# Guidelines for Antimicrobial Prescribing

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<tr>
<th>CATEGORY:</th>
<th>Guideline</th>
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<td>CLASSIFICATION:</td>
<td>Clinical</td>
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<td>PURPOSE</td>
<td>To advise Clinicians on appropriate antimicrobial drug prescribing</td>
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<td>Chair, Antimicrobial Stewardship and Sepsis Group (ASSG) reporting to Medicines Management Advisory Group (MMAG)</td>
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**Distribution:**
- **Essential Reading for:** Clinicians, all non medical Prescribers, Pharmacists
- **Information for:** Wards Managers, Senior Nurses, ADNs, Divisional Directors
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   - "High Risk of Infection" lung transplantation prophylaxis

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- **Biliary endoscopic procedure prophylaxis:**
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• **Biliary endoscopic procedure prophylaxis:**
  o Ongoing cholangitis or sepsis elsewhere
  o Biliary obstruction and/or common bile duct stones and/or straightforward stent change
  o ERCP when complete biliary drainage unlikely to be achieved
  o Communicating pancreatic cyst or pseudocyst
  o Biliary complications following liver transplant
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**Part A. General Information**

1. **Introduction**
   - These guidelines have been produced in collaboration with the Microbiology Department, the University Hospital Birmingham’s Antimicrobial Stewardship and Sepsis Group (ASSG), Medicine Management Advisory Group (MMAG) and relevant clinicians.
   - They are designed to help in the management of infections in adult in-patients and may not be suitable for use in the community. There are separate antimicrobial prescribing guidelines developed by the CCG for use by General Practitioners and in the community.
   - The antimicrobial guidelines should not be expected to cover all circumstances, patient groups and specialist topics. Specialist cases should be discussed with the medical Microbiologists and/or Virologists and discussions should be documented in the patients’ medical notes.
   - Prescribers are advised to check for possible interactions with other drugs in the British National Formulary (BNF) which complement these guidelines (See help tab on PICS for quick link to the BNF).
   - Prescribers are advised to check patient specific factors such as renal function, hepatic function, age and weight when prescribing medication and adjust dosing accordingly - please refer to the relevant section and discuss with ward/antimicrobial Pharmacist, Microbiologist or Virologist if required.
   - These guidelines take into account national and international guidelines as well as the local the local epidemiology of infection and antimicrobial resistance.

2. **Useful telephone numbers**

<table>
<thead>
<tr>
<th>Microbiology, Pharmacy and Infection control team</th>
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<tbody>
<tr>
<td><strong>Consultant Medical Microbiologists &amp; Medical Virologists</strong></td>
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<tr>
<td>Dr I Das – Consultant Microbiologist</td>
</tr>
<tr>
<td>Dr M David – Consultant Microbiologist, Antimicrobial Stewardship Lead</td>
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<tr>
<td>Dr MJ Gill – Consultant Microbiologist</td>
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<tr>
<td>Dr E Holden – Consultant Microbiologist</td>
</tr>
<tr>
<td>Dr S Jog – Consultant Microbiologist</td>
</tr>
<tr>
<td>Dr DE Mortiboy – Consultant Microbiologist</td>
</tr>
<tr>
<td>Dr H Osman – Consultant Virologist</td>
</tr>
<tr>
<td>Dr E Smit – Consultant Virologist</td>
</tr>
<tr>
<td>Dr N Wickramasinghe – Consultant Microbiologist</td>
</tr>
<tr>
<td><strong>Microbiology Registrars</strong></td>
</tr>
<tr>
<td><strong>Call Ext 16516 or 16515 to get advice for the relevant clinical specialty (0900 – 1700h)</strong></td>
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<table>
<thead>
<tr>
<th>Microbiology OUT-OF-HOURS service</th>
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<tr>
<td>(Mon-Thurs 1700-0900h and Fri 1700 till Mon 0900h)</td>
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<tr>
<td>- Microbiology Medical Staff out of hours, for urgent clinical advice: Contact via UHB switchboard</td>
</tr>
<tr>
<td>- Microbiology Biomedical Scientists out of hours, for urgent processing of laboratory specimens: Via UHB switchboard</td>
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<table>
<thead>
<tr>
<th>Antimicrobial Pharmacy team</th>
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<tbody>
<tr>
<td>Mr Martin Biggs – Principal Antimicrobial Pharmacist</td>
</tr>
<tr>
<td>BB: 07876 398720, Bleep: 2554</td>
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<tr>
<td>Monday – Friday 0830 – 1630h</td>
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<tr>
<td>Ext. 13785</td>
</tr>
<tr>
<td>For advice out of hours please contact oncall microbiologist</td>
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<tr>
<td>Contact via UHB switchboard</td>
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3. Protocol for telephone calls to microbiology for antimicrobial treatment or diagnosis advice

Background and indications for standard operating procedure/protocol

Microbiology offers a telephone advice service 24 hours a day, 7 days a week. This is necessary because clinical guidelines cannot cover all situations, particularly early on in a patient’s journey when a diagnosis is unclear or in complex patients with multiple potential foci of infection or when patients fail primary course of antimicrobial therapy.

This protocol is necessary because clinicians frequently call microbiology for advice without all the information that is necessary to make an informed decision. Patient safety may be put at risk and much time is wasted when inadequate information is provided.

The SBAR system should be followed during consultations with microbiology:

- **S** – Situation
- **B** – Background
- **A** – Assessment
- **R** - Recommendation

This protocol should be followed whenever telephone calls are made to microbiology for advice on the diagnosis or treatment of infection or if restricted antimicrobial medication is required.

A call to microbiology for advice is just like any other clinical referral. Safe and appropriate advice cannot be given without appropriate information.

If the information below cannot be provided you will most likely be asked to find it, this protocol will therefore save time in the long run.

Procedure method (step by step)

1. **SITUATION.** Be clear why you are calling and explain the purpose of the call
2. **BACKGROUND.** Be able to provide details of the medical history including:
   - i. presenting complaint and date of admission
   - ii. past medical history
   - iii. other prescribed medication (e.g. immunosuppressants)
   - iv. significant events since admission (e.g. surgical interventions, ICU admissions)
   - v. antimicrobials prescribed during this admission and recently at home (with start and stop dates)
   - vi. antimicrobial allergies. The nature of the reaction and what antibiotics have been previously tolerated (this information can be obtained from the patient, carer, prescription chart and GP)
3. **ASSESSMENT**
   - i. Have current observation, prescription details, notes and (for patients with diarrhoea) Bristol stool chart to hand
   - ii. Recent inflammatory markers/bloods
iii. Recent microbiology results and advice (if calling out-of-hours)
iv. State what you require from the call

4. RESPONSE. Discuss and agree a course of action
5. REPEAT the key actions to the microbiologist
6. RECORD. Immediately after the call, document in the patient's notes: date and time of call, name and grade of microbiologist, advice received (including dose and duration of recommended antimicrobial, if specified)

Associated Documents

For more information on related policies to the Trust’s antimicrobial stewardship and to infection prevention and control management, the following controlled documents are available on the Trust intranet:

- Infection Prevention and Control Policy (last accessed 05/10/2017)
- Procedures for the control of meticillin-resistant Staphylococcus aureus (MRSA). (last accessed 05/10/2017)
- Procedure for outbreaks of infectious disease. (last accessed 05/10/2017)
- Fever in the returning traveller. (last accessed 05/10/2017)

4. General considerations

- Specimen collection
  - Specimens for microbiological diagnosis should be ideally collected before starting antimicrobials.
  - Blood cultures must be taken according to the Trust’s procedure (Procedural Guide for Blood Culture Collection (last accessed 25 November 2017))

- Empirical therapy
  - These guidelines are based on the most likely causative organisms in each clinical situation, but previous antibiotic therapy should always be taken into account.
  - Treatment should be modified to narrow spectrum therapy as soon as culture results are available, provided these results identify a plausible cause of the infection.

