>
<td>+</td>
<td>+/</td>
<td>+/</td>
<td>-</td>
<td>+</td>
<td>-</td>
</tr>
<tr>
<td>Cefepime</td>
<td>/</td>
<td>+</td>
<td>+/-</td>
<td>-</td>
<td>/</td>
<td>+</td>
<td>/</td>
</tr>
<tr>
<td>Piptazobactam</td>
<td>/</td>
<td>+/-</td>
<td>-</td>
<td>-</td>
<td>/</td>
<td>+</td>
<td>/</td>
</tr>
<tr>
<td>Ertapenem</td>
<td>/</td>
<td>+</td>
<td>+</td>
<td>-</td>
<td>/</td>
<td>-</td>
<td>/</td>
</tr>
<tr>
<td>Imipenem</td>
<td>/</td>
<td>/</td>
<td>/</td>
<td>+/-</td>
<td>/</td>
<td>+</td>
<td>/</td>
</tr>
<tr>
<td>Meropenem</td>
<td>/</td>
<td>/</td>
<td>/</td>
<td>+/-</td>
<td>/</td>
<td>+</td>
<td>/</td>
</tr>
</tbody>
</table>

*Associated with much higher rates of toxicity than other antibiotics. Avoid using if a suitable alternative with a similarly narrow spectrum of activity is available

- usually susceptible: recommended first line therapy while awaiting antibiogram
- frequent resistance or poor clinical efficacy: do not use
- +/- variable susceptibility: only use with antibiogram result
- usually susceptible but not first choice: do not use unless there is a compelling reason (e.g. allergy, toxicity or resistance to first line drug or better outcomes for a particular site of infection)

#### b. Assess likelihood of antibiotic resistance

Risk factors include known colonisation with a resistant pathogen, HCAI, recent antibiotic exposure. Local resistance patterns inform prescribing.

#### c. Review potential contraindications

**Allergy:**
Clinicians should differentiate an immediate type 1 IgE mediated hypersensitivity reaction from other less dangerous types of hypersensitivity. Classical signs of type 1 hypersensitivity are anaphylaxis, angioedema, urticarial rash, and bronchospasm. If a type 1
hypersensitivity reaction to penicillin has occurred, then all β-lactam antibiotics should be avoided, unless there is no alternative drug available when penicillin desensitisation can be attempted as an inpatient. Patients with other types of hypersensitivity reactions, usually a maculopapular rash to amoxicillin, should avoid all penicillins but may tolerate other β-lactam antibiotics like cephalosporins. The 1<sup>st</sup> generation cephalosporins should be avoided as they have a higher risk of cross-reactivity with penicillin, but this risk is much lower for second- or third-generation cephalosporins reported to be only 0.1%. If the previous reaction to penicillin was a maculopapular rash, it is relatively safe to use 2<sup>nd</sup>/3<sup>rd</sup> generation cephalosporins and use would depend on the patient’s social circumstances and access to follow-up. However, in patients with a remote history of a rash on penicillin it is often difficult to differentiate a maculopapular rash from an urticarial rash – all β-lactam antibiotics should be avoided if urticaria occurred on penicillins as this is a type 1 reaction. In this setting, skin testing before using a cephalosporin is recommended, as a positive reaction to penicillin indicates type 1 hypersensitivity.

**Toxicity:**
Antibiotics can cause direct dose-dependent toxicity and should be avoided in patients at high risk of developing organ damage with a specific agent. For example, do not use aminoglycosides in patients with renal impairment or hearing loss.

d. Choose drug with adequate target tissue penetration

<table>
<thead>
<tr>
<th></th>
<th>CSF</th>
<th>Lung</th>
<th>Soft tissue</th>
<th>Urinary tract</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ampicillin</td>
<td>Good (in high doses)</td>
<td>Good</td>
<td>Good</td>
<td>Good</td>
</tr>
<tr>
<td>Cloxacillin</td>
<td>Inadequate data</td>
<td>Fair</td>
<td>Good</td>
<td>No data</td>
</tr>
<tr>
<td>Clindamycin</td>
<td>Poor</td>
<td>No data</td>
<td>Good</td>
<td>No data</td>
</tr>
<tr>
<td>Co-amoxiclav</td>
<td>Poor</td>
<td>Good</td>
<td>Good</td>
<td>Fair</td>
</tr>
<tr>
<td>Ceftriaxone</td>
<td>Good (in high doses)</td>
<td>Good</td>
<td>Good</td>
<td>Good</td>
</tr>
<tr>
<td>Aminoglycosides</td>
<td>Poor</td>
<td>Poor</td>
<td>Fair</td>
<td>Good (if normal GFR)</td>
</tr>
<tr>
<td>Ciprofloxacin</td>
<td>Good (in high doses)</td>
<td>Good</td>
<td>Good</td>
<td>Good</td>
</tr>
<tr>
<td>Co-trimoxazole</td>
<td>Good</td>
<td>Good</td>
<td>Good</td>
<td>Good</td>
</tr>
<tr>
<td>Ertapenem</td>
<td>Poor</td>
<td>Good</td>
<td>Good</td>
<td>Good</td>
</tr>
<tr>
<td>Meropenem</td>
<td>Good (in high doses)</td>
<td>Good</td>
<td>Good</td>
<td>Good</td>
</tr>
<tr>
<td>Imipenem</td>
<td>Good*</td>
<td>Good</td>
<td>Good</td>
<td>Good</td>
</tr>
<tr>
<td>Vancomycin</td>
<td>Poor</td>
<td>Fair</td>
<td>Poor</td>
<td>Good</td>
</tr>
<tr>
<td>Linezolid</td>
<td>Good</td>
<td>Good</td>
<td>Good</td>
<td>Good</td>
</tr>
<tr>
<td>Daptomycin</td>
<td>Poor</td>
<td>Good</td>
<td>Good</td>
<td>Good</td>
</tr>
</tbody>
</table>

*Associated with higher risk of seizures

e. Aim for a single drug with the desired spectrum of activity
Monotherapy is preferred unless combination therapy is required for synergy (e.g. endocarditis) or extended spectrum beyond what can be obtained with a single drug (e.g. atypical pathogens in severe CAP).
4. Ensure correct dose and route of administration
The oral/enteral route is preferred whenever possible for patients with mild to moderate infections. Intravenous antibiotics should be reserved for severe infection or for certain sites such as the CSF, bacteraemia, endocarditis, bone and joint infections.

<table>
<thead>
<tr>
<th>Oral absorption (%)</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Penicillin VK</td>
<td>Moderate</td>
</tr>
<tr>
<td>Amoxicillin</td>
<td>Good</td>
</tr>
<tr>
<td>Flucloxacillin</td>
<td>Good</td>
</tr>
<tr>
<td>Clindamycin</td>
<td>Good</td>
</tr>
<tr>
<td>Co-amoxiclav</td>
<td>Good</td>
</tr>
<tr>
<td>Ciprofloxacin</td>
<td>Good</td>
</tr>
<tr>
<td>Doxycycline</td>
<td>Excellent</td>
</tr>
<tr>
<td>Azithromycin</td>
<td>Good</td>
</tr>
<tr>
<td>Metronidazole</td>
<td>Excellent</td>
</tr>
<tr>
<td>Co-trimoxazole</td>
<td>Good</td>
</tr>
<tr>
<td>Linezolid</td>
<td>Excellent</td>
</tr>
</tbody>
</table>

5. Start the appropriate antibiotic rapidly in severe infections
Mortality increases by 8% for every hour antibiotic administration is delayed in septic shock.\(^1\)

6. Practice early and effective source control
Search for and remove any persistent foci of infection

7. Evaluate antibiotic appropriateness every day

---

Chapter 3
Interpreting test results

Non culture-based tests
Non culture-based tests such as urinary dipstick, peripheral white cell count (WCC), and C-reactive protein (CRP) confirm the presence of inflammation when positive but do not differentiate bacterial from non-bacterial causes. However, presence of nitrites on urine dipstick, high neutrophil count with left-shift and CRP >100 mg/ml all suggest bacterial infection. Negative results are generally good at excluding inflammation and therefore bacterial infection.