- Previously known resistant organisms
  - Check PICS for Bee Aware logo. This may indicate that the patient has a previously known resistant organism. Hover over logo for infection details.
  - If patients are known to be colonised or infected (either currently or previously) with resistant organisms such as MRSA or Extended Spectrum Beta-Lactamase (ESBL)-producing Gram-negative organisms, therapy should be adjusted to cover these organisms if they are likely to play a role in the presenting infection.
    - For example:
      - Flucloxacillin would not be a rational choice for the empiric treatment of cellulitis in an MRSA positive patient.
      - Treatment of intra-abdominal sepsis in someone who has had a previous infection with an ESBL positive *E. coli* or *Klebsiella* species, should include another agent known to be active against these organisms.

5. Principles of good antimicrobial prescribing

- The use of antibiotics has the potential for adverse consequences. These include:
  - Adverse drug-related effects
  - Alteration of normal flora and super-infection with organisms (such as *Candida* spp., *Clostridium difficile* and multi-drug resistant organisms) MRSA, ESBLs and CPEs
Unnecessary costs

Antimicrobials should be prescribed according to *Start smart - then focus*

**START SMART – this means:**

- Antimicrobial therapy should not be started unless there is clear evidence of infection
- Take a thorough drug allergy history including the nature of any allergies that are recorded. Record this in the medical notes
- Initiate prompt effective antibiotic treatment as soon as possible (and within one hour of diagnosis (or as soon as possible) in patients with severe sepsis or life-threatening infections)
- Follow the trust antimicrobial guidelines when prescribing antimicrobial therapy. Remember restricted antibiotics have limited indications. For situations not dealt with by this guidance or whenever the prescriber is uncertain, expert advice should be sought.
- Document clinical indication (and disease severity if appropriate), in clinical notes
- Include review / stop date or duration
- Obtain cultures prior to commencing antimicrobial therapy where possible (but do not delay therapy)

**THEN FOCUS – this means:**

- All antimicrobial therapy should be reviewed at 48-72 hours and oral alternatives for intravenous agents should be considered.
- The need for antibiotic therapy should be reviewed on a daily basis. For most infections, 5-7 days should be sufficient. The duration should be kept to a minimum to prevent the emergence of resistant strains, to reduce the emergence of super-infection and the risk of toxicity.
- Switch to oral antibiotics should be based on clinical indicators such as:
  - Normothermia for at least 24 hours (i.e. temperature below 37.5°C)
  - Reducing inflammatory markers e.g. WCC, CRP
  - Clinical improvement
  - Ability to take (and absorb) oral medications

**Key prescribing points prior to starting therapy**

1. Check patient’s previous history
• Check Allergy status including the nature of hypersensitivity. This must be clearly documented in the medical notes and on PICS.
• Patient’s previous infection and antimicrobial history must be checked prior to starting any antimicrobial therapy. Antimicrobial therapy must be prescribed according to local guidelines and informed by local antimicrobial sensitivity patterns.

2. Check for factors that will affect drug choice:
• Route of administration - For severe or life-threatening infections, immediate treatment with intravenous broad-spectrum antimicrobial agents can be lifesaving. Intravenous therapy must only be prescribed for those patients with severe infections and/or who are unable to take oral antimicrobials. Intravenous therapy must be changed to oral as soon as possible when clinically appropriate.
• Interactions – See British national formulary (BNF) link under help tab on PICS for detailed information on each medicine. Contact your ward Pharmacist for further advice.
• Renal function – dosage adjustments may be necessary in renal impairment. Contact your ward Pharmacist or Microbiologist for further advice.
• Age – tetracyclines and quinolones are contra-indicated in children. Dosing in children is based on body weight and/or body surface area. Contact ward Pharmacist for further advice.
• Pregnancy & breastfeeding – Some medicines are contra-indicated in pregnancy and breastfeeding. Contact your ward Pharmacist for further advice.
• Previous Microbiology cultures – review current antibiotic choice once available.

3. Check the appropriate dose is prescribed. This will depend on the following factors:
• Severity of illness
• Host defence systems (Immunocompromised)
• Age (Elderly and children)
• Weight
• Renal/hepatic function

4. Prescribe correct duration of therapy
• When prescribing antimicrobials on PICS ensure you review the duration before authorising the prescription. The default during on PICS may not always be appropriate and should be adjusted accordingly.
• Most intravenous antibiotics are only required for up to 72 hours and thereafter the antibiotic regimen may be converted to an oral agent if appropriate (see IV to oral switch guidelines). Most cultures and sensitivities results should be available within 72 hrs and these should be reviewed along with the patient’s treatment.
• Antimicrobial prophylaxis for surgery should be limited to a single dose for the majority of surgical procedures, according to guidelines.
• The prescription duration should be reviewed daily to ensure the prescription doesn’t ‘run out’ on PICs inadvertently, particularly at weekends.

5. Take specimens prior to starting therapy
• Appropriate specimens for microscopy, culture and sensitivity testing (MC&S) must be taken before starting antimicrobial treatment.
• Examples of this include blood, urine, sputum, wound swabs and drain fluid.
• However, treatment should not be delayed for patients who are severely ill.

6. Review antimicrobials
• Antimicrobial drugs must be regularly reviewed at least daily and at every Consultant ward round.
• Antimicrobial drug prescriptions must be regularly checked.
• Many prescriptions will have a limited duration assigned in PICS – these must be reviewed to see if they need to continue or stop.
• Broad-spectrum antimicrobials must be restricted to the treatment of serious infections when the pathogen is not known or when other effective agents are unavailable. Empirical antimicrobial prescriptions must be reviewed and changed to pathogen directed therapy when relevant microbiology results are available.
• Microbiology results must be reviewed regularly and antimicrobial therapy rationalised accordingly. Contact microbiology for further advice.

7. Support and advice
• Expert advice should be sought from a Medical Microbiologist for complicated infections, interpretation of culture and sensitivity results if there significance is unclear, or in the case of failure of empirical treatment.
• The principal antimicrobial pharmacist can be contacted for advice and help for advice on treatment, dosing and administration (bleep: 2554).

6. Intravenous (IV) to Oral switch guide

Oral antimicrobial agents are generally less expensive than their intravenous counterparts, and less complex, intrusive and risky to administer; an appropriate early switch to oral medication may result in:

• Reduction in the likelihood of hospital acquired bacteraemia and phlebitis / infected intravenous lines.
• Potential reduction in the risk of adverse effects; errors in preparation are significantly higher with parenteral drugs compared to oral formulations.
• Patient is more likely to receive antibiotics at the correct time.
• Reduces discomfort for patients and enables improved mobility and the possibility of earlier hospital discharge.
• Saves both medical and nursing time.
• Potential to significantly reduce treatment cost.