Procalcitonin (PCT) is more specific for bacterial infection than CRP or WCC but 10 times more expensive. There is high quality evidence for its use in a limited number of infections and its use should be limited to these indications. Specifically, low PCT safely excludes bacterial infection such that antibiotics can be withheld in meningitis, and acute exacerbations of chronic obstructive pulmonary disease (see later sections for details). PCT has no value in differentiating bacterial infection from tuberculosis and has very limited value in sepsis. Its price generally excludes its use in serial measurement to determine when to stop, although some evidence in ICU settings alone, exist.

Cultures

Does this positive culture represent infection, colonisation or contamination?

Infection = the presence of one or more microorganisms with an inflammatory response

Colonisation = the presence of microorganisms without significant inflammation.

Contamination = A culture that contains a microorganism(s) that did not originate from the intended anatomical site

Sterile sites
Normally sterile sites are CSF, lungs (below the glottis), urinary tract, biliary tract, and blood. Bacteria cultured from these sites are likely to be causing infection but still sometimes represent colonisation or contamination.

Finding bacteria in a sterile site is abnormal but may represent infection, or contamination. Organisms colonizing skin such as coagulase-negative staphylococci may cause contamination of sterile sites. Colonisation of urinary tract can occur without causing infection. If the organism corresponds with the clinical scenario then this should be considered to be causing infection
**Non-sterile sites**

Non-sterile specimens include sputum (as it must pass through the mouth), pus swabs from skin, GI tract and vagina. Specimens from these sites are **expected to culture bacteria** (unless growth is inhibited by laboratory techniques). Interpretation therefore depends on the organism(s) being compatible with the clinical scenario.

**Cultures from non-sterile sites are often much harder to interpret and usually of less value.**

---

**Colonization or Infection?**

- Positive culture
  - Non-sterile site
    - Organism normally present at this site
      - Definite inflammation at site
        - Infection likely
          - e.g. S. aureus from wound swab with clear cellulitis
    - Organism not normally present at this site
      - Doubtful inflammation at site
        - Colonization/contamination likely
          - e.g. S. aureus from wound swab with no cellulitis
  - Skin site
    - Organism fits clinical picture
      - Infection likely
        - e.g. Neisseria gonorrhoea from vaginal swab without discharge or abdominal pain
    - Organism doesn't fit clinical picture
      - Colonization/contamination likely
        - e.g. Enterooccus sp from urine in patient without urinary symptoms or systemic signs
Chapter 4
Correct techniques of microbiological sampling

Optimal sampling is very important to increase yields and decrease contamination rates (see boxes below). Surgical specimens from abnormal structures such as abscesses should usually be collected at the time of operation. Once surgical drains are placed they quickly become colonised with skin and environmental bacteria and culture results are not interpretable. Pus swabs collected outside of theatre are discouraged, as it is extremely rare for them to yield information that will change patient management.

Box 1. Correct technique for collecting mid-stream urine specimens

Instructions for collection of urine specimens
Females
• Wash your hands
• Clean the vulva front to back with sterile gauze and sterile water
• Spread labia with fingers
• Void and collect urine mid-flow

Males
• Wash your hands
• Retract foreskin and wash glans with sterile gauze and sterile water
• Void and collect urine mid-flow

Box 2. Correct technique for collecting urine specimens from a catheter

• Use aseptic technique with sterile gloves and apron
• Clamp tubing just distal to sampling port
• Wait for urine to collect above clamp
• Wipe sampling port with cleaning solution
• Remove urine with a small gauge sterile needle and syringe
• Transfer urine to sterile container
• Clean port again
• Unclamp tubing
Box 3. Correct technique for performing a pus swab

1. Wounds with slough, necrotic tissue, or dried exudate should first be debrided
2. Wash the wound with sterile saline
3. If the wound is dry moisten the tip of the swab with sterile saline
4. Move swab tip across the wound surface in a zig-zag motion at the same time as being rotated between the fingers
5. Apply gentle pressure to release fluid from the base of the wound
6. Aim to include as much of the area of the wound as possible but avoid intact skin around the wound
7. Document clinical information on laboratory request form
8. Transfer to laboratory as soon as possible

Box 4. Correct technique for performing a blood culture

1. Verify the patient’s identity and obtain verbal consent.
2. Assemble the correct materials required for blood culture:
   - blood culture bottle(s)
   - syringe (10 ml or more)
   - needle (22 gauge or more)
   - sterile gloves
   - tourniquet
   - adhesive strip
   - Cleaning solution*
   - sterile pack containing cotton/gauze swabs, sterile paper x2 and waste bag
   - patient labels
   - sharps waste disposal bin
3. Apply tourniquet and select a suitable vein
4. Wash hands and apply sterile gloves
5. Clean the puncture site with cleaning solution using aseptic technique and allow 30 seconds for the disinfectant to dry
6. Place green sterile cover with opening over site for blood culture
7. Collect 10ml of blood per bottle from adults
8. Release tourniquet and remove needle
9. If not using the vacutainer system, disinfect the top of the blood culture bottle before inoculating blood
10. Do not change needles between blood sample collection and inoculation of blood culture bottle
11. Always fill blood culture bottle before filling vials for other tests
12. Label the blood culture bottle making sure not to cover the bar code label or the bottom of the bottle
13. Complete a laboratory request form in full
14. If there is a delay in getting the sample to the laboratory, do not refrigerate the bottle; rather leave it at room temperature
15. Document in the notes, the date and time that the blood culture was taken

*Chlorhexidine-alcohol is recommended, but if using povidone iodine, it must be left to dry for at least 1 minute prior to performing culture
Chapter 5
Changing Antibiotics

Once antibiotics have been initiated the decision to change or stop therapy depends on the patient's clinical response and culture results (see algorithm).

Abx = Antibiotics, BSA = Broad spectrum antibiotics
Chapter 6
Infection prevention

The most important tools to prevent spread of infection are hand hygiene and contact precautions. Correct management of IV lines and urinary catheters are essential for reducing hospital-acquired infections.

Hand hygiene

WHEN:

HOW:

Use alcohol-based solutions for routine hand decontamination.