Most patients admitted to hospital with an infection do not require intravenous antibiotics. Those that do receive them will normally only need them for the first 48 hours. There are a few exceptions and these are given below.

Considerations for IV to oral switch - ABCD

• A – Afebrile > 24hours?
  o Haemodynamically stable (Patients temperature 36 - 38°C for 48hours )with no signs of fever)
• B – Able to take oral medication?
  o Have a functional GI tract with no malabsorption and there is no interactions with other medications
  o Suitable enteral antimicrobial drug available
  o Patient can swallow and tolerate oral fluids via a tube into the gut
  o Patient has no signs of malabsorption
• C – Clinically improving?
  o Improving signs and symptoms of infection and patients general condition getting better
  o Patients clinical markers improving after treatment with parental antimicrobial drugs:
    ▪ no unexplained tachycardia (heart rate less than 90 beats/minute in the past 12 hours)
    ▪ blood pressure stable (in the past 24 hours)
    ▪ respiratory rate less than 20 breaths/minute (in the past 24 hours)
    ▪ white cell count 4–12 x 10⁹/L OR a high white cell count that is falling (White cell count should show a trend towards normal; absence of such should not impede the switch if all other criteria are met and not neutropenic.
    ▪ falling C-reactive protein (CRP)
• D – Not suffering from certain deep-seated/high-risk infections? (see list below)
  o High tissue antimicrobial drug concentrations are not essential for infection being treated (i.e. it is not high-risk or deep-seated infection)

List of deep seated / high risk infections where IV duration may need to continue for longer:
• Liver abscess
• Osteomyelitis, Septic arthritis
• Inadequately drained abscesses or empyema
• Cavitating pneumonia
• *Staphylococcus aureus* bacteraemia
• Severe necrotising soft tissue infections
• Severe infections during chemotherapy related neutropenia
• Infected implants/prosthesis
• Meningitis/encephalitis
• Intracranial abscesses
• Mediastinitis
• Endocarditis
• Exacerbation of cystic fibrosis/bronchiectasis

**Empirical IV to oral switch**

<table>
<thead>
<tr>
<th>Intravenous (IV)</th>
<th>Oral</th>
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<tbody>
<tr>
<td>Amoxicillin 500mg to 1g tds</td>
<td>500mg to 1g tds</td>
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<tr>
<td>Benzylpenicillin</td>
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<tr>
<td>1.2g to 2.4g qds</td>
<td>Amoxicillin 1g tds</td>
</tr>
<tr>
<td>Ciprofloxacin 400mg bd</td>
<td>Ciprofloxacin 500mg bd (but can increase oral dose up to 750mg BD for <em>Pseudomonas sp</em> or for patients on some enteral feeds)</td>
</tr>
<tr>
<td>Clarithromycin 500mg bd</td>
<td>Clarithromycin 500mg bd</td>
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<tr>
<td>Clindamycin 300mg to 600mg qds</td>
<td>Clindamycin 300mg qds (maximum of 600mg qds in obesity BMI&gt;30 )</td>
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<tr>
<td>Co-amoxiclav 1.2g tds</td>
<td>Co-amoxiclav 625mg tds</td>
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<tr>
<td>Flucloxacillin 1g - 2g qds</td>
<td>Flucloxacillin 1g qds (Max oral dose = 1g qds)</td>
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<tr>
<td>Gentamicin 5mg/kg OD (mono therapy)</td>
<td>Seek microbiology advice</td>
</tr>
<tr>
<td>Linezolid 600mg bd</td>
<td>Linezolid 600mg bd</td>
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<tr>
<td>Metronidazole 500mg tds</td>
<td>Metronidazole 400mg tds</td>
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<tr>
<td>Moxifloxacin 400mg od</td>
<td>Moxifloxacin 400mg od</td>
</tr>
<tr>
<td>Piperacillin/tazobactam</td>
<td>See individual guidelines for IV to oral switch advice</td>
</tr>
<tr>
<td>Meropenem</td>
<td></td>
</tr>
<tr>
<td>Daptomycin</td>
<td></td>
</tr>
<tr>
<td>Teicoplanin</td>
<td></td>
</tr>
<tr>
<td>Vancomycin</td>
<td></td>
</tr>
</tbody>
</table>

6. Avoiding use of broad spectrum antibiotics including cephalosporins and quinolones

• *Clostridium difficile* has been associated with serious complications, such as gastrointestinal haemorrhage and bowel perforation and up to 15% of patients infected with *Clostridium difficile* die as a direct or indirect result (Miller et al 2002).
• Each case results in disruption within the hospital, a stay prolonged by an average of 3.6 days (Kyne et al 2002) and is estimated to cost in the region of £4,000 (Wilcox et al 1996).
• The main risk factor for acquisition of infection with *Clostridium difficile* is prior use of antibiotics, particularly those with a broad spectrum of activity (de Lalla et al 1989; al-Eidan et al 2000; Schwaber et al 2000). Cephalosporins, such as cefuroxime have a great
tendency to precipitate Clostridium difficile-associated diarrhoea as do quinolones (Yip et al 2001).

- Many studies have shown that outbreaks of Clostridium difficile can be controlled and stopped by the introduction of infection control procedures and narrow spectrum antibiotic policies (Khan & Cheesbrough 2003; McNulty et al 1997).

7. Allergies - Penicillin, cephalosporin and carbapenems

Penicillin allergy

- Immediate hypersensitivity reactions to penicillins and cephalosporins are rare (the incidence of anaphylaxis due to penicillin is 1:10,000) but life threatening. It is therefore important that patients who are hypersensitive are identified.
- About 10% of the general population claim to have a penicillin allergy; this has often been because of a skin rash that occurred during a course of penicillin in childhood. Fewer than 10% of people who think they are allergic to penicillin are truly allergic. Therefore, penicillin allergy can potentially be excluded in 9% of the population.
- This is important because studies have shown that people with a label of penicillin allergy are more likely to be treated with broad-spectrum, non-penicillin antibiotics, such as quinolones, vancomycin and third-generation cephalosporins. Excess use of these antibiotics in people with an unsubstantiated label of penicillin allergy is associated with antibiotic resistance and, in some cases, sub-optimal therapy and prolonged length of stay.
- A drug allergy history, specifically seeking evidence of immediate reactions (see table 1) should be taken and clearly documented in the patient's notes and PICS. The following should be documented:
  - the generic and proprietary name of the drug or drugs suspected to have caused the reaction, including the strength and formulation a description of the reaction (see table 1)
  - the indication for the drug being taken (if there is no clinical diagnosis, describe the illness)
  - the date and time of the reaction
  - the number of doses taken or number of days on the drug before onset of the reaction
  - the route of administration

Cross reactivity between penicillin and cephalosporin allergy

- True cross allergy between penicillins and cephalosporins is well recognised although the exact rate of cross reaction is not clear. Older published data suggest that up to 10% of penicillin allergic patients are hypersensitive to cephalosporins. However, the attributable risk from newer data is closer to 0.5% (Pegler & Healy BMJ 2007; 335: 991).
- If there is a history of immediate reaction to penicillin, generally cephalosporins should be avoided.
- In life threatening infections, when use of a non cephalosporin antibiotic would be suboptimal, a third or fourth generation cephalosporin should be considered.
- If a cephalosporin is to be used senior clinician review should be in place, the patient should be informed of the low but real risk and this documented in the patient notes.
- Careful monitoring of the patient is required for the 1 hour during / after administration.

Cross reactivity between penicillin and carbapenems allergy

- If a carbapenem is to be used senior clinician review should be in place, the patient should be informed of the low but real risk and this documented in the patient notes.
- Careful monitoring of the patient is required for the 1 hour during / after administration.

**Table 1: Allergy classification**

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Timing of onset</th>
<th>Clinical signs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Immediate, rapidly evolving reactions</td>
<td>Onset usually less than 1 hour after drug Exposure</td>
<td>Anaphylaxis; Wheezing / bronchospasm; Hypotension; Angioedema; Urticaria / pruritus; Diffuse erythema</td>
</tr>
<tr>
<td>Non-immediate reactions without systemic involvement</td>
<td>Onset usually 6–10 days after first drug exposure or within 3 days of second exposure</td>
<td>Widespread red macules or papules (exanthema-like); Fixed drug eruption (localised inflamed skin)</td>
</tr>
<tr>
<td>Non-immediate reactions with systemic involvement</td>
<td>Onset usually 2–6 weeks after first drug exposure or within 3 days of second exposure</td>
<td>Drug reaction with eosinophilia and systemic symptoms (DRESS) or drug hypersensitivity syndrome (DHS) characterised by: widespread red macules, papules or erythroderma, fever, lymphadenopathy, liver dysfunction; eosinophilia</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Toxic epidermal necrolysis or Stevens–Johnson syndrome characterised by: Painful rash and fever (often early signs) mucosal or cutaneous erosions, vesicles, blistering or epidermal detachment; red purpuric macules or erythema multiforme</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Acute generalised exanthematous pustulosis (AGEP) characterised by: widespread pustules fever neutrophilia</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Common disorders caused, rarely, by drug allergy: Eczema, hepatitis, nephritis, photosensitivity, vasculitis</td>
</tr>
</tbody>
</table>

**Onward referral of patients with drug allergy**
Refer people to a specialist drug allergy service if they have had:
- A suspected anaphylactic reaction
- A severe non-immediate cutaneous reaction (for example, drug reaction with eosinophilia and systemic symptoms [DRESS], Stevens–Johnson Syndrome, toxic epidermal necrolysis).
- Need treatment for a disease or condition that can only be treated by a beta-lactam antibiotic or are likely to need beta-lactam antibiotics frequently in the future (for example people with recurrent bacterial infections or immune deficiency).
## Antimicrobial use in patients with a history of immediate reactions to penicillin

<table>
<thead>
<tr>
<th>Antimicrobials that should not be used in patients with immediate reactions to penicillin</th>
<th>Drugs that can be used with caution in patients who are labelled as penicillin allergic but have NO history of anaphylaxis</th>
<th>Drugs that are considered safe to use in patients with a penicillin allergy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amoxicillin</td>
<td>Cefotaxime*</td>
<td>Amikacin</td>
</tr>
<tr>
<td>Cefalexin</td>
<td>Ceftazidime*</td>
<td>Azithromycin</td>
</tr>
<tr>
<td>Cefuroxime</td>
<td>Ceftriaxone*</td>
<td>Aztreonam</td>
</tr>
<tr>
<td>Co-amoxiclav / Augmentin</td>
<td>Ertapenem*</td>
<td>Chloramphenicol</td>
</tr>
<tr>
<td>Benzathine/ Penicillin</td>
<td>Imipenem*</td>
<td>Ciprofloxacin</td>
</tr>
<tr>
<td>Gprocaine</td>
<td>Meropenem*</td>
<td>Clarithromycin</td>
</tr>
<tr>
<td>Benzylpenicillin</td>
<td></td>
<td>Clindamycin</td>
</tr>
<tr>
<td>Flucloxacillin</td>
<td></td>
<td>Colistin</td>
</tr>
<tr>
<td>Penicillin V</td>
<td></td>
<td>Co-trimoxazole</td>
</tr>
<tr>
<td>(penoxymethylpenicillin)</td>
<td></td>
<td>Daptomycin</td>
</tr>
<tr>
<td>Piperacillin/tazobactam</td>
<td></td>
<td>Pipemocillin/tazobactam</td>
</tr>
<tr>
<td>Pivmecillinam</td>
<td></td>
<td>Doxycycline</td>
</tr>
<tr>
<td>Ticarcillin/clavulanic acid</td>
<td></td>
<td>Erythromycin</td>
</tr>
</tbody>
</table>

* appropriate management and senior clinician review should be in place when prescribing and administering these agents in patients who have a history of penicillin allergy.

Ref. NICE guidelines CG183. Drug allergy: diagnosis and management. September 2014
8. Protected Antimicrobials

Inappropriate use of antimicrobial agents result in higher rates of infection due to resistant organisms, higher rates of *C. difficile* associated diarrhoea and unnecessary costs. Antimicrobial use at UHB is therefore restricted by use of the following categorisation scheme:

<table>
<thead>
<tr>
<th>Unrestricted</th>
<th>Available for specific indications</th>
<th>Restricted</th>
</tr>
</thead>
<tbody>
<tr>
<td>These drugs are frequently used for common infections, and are relatively narrow spectrum. All prescribers may use the following agents:</td>
<td>These drugs may only be prescribed for the indications listed in these guidelines and/or may need Consultant or Registrar authorisation (The authorisation restriction is implemented in PICS).</td>
<td>These drugs are not generally available. If they are required, a Registrar or Consultant must discuss the proposed use with a Medical Microbiologist or Medical Virologist, or specified clinical specialty (in brackets), who will have to approve the specific indication before it can be supplied and administered.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Antimicrobials</th>
<th>Antimicrobials</th>
<th>Antimicrobials</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amoxicillin</td>
<td>Aciclovir</td>
<td>Albenazol</td>
</tr>
<tr>
<td>Benzylpenicillin</td>
<td>Ciprofloxacin</td>
<td>Amikacin</td>
</tr>
<tr>
<td>Clarithromycin</td>
<td>Cefalexin</td>
<td>Azithromycin</td>
</tr>
<tr>
<td>Co-amoxiclav</td>
<td>Cefotaxime</td>
<td>Aztreonam</td>
</tr>
<tr>
<td>Doxycycline</td>
<td>Ceftazidime</td>
<td>Benzathine penicillin</td>
</tr>
<tr>
<td>Erythromycin</td>
<td>Ceftixione</td>
<td>Cefaclor</td>
</tr>
<tr>
<td>Flucloxacillin</td>
<td>Cefuroxime</td>
<td>Cefadroxil</td>
</tr>
<tr>
<td>Gentamicin</td>
<td>Clindamycin</td>
<td>Cefixime</td>
</tr>
<tr>
<td>Metronidazole</td>
<td>Co-trimoxazole</td>
<td>Cefradine</td>
</tr>
<tr>
<td>Nitrofurantoin</td>
<td>Fluconazole</td>
<td>Chloramphenicol IV/PO</td>
</tr>
<tr>
<td>Nystatin</td>
<td>Levofloxacin</td>
<td>Colistin IV</td>
</tr>
<tr>
<td>Penicillin V</td>
<td>Moxifloxacin</td>
<td>Daptomycin</td>
</tr>
<tr>
<td>(phenoxymethylpenicillin)</td>
<td>Meropenem</td>
<td>Dapson</td>
</tr>
<tr>
<td>Trimethoprim</td>
<td>Oseltamivir</td>
<td>Ertapenem</td>
</tr>
<tr>
<td>Vancomycin</td>
<td>Piperacillin/tazobactam</td>
<td>Fosfomycin (IV / Oral)</td>
</tr>
<tr>
<td></td>
<td>Rifampicin</td>
<td>Imipenem</td>
</tr>
<tr>
<td></td>
<td>Sodium Fusidate / Fusidic acid</td>
<td>Linezolid</td>
</tr>
<tr>
<td></td>
<td>Teicoplanin</td>
<td>Norfloxacin</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Ofloxacin</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Pivmecillinam</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Sulfadiazine</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Temocillin</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Ticarcillin/clavulanic acid</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Tigecycline</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Tobramycin (IV / Neb)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Ceftolozane/tazobactam</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Ceftazidime/avibactam</td>
</tr>
</tbody>
</table>