**Indications for soap and water:**
- Hands visibly dirty
- Hands contaminated with body fluids
- After using the restroom or eating
- Exposure *Clostridium difficile*

**Indications for gloves:**
- Patient interactions that involve exposure to blood, mucous membranes or non-intact skin
- Suspected or proven *C. difficile*

*Always wash hands after glove use*
Contact precautions

WARNING – STOP!
CONTACT PRECAUTIONS

ALL STAFF AND VISITORS
GLOVES AND APRON FOR ALL PATIENT CONTACT
DISINFECT/WASH YOUR HANDS BEFORE & AFTER
PATIENT CONTACT

These should be implemented for any patient infected by or colonised with a drug-resistant bacterial pathogen other than tuberculosis (which requires airborne precautions to prevent small droplet spread). Contact precautions involve the following:
1. Clear signage indicating that contact precautions are in place
2. Patient preferably placed in isolation
3. Hand disinfection prior to patient contact
4. Mandatory use of apron and gloves when entering the patient’s room, before any contact with the patient or their surroundings and during examination
5. Remove apron first, followed by gloves
6. Hand disinfection after disposal of apron and gloves (use soap and water for C. difficile exposure)
7. Contact precautions remain in place even after treatment with antibiotics and for every hospital or nursing care re-admission for a period of 6 months. For patients with C. difficile associated diarrhoea contact precautions can be withdrawn after completion of treatment and resolution of diarrhoea.
Management of peripheral IV lines

Correct indication
- Require IV antibiotics
- Require IV fluids or nutrition
- Require other IV therapy: contrast, heparin, insulin, etc

Insertion
- Hand hygiene
- Sterile technique: clean skin with antiseptic
- Use smallest needle possible
- Secure properly

Prevention of drip site sepsis
- Examine daily for signs of inflammation/sepsis
- Remove IV lines if any sign of drip site inflammation
- Always remove when drip ‘tissues’ and discard and replace giving set and fluid
Management of urinary catheters

Correct indication
- Acutely ill patient requiring monitoring of urine output
- Urinary retention (obstruction or neuropathy)
- Local wounds requiring intensive wound care

Insertion
- Hand hygiene
- Sterile technique
- Use smallest catheter possible
- Secure properly

Prevention of CA-UTI
- Collect fresh urine only from sampling port using a sterile needle and syringe after cleansing the port with disinfectant
- Empty collecting bag regularly
- Keep collecting bag below level of the bladder and suspend off the floor

Do not...
- Clean the meatal area with antiseptics after insertion
- Screen for asymptomatic bacteriuria
- Treat asymptomatic bacteriuria
- Use systemic antibiotics as prophylaxis
- Change catheters routinely
- Irrigate catheters routinely

Every time you see a patient you should be asking the questions:
1. Can I stop or de-escalate antibiotics?
2. Can I remove this urinary catheter?
3. Can I remove this IV line?
Chapter 7
Acute Upper Respiratory Tract Infection

Over-prescribing of antibiotics for upper respiratory tract infection (URTI) is a major driver of bacterial resistance in the community. URTI comprises three clinical syndromes depending on the site of infection; pharyngotonsillitis (sore throat), acute otitis media, and acute bacterial sinusitis.

**Acute pharyngotonsillitis (sore throat)**

![Typical appearance of viral pharyngitis](image1)

**Typical appearance of viral pharyngitis**

![Typical appearance of bacterial pharyngitis](image2)

**Typical appearance of bacterial pharyngitis**

**Definition**
- Acute inflammation of the pharyngeal wall and tonsils.
Likely pathogens
- Commonly respiratory viruses and Epstein-Barr virus. Around 5-30% caused by group A β-haemolytic streptococci (GABHS) (*S. pyogenes*).
- Viral and bacterial acute pharyngitis are self-limiting, including those caused by GABHS, hence, the primary reason for considering antibiotic therapy is to prevent Acute Rheumatic Fever (ARF)

Clinical features
- Sore throat
- It is possible to differentiate bacterial from viral causes on clinical grounds.

**Pharyngotonsilitis**

- **Bacterial**
  - Acute onset
  - Temperature >38°C
  - Tender anterior cervical lymph nodes
  - Age 3-15 years
  - Previous rheumatic fever or rheumatic heart disease
  - Pur or white patches on tonsils
  - PCT > 0.25 ng/ml

- **Viral**
  - Rhinorrhoea
  - Cough
  - Diarrhoea
  - Conjunctivitis
  - Age >45 years
  - PCT < 0.25 ng/ml

- **Penicillin VK 500 mg po 12-hourly for 10 days or Benzathine penicillin 1.2 mL im single dose**

Penicillin allergy
Azithromycin 500 mg po daily for 3 days

**Acute otitis media**

Definition
Acute inflammation of the middle ear
Likely pathogens
  • Haemophilus influenza, Streptococcus pneumoniae, Moraxella catarrhalis

Clinical features
  • Ear pain and decreased hearing
  • Reddened and bulging tympanic membrane, which may be draining pus.

Tests
  • None required

Treatments
  • Initially analgesics and decongestants only
  • Antibiotics if febrile or symptoms do not settle within 48 hrs

First line
  Amoxicillin 1g po 8-hourly for 5 days
Alternative in beta-lactam allergic patients
  Azithromycin 500 mg po daily for 3 days

Acute bacterial sinusitis
Definition- Acute bacterial infection of para-nasal sinuses

Likely pathogens- *Haemophilus influenzae, Streptococcus pneumoniae, Moraxella catarrhalis*

Clinical features
- Often preceded by a viral URTI
- Fever, facial tenderness, dental tenderness, nasal discharge, nasal congestion and anosmia.

Tests
- Usually none
- If failure of initial therapy a CT scan, fibre-optic endoscopy with aspiration and culture of pus may be necessary

Treatments
- Symptomatic treatment: paracetamol, decongestant, nasal steroids perform better than antibiotics
- Antibiotics should be prescribed if any of the following are present-
  - Symptoms lasting > 10 days
  - Fever >39°C
  - Purulent discharge
  - Facial pain
  - Biphasic illness with sinusitis following typical viral URTI

First line
- Amoxicillin 1g 8 hourly for 5 days po

Alternative for beta-lactam allergy
- Azithromycin 500 mg po daily for 3 days
Chapter 8
Lower Respiratory Tract Infection

Acute bronchitis
Definition
Self-limited inflammatory process involving large and mid-sized airways

Common aetiologies
- Respiratory viruses (>90%)
  - Influenza
  - Parainfluenza 3
  - Respiratory syncytial virus
  - Human metapneumovirus
- Non-viral (<10%)
  - Suspect if prolonged cough, longer incubation period, local outbreaks
    - *Mycoplasma pneumoniae*
    - *Chlamydia pneumoniae*
    - *Bordetella pertussis*
  - No association with *S. pneumoniae* or *H. influenzae* in patients without evidence of underlying lung disease

Tests
No investigations are required in the vast majority of cases:
- Gram stain not recommended
- Nasopharyngeal swab for influenza PCR not recommended for uncomplicated influenza-like illness

Diagnosis and management

<table>
<thead>
<tr>
<th>Acute cough (≤ 3 weeks’ duration)</th>
</tr>
</thead>
<tbody>
<tr>
<td>PLUS</td>
</tr>
<tr>
<td>Normal vital signs and no signs of pneumonia</td>
</tr>
<tr>
<td>PLUS</td>
</tr>
<tr>
<td>Not associated with pneumonia on chest X-ray</td>
</tr>
</tbody>
</table>

Antibiotics not indicated

*Chest X-rays are not necessarily indicated for all patients with acute bronchitis and should be performed only if likely to influence management*
Acute Exacerbation of COPD (AECOPD)

Definition
Acute increase in baseline dyspnoea, cough and/or sputum above the normal day-to-day variations, requiring a change in medication. Up to 80% of AECOPD have an infectious aetiology.