**Antiretroviral Drugs (Transplant teams)**

<table>
<thead>
<tr>
<th>Antiretroviral Drugs</th>
<th>Antiretroviral Drugs</th>
<th>Antiretroviral Drugs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Foscarnet</td>
<td>Ganciclovir</td>
<td>Artesunate</td>
</tr>
<tr>
<td>Ganciclovir</td>
<td>Valaciclovir</td>
<td>Chloroquine</td>
</tr>
<tr>
<td>Valganclovir</td>
<td>Zanamivir (IV / Inahler)</td>
<td>Primaquine</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Riamet</td>
</tr>
</tbody>
</table>

**Antimalarials (Infectious Diseases via HEFT switchboard)**

<table>
<thead>
<tr>
<th>Antimalarial Drugs</th>
<th>Antimalarial Drugs</th>
<th>Antimalarial Drugs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Artesunate</td>
<td>Chloroquine</td>
<td>Primaquine</td>
</tr>
<tr>
<td></td>
<td>Riamet</td>
<td>(Artemether/Lumefantrine)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Quinine</td>
</tr>
</tbody>
</table>
Part B. Treatment Guidelines

1. Gastro-intestinal System

ANTIBIOTIC PROPHYLAXIS IN ACUTE LIVER FAILURE

Practice points:
- Acute liver failure (ALF) refers to the development of severe acute liver injury with encephalopathy and impaired synthetic function (INR of ≥1.5) in a patient without cirrhosis or preexisting liver disease. While the time course that differentiates acute liver failure from chronic liver failure varies between reports, a commonly used cutoff is an illness duration of <26 weeks. (Lee et al. AASLD Position Paper: The Management of Acute Liver Failure: Update 2011).
- Organisms: Aerobic Gram negative bacteria and fungi.

First line:

Co-amoxiclav
Dose (orally) – 625mg tds for 5 days
Dose (intravenously for patients with swallowing difficulties) – 1.2g tds (three times a day) for 5 days

PLUS
Fluconazole
Dose oral): 100mg – od (once a day) for 5 days
Dose (intravenous in patients with swallowing difficulties): 100mg – od (once a day). Review to oral when can swallow.

Second line (penicillin allergic):

Ciprofloxacin
Dose (oral): 500mg – bd (twice a day) for 5 days
Dose (intravenous in patients with swallowing difficulties): 400mg – bd (twice daily). Review to oral when can swallow.

PLUS
Metronidazole
Dose: 400mg - oral – tds (three times a day) for 5 days
Dose (intravenous in patients with swallowing difficulties): 500mg – tds (three times a day). Review to oral when can swallow.

PLUS
Fluconazole
Dose: 100mg - oral – od (once a day) for 5 days
Dose (intravenous in patients with swallowing difficulties): 100mg – od (once a day). Review to oral when can swallow.

Comment:
- Patients with ALF are prone to infection from Gram negative and Gram positive bacteria and fungi.
- However, the role of prophylactic antimicrobial drugs has never been proven to reduce mortality risk. Prophylactic antimicrobial therapy is an area of contention reduces the incidence of infection in certain groups of patients with acute liver failure, but no actual survival benefit has been shown (Lee et al. AASLD Position Paper: The Management of Acute Liver Failure: Update 2011, Dharel et al 2014, Karvellas et al. 2014).
GASTROENTERITIS

Practice points:
• Antibiotics are not usually indicated for diarrhoea unless systemically unwell
• Any patient with diarrhoea should be isolated in side room
• Viruses are the most common infectious cause of diarrhoea
• ‘Food poisoning’ is a Statutory Notifiable disease on clinical suspicion (i.e., even before laboratory confirmation)
• Oral rehydration is the treatment of choice (Clinical Evidence 9, BMJ Publishing, 2003)
• The harms of antimicrobial treatment in gastroenteritis outweigh the benefits in the absence of systemic disease. Antimicrobial therapy has been associated with prolonged presence of bacterial pathogens and the development of resistant strains

A) Organisms: Campylobacter spp.

<table>
<thead>
<tr>
<th>Antibiotics are not indicated unless there is evidence of systemic disease</th>
</tr>
</thead>
</table>

**First line (if evidence of systemic disease):**

Clarithromycin  
Dose - 500mg - oral – bd (twice daily) for 5 days

**Second line (if evidence of systemic disease):**

Ciprofloxacin*  
Dose - 500mg - oral – bd (twice daily) for 5 days

*Note: There is increasing resistance of Campylobacter to quinolones in many parts of the world. Monitor patient carefully for signs of treatment failure.

B) Organisms: Non-typhoid Salmonella spp.

<table>
<thead>
<tr>
<th>Antibiotics are not indicated unless there is evidence of systemic disease</th>
</tr>
</thead>
</table>

• Antibiotic treatment is not recommended for healthy people with gastroenteritis due to Salmonella infection.
• Consider antibiotic treatment for people who:
  o Are older than 50 years of age
  o Are immunocompromised
  o Have cardiac valve disease or endovascular abnormalities, including prosthetic vascular grafts. If antimicrobial therapy indicated, seek advice from Microbiology

  • If diarrhoea is associated with travel abroad, there might be an increased risk of antimicrobial resistance.
  • **If antibiotic treatment is indicated, prescribe ciprofloxacin 500 mg twice a day for 1 day only** (check with the microbiology laboratory that the isolate is sensitive).

  • Basis for recommendation
    o A Cochrane systematic review showed no evidence of benefit of antibiotic treatment in healthy people with Salmonella gastroenteritis; however, there was an increased risk of adverse effects, and carriage of Salmonella was prolonged [Onwuezobo et al, 2012].
    o However, expert opinion in a review article and a textbook on infectious diseases is that older people, people who are immunocompromised, and people with cardiac valvular or endovascular abnormalities (including prosthetic vascular grafts) have an increased risk of invasive infection and may benefit from early antimicrobial treatment [Hsu and Lin, 2005; Pegues et al, 2005].
    o The choice of antibiotic and the recommended dosage is based on the British National Formulary [BNF 67, 2014].
First line if evidence of systemic infection (such as bacteraemia):

Ceftriaxone
Dose - 2g IV od
Duration: prolonged treatment is required, please discuss with Microbiology.