Common aetiologies
- Viral (up to 50%) – more common in winter months
  - Rhinoviruses
  - Parainfluenza
  - Coronavirus
  - Influenza (in non-vaccinated)
  - RSV
- Bacterial
  - *H. influenzae*
  - *S. pneumoniae*
  - *M. catarrhalis*
  - Enterobacteriaceae (frequent hospitalisation and antibiotic use)
- Atypical bacteria are not implicated in AECOPD

Tests

<table>
<thead>
<tr>
<th>Mild (Not requiring hospitalisation)</th>
<th>Moderate (Requiring hospitalisation)</th>
<th>Severe (Requiring high care/ICU)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sputum culture not routine</td>
<td>Sputum culture if frequent admissions or poor response to antibiotics</td>
<td>Sputum culture</td>
</tr>
<tr>
<td>CRP or PCT (if available)</td>
<td>CRP or PCT (if available)</td>
<td>Blood culture if pyrexial</td>
</tr>
<tr>
<td>o Withhold antibiotics if negative</td>
<td>o Withhold antibiotics if negative</td>
<td>Nasopharyngeal swab for influenza</td>
</tr>
<tr>
<td></td>
<td></td>
<td>PCR if in flu season</td>
</tr>
</tbody>
</table>
Diagnosis and management

**Are antibiotics indicated?**
- Episode of AECOPD (see definition)
- PLUS
- Increased sputum purulence and increased dyspnea or sputum volume
- OR
- Requiring mechanical ventilation or admission to ICU

<table>
<thead>
<tr>
<th>Yes</th>
<th>No → Withhold antibiotics</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Mild**
- Comorbidities
  - AECOPD > 3/year
  - Antibiotics in past 3 months

<table>
<thead>
<tr>
<th>No</th>
<th>Yes</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- Outpatient oral antibiotics
- Amoxicillin 500 mg po 8-hourly
- Co-amoxiclav 1 g po 12-hourly
- Ceftriaxone 1 g iv daily
  OR
  Co-amoxiclav 1 g po 12-hourly

**Moderate**
- Requiring admission to general ward
- May require initial IV antibiotics

**Severe**
- Requiring admission to high care or ICU
- Initial IV antibiotics
- Ceftriaxone 1 g iv daily
  OR
  Co-amoxiclav 1.2 g iv 8-hourly

COMPLETE A TOTAL OF 5 DAYS ANTIBIOTICS

**Prevention**
- Annual influenza vaccine recommended for all patients with COPD
- Pneumococcal polysaccharide (PPSV23) vaccine is recommended for all individuals over 65 years of age and anyone with COPD
- Antiviral chemoprophylaxis is not recommended

**Pneumonia**
Definition
Pneumonia is acute infection of lung parenchyma distal to the terminal bronchiole and causes consolidation.

Common aetiologies of community acquired or health care associated pneumonia

<table>
<thead>
<tr>
<th>Agent</th>
<th>Comments</th>
<th>CAP</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>S. pneumoniae</em></td>
<td>Most common cause</td>
<td></td>
</tr>
<tr>
<td><em>H. influenzae</em></td>
<td>More common in COPD</td>
<td></td>
</tr>
<tr>
<td>Tuberculosis</td>
<td>More common in HIV</td>
<td></td>
</tr>
<tr>
<td>‘Atypical organisms’</td>
<td>Not cultured</td>
<td></td>
</tr>
<tr>
<td>−  <em>M. pneumoniae</em></td>
<td>No specific clinical/</td>
<td></td>
</tr>
<tr>
<td>Chlamydophilia</td>
<td>radiological features</td>
<td></td>
</tr>
<tr>
<td>−  Legionella spp.</td>
<td>Suspect if risk factors or non-response to beta-lactams</td>
<td></td>
</tr>
<tr>
<td>Oral anaerobes</td>
<td>Risk factors: alcoholism, aspiration, lung abscess</td>
<td></td>
</tr>
<tr>
<td><em>P. jirovecii</em></td>
<td>HIV, bilateral infiltrates, desaturation on minimal exertion, poor response to beta-lactams</td>
<td></td>
</tr>
<tr>
<td>Respiratory viruses</td>
<td>Seasonal Risk factors: pregnancy, elderly, co-morbidities</td>
<td></td>
</tr>
</tbody>
</table>

Tests

<table>
<thead>
<tr>
<th>CAP</th>
<th>HCAP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Only perform if likely to influence empiric management decisions</td>
<td>Always send specimens prior to initiation of empiric antibiotics</td>
</tr>
<tr>
<td>Mild (CRB-65 score ≤ 2)</td>
<td>In all cases</td>
</tr>
<tr>
<td>• Sputum culture and Xpert MTB/Rif if failed outpatient Abx therapy</td>
<td>• Blood culture</td>
</tr>
<tr>
<td>Severe (CRB-65 ≥ 3) or co-morbidities*</td>
<td>• Sputum Gram stain and culture</td>
</tr>
<tr>
<td>• Sputum Gram stain and culture</td>
<td>• Sputum for <em>P. jirovecii</em> DFAT if HIV +ve</td>
</tr>
<tr>
<td>• Blood culture</td>
<td>• Urine Legionella antigen testing</td>
</tr>
<tr>
<td>• Sputum for <em>P. jirovecii</em> DFAT if HIV +ve</td>
<td>• NP swab for influenza PCR if flu season</td>
</tr>
</tbody>
</table>

NP = Nasopharyngeal, DFAT = direct fluorescent antibody test
* Chronic cardio-pulmonary disease, alcoholics, immune suppression (excluding HIV), CKD, cirrhosis

Diagnosis and management
Special circumstances

1. No response to initial therapy after 48 hours
   - All patients
   - Send sputum GeneXpert MTB/rif
   - Exclude empyema or lung abscess
   - Add clarithromycin 500 mg 12-hourly (or azithromycin 500 mg daily)
   - Send additional blood and sputum cultures
   - Consider empiric therapy for pneumocystis pneumonia if:
     - Desaturation on minimal exertion
     - Bilateral ground-glass infiltrates

2. Health care associated pneumonia
   - Send blood and sputum cultures prior to initiating broad spectrum antibiotics
   - Consult microbiologist or infectious diseases specialist about choice of appropriate empiric antibiotic

3. Penicillin allergy
   - Moxifloxacin 400 mg po/iv daily or levofloxacin 500mg po 12-hourly (750mg iv 12-hourly in severe pneumonia)
Chapter 9
Intra-abdominal infection

Definitions and causes
Infections in the abdomen can be divided into the following main groups:
1. Infections of the biliary system, including cholecystitis and cholangitis
2. Infections of the bowel, including appendicitis and diverticulitis
3. Intra-abdominal collections or abscesses
4. Peritonitis, including bowel perforations and spontaneous bacterial peritonitis (SBP) related to liver disease

Common aetiologies
Empiric antibiotic therapy for community-acquired intra-abdominal infections should cover all of the following organisms:
• Enteric gram-negative bacilli: *E. coli, K. pneumoniae*
• Anaerobic organisms
• Enteric streptococci

Other possible causes in health care-associated infections or severely ill patients include:
• Enterococci
• Candida
• MRSA

Tests
Most cases will require abdominal imaging (either ultrasound or CT), unless there is a clear indication for urgent laparotomy.
• Blood culture is recommended for patients with sepsis syndrome and suspected intra-abdominal infection.
• Culture of infected material is generally not helpful but is recommended in the following situations:
  o HCAI
  o SBP
  o Infections with incomplete source control (e.g. inability to clear liver abscess)
  o Re-do laparotomies

Diagnosis and management
1. Spontaneous bacterial peritonitis
   
   **Diagnosis:**
   • Ascitic fluid aspirate with WCC > 250 cells/mm³
   • Positive ascitic fluid culture (low sensitivity; high specificity if sample taken properly)

   **Management:**
• Ceftriaxone 1 g IV daily for 5 days
• Add ampicillin 1 g QID in the following situations only:
  – Cholestatic liver disease
  – Fulminant liver failure (encephalopathy with coma)
  – Not responding to ceftriaxone after 48 hours

2. Most other intra-abdominal infections

Alternative antibiotic regimens
• Co-amoxiclav unavailable:
  o Ampicillin 1 g iv 6 hourly PLUS gentamicin 6 mg/kg/day PLUS metronidazole 500 mg iv 8-HOURLY
  OR
  o Ceftriaxone 1 g daily PLUS metronidazole 500 mg 8-hourly
• Severe Penicillin allergy:
  o Ciprofloxacin 400 mg iv 8-hourly PLUS metronidazole 500 mg iv 8-hourly
Chapter 10
Acute diarrhoea

Definition
Diarrhoea for < 2 weeks duration

Likely pathogens-
• Viruses (norovirus, rotavirus, adenoviruses, astrovirus),
• Bacteria (Salmonella, Campylobacter, Shigella, Enterotoxigenic E. coli, C. difficile) and bacterial toxins
• Protozoa (Cryptosporidium, Giardia, Cyclospora, Entamoeba)

Clinical features
• Stool taking the shape of its container > 3 times per day
• Blood in stool
• Fever

History
• Food exposure
• Illness among close contacts
• Recent travel
• HIV status
• Recent antibiotics

Tests (see algorithm)
The vast majority of episodes of diarrhoea DO NOT require antibiotics. Mild cases are usually self-limiting and require symptomatic treatment only. Moderate to severe cases require investigation +/- hospitalisation.

Diagnosis and management
### Treatments

- **Empiric:**
  - Ciprofloxacin 500 mg po 12-hourly for 3 days pending results of culture and sensitivity
  - If bloody diarrhoea add empiric metronidazole 500 mg iv 8-hourly (or 400 mg po 8-hourly) for 5 days

- **Definitive:**
  - Based on culture results

- **Clostridium difficile** toxin or molecular test positive:
  - See algorithm
  - Resolution of symptoms generally occurs within 5-7 days, but it is not unusual for symptoms to persist for the first 3-5 days
  - 25% of patients with *C. difficile* will relapse
Management of *C. difficile* diarrhoea

1. **Clostridium difficile diarrhoea**

2. Stop all precipitating antibiotics whenever possible

3. Signs of moderate/severe disease
   - WCC >15
   - Deteriorating renal function
   - Clinical signs of colitis

4. **No**
   - Metronidazole 400mg po 8-hourly 10 days
   - Improvement after 5-7 days?
     - **Yes**
       - Complete 10 day course
     - **No**
   - **Complete 10 day course**

5. **Yes**
   - Vancomycin 125mg po 8-hourly 10 days
   - Improvement after 5-7 days?
     - **Yes**
       - Complete 10 day course
     - **No**
     - **ADD intravenous metronidazole 500mg iv 8-hourly and consult surgery**
Chapter 11
Urinary tract infections

Uncomplicated UTI

Definition
‘Uncomplicated’ refers to either a lower urinary tract infection or upper urinary tract infection (pyelonephritis) in non-pregnant women with structurally and neurologically normal genitourinary tracts. Acute uncomplicated cystitis is defined as:

- Symptomatic bladder infection characterised by a clinical syndrome of frequency, urgency, dysuria or suprapubic pain

Common aetiologies

<table>
<thead>
<tr>
<th>Pathogens</th>
<th>Common contaminants of urine cultures</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Enterobacteriaceae</td>
<td>• Candida species</td>
</tr>
<tr>
<td>- <em>E. coli</em> (most common)</td>
<td>• <em>Enterococcus</em> spp.</td>
</tr>
<tr>
<td>- <em>K. pneumoniae</em></td>
<td>• <em>Gardnerella vaginalis</em></td>
</tr>
<tr>
<td>- <em>Enterobacter</em> spp.</td>
<td>• <em>Mycoplasma hominis</em></td>
</tr>
<tr>
<td>• Coagulase negative staphylococci</td>
<td>• <em>Ureaplasma urealyticum</em></td>
</tr>
<tr>
<td>- <em>S. saprophyticus</em></td>
<td></td>
</tr>
<tr>
<td>• Group B streptococcus</td>
<td></td>
</tr>
<tr>
<td>• <em>Enterococcus</em> spp.</td>
<td></td>
</tr>
</tbody>
</table>

Tests
- Urine culture only for:
  - Reinfecion, persistent or recurrent cystitis
  - Symptoms with negative dipstick
- Do not perform follow-up cultures if symptoms have resolved
- Do not perform screening cultures in asymptomatic diabetics, elderly or patients with indwelling urinary catheters

Diagnosis and management
The diagnosis of urinary tract infection requires the presence of compatible symptoms plus bacteriuria (bacteria in the urine) or indirect evidence of infection, such as:
- Urine dipstick leucocyte esterase or nitrite positive
- Urine microscopy showing > 1+ leucocytes

Asymptomatic bacteriuria (a positive urine culture from patients without symptoms referable to the urinary tract) should not be treated, except in pregnant women and prior to invasive urological procedures.
Pyelonephritis

Symptoms:
Frequency, urgency, dysuria or supra-pubic pain
PLUS
Evidence of infection
Dipstick +ve for nitrite & leukocyte esterase OR >1+ leukocytes on urine microscopy

Ciprofloxacin 500 mg po 12-hourly for 3 days

Start empiric antibiotics

Severely ill or unable to tolerate oral

No
Outpatient
Ciprofloxacin 500 mg po 12-hourly

Yes
Inpatient
Ceftriaxone 1 g iv daily OR gentamycin 6 mg/kg/day iv
Switch to oral after clinical response & defervescence
De-escalate to narrower spectrum antibiotics
7 days for ciprofloxacin
14 days for cotrimoxazole or beta lactam
Complicated UTI

Definitions
A symptomatic urinary tract infection in:
- Individuals with functional or structural abnormalities of the genitourinary tract
- Men
- Pregnant women
- Patients with indwelling urinary catheters

Common infectious aetiologies
Caused by the same pathogens as uncomplicated UTIs. Infections in patients with indwelling urinary catheters more likely to be caused by drug resistant organisms.

Tests
Perform urine cultures in all of the above patient groups presenting with symptoms of UTI. In catheterised patients urine specimens should be obtained after catheter removal from a freshly placed catheter or voided midstream sample.
If fever/symptoms persist > 48 hours:
- Perform blood culture (in case of resistant bacteria)
- Image the urinary tract and abdomen to exclude collections
Catheter-associated UTI

Signs/symptoms compatible with UTI or sepsis syndrome
PLUS
Dipstick positive for nitrite and leucocytes
OR
> 1+ leucocytes on urine microscopy
PLUS
No other source identified

Yes
No

Stable, cystitis, absent systemic signs of infection

Do not treat or replace catheter

No

Initial IV antibiotics

Replace or remove catheter
Blood culture
Consult local resistance patterns for choice of empiric antibiotic

De-escalate to narrower spectrum antibiotics once organism and sensitivities available

7 days if cystitis and rapid response (3 days for women < 65 years)
14 days if delayed response or pyelonephritis

Yes
No

Start appropriate oral antibiotic
No antibiotics

Replace or remove catheter
Send urine culture

Culture ≥ 10^4 organisms

NB: non-specific signs of CA-UTI include fever or rigors, altered mental state and unexplained lethargy
UTI in men

<table>
<thead>
<tr>
<th>Signs/症状s compatible with UTI PLUS</th>
<th>( \geq 10^5 \text{ cfu/ml} ) of urinary pathogen on urine culture</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>Antibiotics as per uncomplicated UTI algorithms</td>
</tr>
<tr>
<td>No</td>
<td>Do not treat for UTI. Search for other causes. See STI guidelines</td>
</tr>
</tbody>
</table>

Deescalate to narrower spectrum antibiotics once organism and sensitivities available.
- 7 days if cystitis and rapid response
- 14 days if delayed response or pyelonephritis

Investigate for urinary tract abnormalities

UTI in pregnancy

i. Asymptomatic bacteriuria

Pregnant women with asymptomatic bacteriuria are at increased risk of developing pyelonephritis. Therefore all pregnant women should be screened for bacteriuria.