Comments:
- If typhoid or paratyphoid fever (enteric fever) suspected, please contact Medical Microbiologist for advice.
- Diarrhoea is uncommon in early typhoid or paratyphoid fever, but may be a feature of late presentation.

C) Organisms: *Shigella* spp.

Practice point:
- Antibiotic treatment is not recommended for healthy people with mild shigellosis.
- Consider antibiotic treatment for people:
  - With severe disease
  - Who are immunocompromised
  - With bloody diarrhoea
- If antibiotic treatment is indicated, seek advice from the local microbiologist regarding antibiotic management and consider testing for HIV in the appropriate epidemiological context.

First line:

Ciprofloxacin
Dose - 500mg – oral – bd (twice a day) for 1 day
(unless organism is *Shigella dysenteriae* then treatment is continued for 5 days)

Second line:

Trimethoprim
Dose - 200mg – oral – bd (twice a day) for 3 days

OR

Azithromycin
Dose - 500 mg – oral – od (once a day) for 3 days (off-label)

Reference:
- Christopher PRH et all. Cochrane review _Antibiotic therapy for Shigella dysentery_ 2010

D) Organisms: *E. coli* O157.

Antibiotics are contraindicated in most cases as they can increase the risk of complications developing such as haemolytic uraemic syndrome (HUS).

Comments:
- Antibiotic use in *E. coli O157* disease has been associated with an increased risk of haemolytic uraemic syndrome in children (Wong et al. Clin Infect Dis. 2012; 55:33-41), and may occur in the elderly.
E) Organisms: *Giardia lamblia*

**First choice:**
Metronidazole  
Dose - 400mg - oral – tds (three times a day) for 5 days

---

### ANTIBIOTIC-ASSOCIATED DIARRHOEA

**Stop all antibiotics if clinically possible**

**Prevention**

- Avoid the use of antibiotics for patients who do not require them.
- Avoid the use of broad spectrum beta-lactam and carbapenem antibiotics, such as co-amoxiclav, cefuroxime, cefpodoxime, cefotaxime, ceftriaxone, ceftazidime, piperacillin/tazobactam, carbapenems (ertapenem, Meropenem and imipenem) and quinolones (ciprofloxacin, levofloxacin and moxifloxacin).
- All antibiotics that are clearly not required should be stopped, as should other drugs that might cause diarrhoea if appropriate.
- Isolate the patient in a side room.
- There is accumulating evidence that the use of PPIs (proton pump inhibitors) may predispose to the development of *Clostridium difficile* infection (CDI) and pseudomembranous colitis. PPIs should be prescribed with care in hospitalized patients to prevent the risk of patient developing CDI.

---

### *Clostridium difficile* DISEASE MANAGEMENT

- Management of *Cl. Difficile* disease should be according to the UHB guideline, ‘Procedure for *Clostridium difficile* infection (CDI)’, Section 7 - Management; pages 5-8: [http://uhbpolicies/assets/ClostridiumDifficileProcedure.pdf](http://uhbpolicies/assets/ClostridiumDifficileProcedure.pdf) (last accessed 06/10/2017)
ACUTE CHOLANGITIS/CHOLECYSTITIS

Practice points:
- Antibiotics should be combined with drainage of obstructed bile.
- Organisms: Coliforms (mainly *Escherichia coli*), rarely *Pseudomonas aeruginosa* or anaerobes

<table>
<thead>
<tr>
<th>First line:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Piperacillin/Tazobactam</td>
</tr>
<tr>
<td>Dose: 4.5g – IV (intravenous infusion over 30 minutes) – tds (three times a day) for 7 to 10 days, duration depending on clinical response. Review after 48-72hours</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Oral switch:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Co-amoxiclav</td>
</tr>
<tr>
<td>Dose: 625mg – oral – tds (three times a day) for total 7 to 10 days treatment including IV course.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Second line (penicillin allergic):</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ciprofloxacin</td>
</tr>
<tr>
<td>Dose: (oral) 500mg bd (twice a day) for 7 to 10 days, duration depending on clinical response</td>
</tr>
<tr>
<td>Dose: (intravenous, if unable to take oral) 400mg bd (twice a day), review need for IV daily.</td>
</tr>
</tbody>
</table>

**PLUS**

<table>
<thead>
<tr>
<th>Metronidazole</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dose: (oral) 400mg tds (three times a day) for 7 to 10 days, duration depending on clinical response.</td>
</tr>
<tr>
<td>Dose: (intravenous, if unable to take oral) 500mg tds (three times a day), review need for IV daily.</td>
</tr>
</tbody>
</table>

Previous ESBL positive (*E.coli or Klebsiella*)

Check previous cultures and sensitivities on PICS for appropriate choice of therapy.
DIVERTICULITIS / PERITONITIS

Practice points:
- Oral antibiotics should be used whenever possible
- Organisms: Mixed infection, coliforms and anaerobes

First line (for community-acquired infections in patients who are not severely ill):
Tigecycline
Loading dose: 100mg – intravenous infusion – STAT
Maintenance dose: 50mg – intravenous infusion – bd (twice daily) for 5 days, depending on clinical response

First line (for hospital-acquired infections or in patients who are severely ill):
Piperacillin/tazobactam
Dose: 4.5g - intravenous infusion over 30 minutes – tds (three times a day) for 5 days, depending on clinical response
(For penicillin allergic patients use Tigecycline above)

Oral switch:
Ciprofloxacin
Dose (oral): 500mg bd (twice a day) for 5 days, depending on clinical response
PLUS
Metronidazole
Dose: (oral) 400mg tds (three times a day) for 5 days, duration depending on clinical response.

Previous ESBL positive (E.coli or Klebsiella)
Check previous cultures and sensitivities on PICS for appropriate choice of therapy.

Comment:
- Comment: The underlying cause of peritonitis is usually managed surgically; antibiotics should be used as an adjunct, not as an alternative. Oral antibiotics can be used to complete the course once the patient can tolerate an oral diet.
- Even when fungi are recovered from microbiological samples following acute GI perforation, antifungal drugs are unnecessary in adults unless the patient has recently received immunosuppressive therapy for neoplasm or has a perforation of a gastric ulcer, on acid suppression or malignancy, transplantation, or inflammatory disease or has postoperative or recurrent intra-abdominal infection (Solomkin et al. Surgical Infection Society & the Infectious Diseases Society of America guideline. Clinical Infectious Diseases 2010; 50:133–640).
- If ESBL positive Gram negative organisms have been previously isolated in a patient, the antibiotic prophylaxis should include adequate cover, eg: such as meropenem or tigecycline.
- Duration of treatment is that recommended by the American Surgical Infection Society (Mazuski et al. Surgical Infections 2002;3;161 - 73). A Cochrane Review (Shabanzadeh & Wille-Jørgensen, Nov 2012), showed no effect of antibiotics in one of three trials reviewed, and suggests confirmation of this finding by other trials).
- In case of a diverticular abscess, US- or CT-guided drainage may be required.
Most patients with pancreatitis need no antibiotics
Antibiotics should not be given unless there is evidence of severe pancreatitis and infection

Practice points:

- The administration of prophylactic antibiotics to patients with severe necrotizing pancreatitis prior to the diagnosis of infection is not recommended.
- The presence of fever alone is not an indication to start antibiotic therapy.
- Infected pancreatic necrosis is defined as one or both of the following:
  - CT scan with gas
  - Percutaneous aspirate or surgical specimen with organisms evident on Gram stain or culture
- Organisms: Mixed infection, coliforms and anaerobes.

**First line (as per definition above):**

Meropenem
Dose: 1g - intravenous injection – tds (three times a day), duration 5 days depending on clinical response.

**Second line (penicillin allergic / oral switch):**

Ciprofloxacin
Dose (oral): 500mg bd (twice a day) for 5 days, depending on clinical response
Dose (intravenous if patient unable to swallow): 400mg bd (twice a day) for 5 days, depending on clinical response

**PLUS**

Metronidazole
Dose: (oral) 400mg tds (three times a day), duration depending on clinical response.
Dose: (intravenous, if unable to take oral) 500mg tds (three times a day), review need for IV daily.

Comment:

- **Antibiotics are indicated mainly for patients with evidence of secondary infection.** The antibiotics recommended achieve therapeutic levels in pancreatic tissue. They should be used for as short a period as possible to decrease the possibility of superadded fungal infection. (Yousaf et al. Br J Surg 2003:90; 407-20)
- **Review the empirical antibiotic choice.** Review after 48-72hours with the culture results
- The’ Acute Pancreatitis: Treat the cause’ 2016 NCEPOD report highlighted that antibiotics are still prescribed unnecessarily in 20% of cases.
SPONTANEOUS BACTERIAL PERITONITIS (SBP) IN CIRRHOSIS

Practice points:
- Organisms: Coliforms and enterococci, rarely may be pneumococci

First line:
Ceftriaxone 1g – intravenous – od (once daily) for 5 days (in severe infection increase dose to 2g od)

Second line in patients with cephalosporin or severe penicillin allergy or when oral switch is desired AND there has been no previous use of quinolones (eg, ciprofloxacin, levofloxacin):

Ciprofloxacin
Dose (oral): 500mg bd (twice a day) for 5 days
Dose (intravenous if patient unable to swallow): 400mg bd (twice a day) for 5 days, depending on clinical response

Second line in patients with cephalosporin or severe penicillin allergy or when oral switch AND there has been previous use of quinolones (e.g. ciprofloxacin, levofloxacin):
Contact Medical Microbiologist. Tigecycline is an option if patient not thought to be bacteraemic.

Previous ESBL positive (E.coli or Klebsiella)
Check previous cultures and sensitivities on PICS for appropriate choice of therapy (meropenem or tigecycline may be potential options).

Comment:
- Duration of antimicrobial therapy depending on clinical response. Review after 48-72hours.
- Ciprofloxacin is unlikely to be effective in this group of patients as they often have had previous treatment with quinolones. One small RCT indicated that 5 days treatment was as good as 10 days.
- A systematic review (Chavez-Tapia et al. The Cochrane Library, Issue 1, 2009) found no convincing evidence that any particular antibiotic was better than any other. Ciprofloxacin is unlikely to be effective in this group of patients as they often have had previous treatment with quinolones. One small RCT indicated that 5 days treatment was as good as 10 days.

Reference:
**HELCOBACTER PYLORI (H. PYLORI)**

**Practice points:**
- Patients over the age of 55, with recent onset, unexplained and persistent dyspepsia (over 4-6 weeks) should be referred urgently for endoscopy to exclude cancer (See link).
- Check antibiotic history as each additional course of clarithromycin, metronidazole or quinolone increases resistance risk.
- Patient compliance with one of the below regimens is essential in order to achieve an eradication rate of 90%.

<table>
<thead>
<tr>
<th>No Penicillin allergy</th>
<th>Penicillin allergic</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>First line:</strong></td>
<td><strong>First line:</strong></td>
</tr>
<tr>
<td>Amoxicillin 1g oral bd</td>
<td>Clarithromycin 500mg oral bd</td>
</tr>
<tr>
<td>PLUS</td>
<td>PLUS</td>
</tr>
<tr>
<td>either clarithromycin 500mg oral bd OR metronidazole 400mg oral bd</td>
<td>Metronidazole 400mg oral bd</td>
</tr>
<tr>
<td>Duration: 7 days</td>
<td>Duration: 7 days</td>
</tr>
<tr>
<td>PLUS Lansoprazole 30mg bd for 7 days then reduce to od thereafter</td>
<td>PLUS Lansoprazole 30mg bd for 7 days then reduce to od thereafter</td>
</tr>
</tbody>
</table>

**ONGOING SYMPTOMS after first-line**

<table>
<thead>
<tr>
<th>Second line:</th>
<th>Second line:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amoxicillin 1g oral bd</td>
<td>Metronidazole 400mg oral bd</td>
</tr>
<tr>
<td>PLUS</td>
<td>PLUS</td>
</tr>
<tr>
<td>second antibiotic not used in first line, either clarithromycin 500mg oral bd OR metronidazole 400mg oral bd</td>
<td>Levofoxacin 250mg bd</td>
</tr>
<tr>
<td>Duration: 7 days</td>
<td>Duration: 10 days</td>
</tr>
<tr>
<td>PLUS Lansoprazole 30mg bd for 7 days then reduce to od thereafter</td>
<td>PLUS Lansoprazole 30mg bd for 7 days then reduce to od thereafter</td>
</tr>
</tbody>
</table>

**ONGOING SYMPTOMS after first-line AND previous exposure to MZ and CLAR**

<table>
<thead>
<tr>
<th>Second line:</th>
<th>Second line:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amoxicillin 1g oral bd</td>
<td>Metronidazole 400mg oral bd</td>
</tr>
<tr>
<td>PLUS</td>
<td>PLUS</td>
</tr>
<tr>
<td>either Tetracycline hydrochloride 500mg oral qds OR Levofoxacin 250mg bd</td>
<td>Levofoxacin 250mg bd</td>
</tr>
<tr>
<td>Duration: 10 days</td>
<td>Duration: 10 days</td>
</tr>
<tr>
<td>PLUS Lansoprazole 30mg bd for 10 days then reduce to od thereafter</td>
<td>PLUS Lansoprazole 30mg bd for 7 days then reduce to od thereafter</td>
</tr>
</tbody>
</table>

**Comment:**
- Absolute compliance with one of above regimens is essential in order to achieve an eradication rate of 90% These recommendations are adapted from the following;
- Helicobacter pylori eradication first choice.
- Quadruple therapy
  - Test and treat for Helicobacter pylori (HP) in dyspepsia Management of infection for primary care for consultation and local adaptation – HPA PHE guideline, July 20170.