Diagnosis:
- Any culture showing \( \geq 10^3 \text{ cfu/ml} \) of a single organism (or any \( E. \text{ coli} \)) in an asymptomatic pregnant woman

Management:
- Appropriate oral antibiotic for 5 days (see below)
- Perform follow-up urine culture to confirm sterility

ii. Cystitis and pyelonephritis

Diagnosis:
- As per uncomplicated UTI guidelines
• Always send urine culture

Management:

Ciprofloxacin is contraindicated in pregnancy. Therefore the following empiric antibiotics should be used, with de-escalation to narrower spectrum antibiotics once organism and sensitivities available:

• Cystitis or mild pyelonephritis:
  – Coamoxiclav 1 g po 12-hourly before the 3rd trimester. Cefuroxime 250 mg po 8-hourly is preferred in the 3rd trimester due to decreased risk of necrotizing enterocolitis
  – Duration 5 days for cystitis, 14 days for pyelonephritis

• Severe pyelonephritis
  – Treat as per uncomplicated UTI guidelines
Chapter 12
Sexually transmitted infections

Vaginal discharge

Definitions
Vaginal and occasionally cervical infection characterised by discharge, itching or odour.

Common aetiologies
- Bacterial vaginosis (BV): replacement of normal flora by polymicrobial overgrowth
- Trichomoniasis: T. vaginalis
- Candidiasis: Candida albicans
- Cervicitis: C. trachomatis and N. gonorrhoeae

Tests
No tests are necessary to confirm specific causes at the initial presentation. For recurrent or persistent symptoms, attempt to confirm diagnosis by office tests:
- Bacterial vaginosis
  - Clue cells on microscopy
  - pH of vaginal fluid > 4.5
  - Whiff test: fishy odour after addition of KOH to vaginal fluid
- Trichomoniasis
  - Wet prep slide to visualise motile organisms (sensitivity 70%)
- Candidiasis
  - Wet prep slide with KOH demonstrating yeasts and pseudohyphae
Diagnosis and management

Abnormal vaginal discharge confirmed with speculum exam
  No signs of pelvic inflammatory disease

Offer HIV test
  Abstain from sex until after therapy and symptom resolution
  Refer sex partner for empiric treatment of chlamydia and trichomoniasis

Sexually active in past 3 months

Ceftriaxone 250 mg im single dose
  PLUS
  Azithromycin 1 g po single dose
  PLUS
  Metronidazole 2 g po single dose
  PLUS
  Clotrimazole vaginal pessary 500 mg single dose (if evidence of candida)

Persistent symptoms

No

Yes

Metronidazole 2 g po single dose
  PLUS
  Clotrimazole pessary vaginal single dose (if evidence of candida)

Penicillin allergy (severe)
  Omit ceftriaxone and increase azithromycin: 2 g po single dose
Urethritis

Definition
Urethral inflammation from infectious and non-infectious causes

Common aetiologies
• Gonococcal urethritis (*N. gonorrhoeae*)
• Non-gonococcal urethritis (NGU)
  – Chlamydia (*C. trachomatis*)
• Non-chlamydial NGU: usually no pathogen found

Tests
Usually requires no special investigations.

Diagnosis and management
Genital ulcer syndrome (GUS)

Definition
New genital, anal or perianal lesion after recent sexual activity.

Common aetiologies
Sexually transmitted
- HSV and syphilis most common
- H. ducreyi (chancroid)
- C. trachomatis (LGV)

Non-sexually transmitted
- Infectious: folliculitis, candida, tuberculosis
- Non-infectious: trauma, malignancy, eczema, psoriasis, contact dermatitis (latex allergy), aphthous ulcers

**Diagnosis**
It is not possible to distinguish the causes on clinical grounds alone. Do not diagnose a venereal cause of GUS if no sexual activity in the past 3 months (except for reactivated HSV).

<table>
<thead>
<tr>
<th>Recurrent</th>
<th>Herpes simplex reactivation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Painless</td>
<td>Primary syphilis</td>
</tr>
<tr>
<td></td>
<td>Lymphogranuloma venerum (LGV)</td>
</tr>
<tr>
<td>Painful</td>
<td>Herpes simplex (HSV)</td>
</tr>
<tr>
<td></td>
<td>Chancroid</td>
</tr>
<tr>
<td>Lymphadenopathy</td>
<td>Syphilis</td>
</tr>
<tr>
<td></td>
<td>HSV</td>
</tr>
<tr>
<td></td>
<td>LGV (massive, often unilateral)</td>
</tr>
<tr>
<td></td>
<td>Chancroid</td>
</tr>
</tbody>
</table>

**Tests**
Usually requires no investigations.

**Management**

```
Genital ulcer

Offer HIV test
Abstain from sex until after therapy and symptom resolution

Sexually active in past 3 months?

Yes
Syndromic therapy

Benzathine penicillin 2.4 mU im single dose
PLUS
Aciclovir 400 mg po 8-hourly for 7 days

No
Persistent symptoms

No
No follow up

Yes
Azithromycin 1 g po single dose (refer if not improved in 48 hours)

Aciclovir 400 mg po 8-hourly for 7 days
```
Chapter 13
Acute meningitis

Definition

- Acute inflammation of the meninges of <7 days duration.

Likely pathogens

- Common – Various bacteria, viruses. TB meningitis can present acutely. Rare - fungi, protozoa and helminths
- Common bacterial pathogens are *Streptococcus pneumoniae*, *Neisseria meningitidis*, *Haemophilus influenzae* and *Listeria monocytogenes* (in immunocompromised and elderly patients).

Clinical features

- Any 2 of the 4 cardinal features; headache, fever > 37.5°C, neck stiffness and altered mental status
- Supporting features are photophobia, blanching or purpuric rash and vomiting

Tests

- See algorithm for lumbar puncture and CT brain

Contraindications for lumbar puncture before CT brain

<table>
<thead>
<tr>
<th>Reduced level of consciousness (GCS &lt;10), papilloedema, presence of a V-P shunt, Unexplained seizure or unexplained new focal neurological deficit such as hemiparesis or dysphasia, but NOT cranial nerve palsy</th>
<th>No</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Blood culture AND antibiotics</th>
<th>Non-neurological contraindications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Severe cardiorespiratory compromise*</td>
<td>OR clinical evidence of abnormal bleeding*</td>
</tr>
<tr>
<td>OR clinical evidence of abnormal bleeding*</td>
<td>OR sepsis over the LP site</td>
</tr>
<tr>
<td>OR sepsis over the LP site</td>
<td>Blood culture Antibiotics</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Contraindication to LP on the CT scan?</th>
<th>Blood culture Antibiotics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Continue antibiotics CT brain ASAP</td>
<td>LP if contraindication resolves</td>
</tr>
</tbody>
</table>

| LP | Continue antibiotics |

\* Shocked or unable to be positioned for procedure

* Unexplained bleeding from mucous membranes or multiple vasculitic lesions
Management
General principles:

• Patients with suspected bacterial meningitis should receive ceftriaxone 2 g iv immediately. The dose for continued treatment is 2 g iv 12-hourly
• Penicillin allergy is not a contra-indication to use of ceftriaxone, unless the allergy was life threatening
• Blood culture and lumbar puncture should be performed before administration of antibiotics ONLY if this does not cause significant delay
• If bacterial meningitis is strongly suspected on the basis of clinical and CSF findings and all cultures are negative give ceftriaxone for 10 days
• Steroids are not recommended

Specific therapy:

• S pneumoniae: duration 10 days
  – If MIC unknown or > 0.1 microg/ml: ceftriaxone 2 g iv 12-hourly
  – If MIC < 0.1 microg/ml: penicillin G 4 mU ivi 4-hourly or ampicillin 2 g iv 4-hourly
• N meningitidis: duration 7 days
  – Ceftriaxone 2 g iv 12-hourly
• L monocytogenes: duration 21 days
  – Ampicillin 2 g iv 4-hourly
• Gram-negative infection: duration 21 days
  – Community-acquired: cefepime 2 g iv 8-hourly or ceftazidime 2 g iv 8-hourly
  – Health care associated: meropenem 2 g iv 8-hourly
Algorithm following first dose of antibiotics

LP performed

LP contraindicated

Continue antibiotics & LP when safe

CSF Gram stain +ve

Continue Antibiotics Directed Rx based on culture & sensitivity

CSF Gram stain -ve

CSF cell count, protein, glucose NORMAL AND PCT < 0.5 (CRP < 20) OR CLAT positive

No

CSF OR blood culture +ve with meningeal pathogen

Yes

No

Stop antibiotics
Seek alternative diagnosis
Refer to specific guidelines if CLAT +ve

Normalisation of symptoms and signs after 48-72 hours

Repeat LP

Improved

Continue antibiotics for recommended treatment duration

Not Improved

Stop Antibiotics. Send large volume CSF for mycobacterial culture/PCR and consider anti-TB therapy and non-infectious cause

Opening pressure, protein, total WCC and % neutrophils reduced. % lymphocytes & CSF/serum glucose increased
Chapter 14
Peripheral line sepsis

Peripheral line-related infections increase morbidity, mortality, antibiotic usage and length of stay. PREVENTION BY EARLY REMOVAL OF LINES IS THE KEY INTERVENTION. By definition these are healthcare associated infections (HCAI) with a high risk of resistant pathogens.

Likely pathogens
*Staphylococcus aureus* (MSSA/MRSA), Coagulase negative staphylococci, *Streptococcus spp.*

Diagnosis and management

```
Peripheral line infection
  Remove line
    Small area of erythema
      No treatment
    Large area of erythema, patients systemically well
      No response
        Clindamycin 450 mg po 8-hourly for 5 days
          No response
            Send blood culture
              Start vancomycin (see chapter 15 for dosing)
                No response
                  Exclude or drain collections
                  Ensure adequate vancomycin trough levels (15 - 20 mg/ml)
                  Repeat blood cultures
```
Chapter 15

*Staphylococcus aureus* bacteraemia

*Staphylococcus aureus* (*S. aureus*) bloodstream infection carries a high mortality rate. It is commonly introduced by vascular line infections or other health-care associated interventions, but can result from invasive *S. aureus* at any site. *S. aureus* bacteraemia can disseminate to any organ including heart valves, bone and lungs, and therefore requires prolonged intravenous therapy with higher doses of appropriate antibiotics.

**Definitions and dosing**

**Methicillin sensitive *S. aureus* (MSSA)**

- Sensitive to anti-staphylococcal beta-lactam antibiotics
- Cloxacillin is the treatment of choice:
  - Initial dose 2 g 6 hourly IV
  - Use 3 g 6 hourly for endocarditis, prosthetic heart valves or other endovascular material, meningitis and osteomyelitis

**Methicillin resistant *S. aureus* (MRSA)**

- Resistant to beta-lactam antibiotics
- Vancomycin is the treatment of choice:
  - Loading dose 25 – 30 mg/kg slow infusion
  - Thereafter 15-20 mg/kg BD (will require lower doses and/or less frequent intervals in renal impairment)
  - Measure trough levels before the 4\textsuperscript{th} dose and aim for a target of 15 – 20 mg/L
Management

Clinical features of complicated *S. aureus* bacteraemia include persistent fever, bone pain, new murmur or peripheral manifestations of endocarditis or focal neurological signs. Patients with these problems require directed investigations for source control and should be discussed with an infectious diseases specialist.
Chapter 16
Skin and soft tissue infections

Cellulitis

Definition
Acute infection involving skin and subcutaneous tissue
• Commonly precipitated by minor trauma or underlying skin lesion

Diagnosis (Image: http://treatmentofcellulitis.net)
Clinical only:
• Redness, tenderness, local heat, non-raised edges

Differentiate from:

<table>
<thead>
<tr>
<th>Infections</th>
<th>Non-infectious</th>
</tr>
</thead>
<tbody>
<tr>
<td>Erysipelas</td>
<td>DVT</td>
</tr>
<tr>
<td>Necrotising fasciitis</td>
<td>Insect bites</td>
</tr>
<tr>
<td>Gas gangrene</td>
<td>Fixed drug reaction</td>
</tr>
</tbody>
</table>

Common aetiologies
• *Streptococci* (usually *S. pyogenes*)
• *S. aureus*

Tests
None recommended
• Blood cultures are rarely positive and not generally helpful unless extensive or severe infection.
• Superficial pus swabs are not helpful and should NOT be performed
Cutaneous abscess

Definition
Deep inflammatory nodule extending into subcutaneous tissue that develops from preceding folliculitis

Common aetiologies
*S. aureus*

Tests
None

Management
All cases require surgical drainage.

*Uncomplicated cases*
- No antibiotics required

*Complicated cases* (surrounding cellulitis, located on face, systemic symptoms)
- Flucloxacillin 500 mg po 6-hourly for 5 days or co-amoxiclav 1g po 12-hourly
- In penicillin allergy use clindamycin 450 mg po 8 hourly
Diabetic foot

Definition
Chronic foot infections in diabetics
- Mild: limited to skin/superficial subcutaneous tissue < 2 cm beyond ulcer margin
- Moderate: cellulitis > 2 cm, deep fascial involvement, gangrene, abscess, osteomyelitis
- Severe: systemic complications

Common aetiologies
- Mild infections or previously untreated
  - *S. aureus*
  - *Streptococci*
- Chronic lesions or previously treated
  - Above plus
  - Enterobacteriaceae
- Chronic, refractory or prolonged broad spectrum antibiotics
  - Above plus
  - *Pseudomonas*
  - Anaerobes
  - *Enterococci*

Tests
None required in mild or previously untreated infections. Tissue cultures are recommended in all other scenarios. It is essential to clean and debride the lesion before obtaining specimens for culture. Blood cultures should be performed in severe infections.
Penicillin allergy:
- **Mild/moderate infections:**
  Clindamycin 450 mg po 8-hourly (add ciprofloxacin 500mg po 12-hourly if requires admission)
- **Severe infections:**
  Clindamycin 600 mg iv 8-hourly PLUS ciprofloxacin 400 mg iv 8-hourly

**Wound management**
Optimal wound care is essential. Surgical consultation is recommended for the following problems:
- Deep abscess
- Bone or joint involvement
- Crepitus
- Gangrene
- Necrotising fasciitis
- Severe vascular insufficiency
Necrotising fasciitis

Acute severe infection involving subcutaneous soft tissues including the fascial layers. Usually precipitated by trauma, surgery, peri-rectal abscess, bedsores or bowel perforation.

Common aetiologies
Usually polymicrobial infections:
• *Streptococci*
• Enterobacteriaceae
• Anaerobes

Tests
Blood cultures and surgical tissue specimens.

Diagnosis and management
Necrotising fasciitis is commonly associated with systemic toxicity manifested by fever, leukocytosis and possibly organ dysfunction. It rapidly progresses to cutaneous gangrene. Management involves the following:
1. Early and aggressive surgical debridement
2. Co-amoxiclav 1.2 g IV continued until clinical resolution

Alternative antibiotic regimens
• If co-amoxiclav unavailable: ampicillin 1 g 6-hourly PLUS metronidazole 500 mg 8-hourly PLUS gentamicin 6 mg/kg/day, all iv
• For refractory infections and in penicillin allergy: clindamycin 600 mg 8-hourly PLUS ciprofloxacin 400 mg 8-hourly, both iv
Chapter 17
Bone and joint infections

SEPTIC ARTHRITIS

Definition
Bacterial joint infection, usually due to haematogenous spread.

Common aetiologies
- Non-gonococcal
  - *S aureus* most common
  - *Streptococcus* spp. (*S pyogenes, S pneumoniae, S agalactiae*)
  - Gram-negative organisms (elderly, immunocompromised, comorbidities)
- *N gonorrhoeae*

Tests
In all cases:
- Joint aspirate BEFORE ANTIBIOTICS
  - Cell count plus differential: high neutrophil count in most cases
  - Gram stain and culture
  - Microscopy for crystals
- Plain X-ray

Diagnosis and management

Clinical features of septic arthritis
- Acute-onset painful swollen joint(s) with decreased range of movement

Purulent joint aspirate

Withhold antibiotics
Await microscopy and culture results

Elevated neutrophil count and/or positive Gram stain

Cloxacillin 2 g iv 5-hourly
(or ceftriaxone 1 g iv daily for gram -ve cocci)
PLUS
Early surgical drainage

- Deescalate to appropriate narrow spectrum antibiotic if susceptibilities available
- Negative Gram stain: at least 2 weeks of IV therapy
- Confirmed *S aureus* or Gram-negative: 4 weeks of IV therapy
- *N gonorrhoeae*: 10 days of therapy

No antibiotics
Investigate other cause
OSTEOMYELITIS

Definition
Bacterial infection of bone due to contiguous spread from soft tissues, haematogenous seeding, or direct inoculation.

Common aetiologies
• Common
  – *Staphylococcus aureus*
  – Coagulase-negative staphylococci
• Occasional
  – Streptococci
  – Enterococci
  – Gram-negative bacilli
• Other
  – *Mycobacterium tuberculosis*
  – Fungal infections

Tests
• Always send specimens for culture
  – Deep tissue specimen: open surgical procedure or guided needle aspiration
  – Blood culture
• Imaging
  – Plain X-ray in all cases
  – May require other modalities such as bone scan, CT or MRI
• CRP may be useful to monitor response to therapy

Diagnosis and management
Notes:
- May need to continue IV therapy for 6 weeks or longer
- Do not add rifampicin in cases without foreign material
- Consider tuberculosis if culture-negative or no clinical improvement
- Vancomycin is used for health care-associated osteomyelitis or confirmed MRSA (loading dose 23 – 30 mg/kg followed by 15 – 20 mg/kg 12-hourly; maintain trough levels 15 – 20 mg/mL)
- See Chapter 18 for management of open fractures
- Infections associated with prosthetic material should be discussed with an expert
Chapter 18
Prophylaxis

Surgery
Surgical prophylaxis aims to prevent infection following a predictable exposure to bacteria. Antibiotics are only required during exposure and a single dose taken pre-operatively is usually sufficient. A repeat dose should only be given if surgery is prolonged or there is massive blood loss. Choice of antibiotic depends on which bacteria are likely to be introduced by the operation, usually normal colonisers of skin or bowel. Examples are given below but refer to local policies for guidance.

<table>
<thead>
<tr>
<th>Type of surgery</th>
<th>Prophylaxis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cardiothoracic</td>
<td>Cefazolin 2g iv</td>
</tr>
<tr>
<td>Upper GI</td>
<td></td>
</tr>
<tr>
<td>Neurosurgery</td>
<td></td>
</tr>
<tr>
<td>Orthopaedic (elective non-trauma)</td>
<td></td>
</tr>
<tr>
<td>Lower limb amputation</td>
<td>Cefazolin 2g iv</td>
</tr>
<tr>
<td>Colorectal</td>
<td>Plus Metronidazole 500mg iv</td>
</tr>
<tr>
<td>Biliary</td>
<td></td>
</tr>
<tr>
<td>Pelvic</td>
<td></td>
</tr>
<tr>
<td>ENT</td>
<td></td>
</tr>
<tr>
<td>Ophthalmic</td>
<td>Chloramphenicol 0.5% drops</td>
</tr>
<tr>
<td>ERCP with obstruction</td>
<td>Ciprofloxacin 500mg po 2h prior to the procedure or cefuroxime 1.5g iv or PIP/TZ 4.5g iv, both 1h prior to the procedure</td>
</tr>
<tr>
<td>Surgery for the implantation of any permanent prosthetic material</td>
<td>Cefazolin 2g iv or cefuroxime 1.5g iv or vancomycin 1g iv as single dose</td>
</tr>
<tr>
<td>Penetrating abdominal trauma or open fracture</td>
<td>Cefazolin 2g iv + metronidazole 500mg iv and second dose if procedure &gt; 3h</td>
</tr>
</tbody>
</table>

Head injuries
Closed head injuries with non-penetrating wounds do not require antibiotic prophylaxis even if there is a CSF leak. Compound depressed skull fractures and penetrating spinal cord injuries do require prophylaxis/pre-emptive treatment e.g. ceftriaxone plus metronidazole for 5 days.

Open long bone fractures
If early (< 5 hours) washout and debridement, provide prophylaxis with cefazolin 1g iv 12-hourly for 48 hours only. If long delay to washout or significant contamination, treat with coamoxiclav 1.2 g ivi 12-hourly for 5 days.

Infective endocarditis
The evidence base is weak and guidelines are largely based on expert opinion, which differs between countries and region. In general only those at the highest risk of
infective endocarditis should be offered prophylaxis and then only when the risk of bacteraemia from the procedure is high.

Conditions requiring prophylaxis
• Significant congenital or acquired cardiac abnormalities
• Prosthetic valves or valvular repair utilising prosthetic material
• Previous infective endocarditis

Procedures requiring prophylaxis
• Dental procedures involving manipulations if the gingival or perapical region of the teeth or perforating the oral mucosa.

Examples of regimens are given in the table.

<table>
<thead>
<tr>
<th>Procedure</th>
<th>Regimen</th>
<th>Alternative</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dental, oral or upper respiratory tract</td>
<td>Amoxicillin 3g po</td>
<td>Clindamycin 600mg iv</td>
</tr>
<tr>
<td>Genitourinary, gastrointestinal or biliary</td>
<td>Ampicillin 2g iv Plus gentamicin 1.5mg/kg</td>
<td>Vancomycin 1g iv Plus gentamicin 1.5mg/kg</td>
</tr>
</tbody>
</table>

Rheumatic fever
• Secondary prophylaxis should be prescribed for all patients following rheumatic fever to prevent recurrences

Duration
• Without carditis 5 years after last attack or 21 years (whichever is longer)
• With mild carditis 10 years after last attack or 21 years (whichever is longer)
• With carditis and residual heart disease 10 years or until age 40 (whichever is longer). Sometimes life-long prophylaxis.

Regimen
• Benzathine penicillin 1.2MU IM every 3-4 weeks or penicillin V 250mg po 12-hourly. If penicillin allergic azithromycin 250mg daily.