References:
- PHE guidance
2. Cardiovascular System

NATIVE VALVE INFECTIVE ENDOCARDITIS

Practice points:
- Take blood cultures prior to starting antibiotics. In stable patients, three sets taken at least 30 minutes apart, ideally from separate sites, is recommended.
- Do not unduly delay prompt antibiotic administration in acutely unwell patients.
- Blood cultures from intravascular catheters should be avoided, unless part of a paired ‘through-line’ and peripheral blood sampling to diagnose concurrent intravascular catheter-related bloodstream infection.
- In stable patients with suspected endocarditis where antibiotics have been started prior to blood cultures being taken, consider stopping antibiotics and performing three sets of blood cultures as above. Antibiotic therapy may need to be stopped for 7-10 days to enhance the chances of a positive yield from the blood cultures.
- Patient with suspected infective endocarditis should be promptly referred to Cardiology for clinical assessment and echocardiography.
- Common organisms: *Staphylococcus aureus*, viridans group streptococci, coagulase-negative staphylococci, enterococci

Native Valve Endocarditis (NVE): Indolent presentation (>2 weeks symptoms), patient not severely septic —:

**First Line:**
- Amoxicillin
  - Dose: 2g - intravenous injection - every 4 hours (6 times daily)

**PLUS**
- Gentamicin
  - Dose: See [intravenous gentamicin – multiple daily dosing](#) guideline for prescribing and monitoring

**Second Line (Penicillin allergy or suspected MRSA):**

The choice below is guided by clinical conditions (e.g. renal impairment, drug interactions with other medication). For further advice please consult Medical Microbiologist.

**Either:**
- Vancomycin
  - Dose: see [intravenous vancomycin – intermittent infusion](#) guideline for dosing and monitoring.
    - (Aim pre-dose levels between 15-20mg/L)

  **PLUS**
  - Rifampicin
    - Dose: 600mg - oral - bd (twice daily)

  **OR**
  - Vancomycin
    - Dose: see [intravenous vancomycin – intermittent infusion](#) guideline for dosing and monitoring.
      - (Aim pre-dose levels between 15-20mg/L)

  **PLUS**
  - Gentamicin
    - Dose: See [intravenous gentamicin – multiple daily dosing](#) guideline for prescribing and monitoring
### Native Valve Endocarditis (NVE) - Acute presentation (within 2 weeks of symptom onset) and septic patient

<table>
<thead>
<tr>
<th>First line:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Meropenem</td>
</tr>
<tr>
<td>Dose: 2g - intravenous injection - every 8 hours</td>
</tr>
</tbody>
</table>

**PLUS**

<table>
<thead>
<tr>
<th>Vancomycin</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dose: see <a href="#">intravenous vancomycin – intermittent infusion</a> guideline for dosing and monitoring. Aim pre-dose levels between 15-20mg/L)</td>
</tr>
</tbody>
</table>

- Please discuss adjustments with Pharmacist or Medical Microbiologist.
- In the case of serious penicillin, cephalosporin or carbapenem allergy, please discuss with Medical Microbiologist giving details of nature of the allergy.

### Reference:

PROSTHETIC VALVE INFECTIVE ENDOCARDITIS

Practice points:
- See above – Same as for native valve endocarditis (NVE)
- Start empirical therapy after blood cultures are taken
- Organisms: Coagulase-negative staphylococci, Staphylococcus aureus, viridans streptococci, enterococci.

First line:

Vancomycin
Dose: see intravenous vancomycin – intermittent infusion guideline for dosing and monitoring. Aim pre-dose levels between 15-20mg/L)

PLUS
Rifampicin
Dose: 600mg - oral - bd (twice daily)

PLUS
Gentamicin
Dose: See intravenous gentamicin – multiple daily dosing guideline for prescribing and monitoring


VASCULAR SURGERY GRAFT INFECTION

- Take blood cultures prior to starting antibiotics. In stable patients, three sets taken at least 6 hours apart, ideally from separate sites, is recommended.
- Discuss with Medical Microbiologist.
3. Respiratory System

COMMUNITY ACQUIRED PNEUMONIA (CAP)

Practice points:

- **Use the flowchart (fig 1: below) for severity assessment and management of patients with CAP**
- **Microbiology investigations for moderate and severe CAP**
  - Blood culture
  - Sputum culture
  - Urine for Legionella antigen testing
  - Serum for atypical pneumonia – acute and convalescent
  - Viral swabs to rule out influenza
  - Sputum for TB investigation for those with risk factors for TB
- **Organisms:** *Streptococcus pneumoniae*, ‘atypical organisms’ (chlamydiae, mycoplasma, legionella)
- **Definition of CAP is radiological evidence of consolidation. Ensure chest x-ray is performed promptly**
- **For clarithromycin and moxifloxacin, consider IV to oral switch as soon as possible, since both antibiotics are well absorbed from the gastro-intestinal tract**
- **Proven Legionella pneumonia may need treatment for 21 days**
- **Severe atypical pneumonia of an undiagnosed aetiology may need treatment for up to 14 days**
- **Consult Respiratory Physician or Medical Microbiologist if features suggestive of PVL-positive *S aureus* pneumonia (such as extensive necrotizing pneumonia, influenza-like prodrome, haemoptysis) or Klebsiella pneumonia (such as extensive necrotizing pneumonia, haemoptysis)**
Fig 1: Community acquired pneumonia (CAP) flowsheet

Triage / Initial Assessment suggestive of CAP

Result of CXR reviewed by clinician

- No consolidation
  - Reassess
- Consolidation
  - Does the patient meet criteria for CAP?
    - Yes
      - Treat according to clinical judgement and CURB65 severity score
        - 0-1
          - Low severity (risk of death <3%)
            - Other reasons for admission (unstable co-morbidity, social)
              - No
                - Home
                  - Antibiotics
              - Yes
                - Hospital
                  - Supportive care
                  - Microbiological investigations
                  - Antibiotics
          - 2
            - Moderate severity (risk of death 9%)
            - Hospital
              - Supportive care
              - Microbiological investigations
              - Antibiotics
              - Urgent senior review
              - Decision re transfer to critical care unit (especially if CURB65 = 4 or 5)
            - Yes
                - Hospital
                  - Supportive care
                  - Microbiological investigations as per table 4
                  - Antibiotics
                  - Urgent senior review
                  - Decision re transfer to critical care unit (especially if CURB65 = 4 or 5)
        - 3-5
          - High severity (risk of death 15–40%)
            - Consider other diagnoses

CURB65 severity score:
1 point for each feature present:
- Confusion
- Urea > 7 mmol/l
- Respiratory rate ≥ 30/min
- Blood pressure (SBP < 90 or DBP ≤ 60mmHg)
- Age ≥ 65 years

Aim by 4 hours: diagnosis made and management including antibiotics started
Low / Mild (CURB65 score 0 or 1)

**First choice:**
Amoxicillin
Dose: 500mg - oral – tds (three times a day) for 5 days.

**Second choice (penicillin allergy):**
Doxycycline
Dose: 200mg - oral - stat
followed by 100mg - oral – od (once a day) – total course including ‘stat dose’, for 5 days

**Comment:** Patients with CURB 65 score of 0 do not need admission for this infection.

Moderate (CURB65 score 2)

**First line (oral switch):**
Amoxicillin
Dose: 500mg - oral – tds (three times a day) for 7 days

PLUS
Clarithromycin
Dose: 500mg - oral – bd (twice a day) for 7 days

**First line (if patient unable to swallow or contra-indicated):**
Benzylpenicillin
Dose: 1.2g - intravenous injection – qds (four times a day) for 7 days

PLUS
Clarithromycin
Dose: 500mg - intravenous infusion over 60 minutes – bd (twice a day) for 7 days

**Second line (penicillin allergy):**
Moxifloxacin
Dose: 400mg – oral – od (once a day) for 7 days.
(If patient unable to take medication orally: 400mg – intravenous infusion over 60 minutes – od (once a day). Switch to oral as soon as patient able to swallow medication.

Severe (CURB 65 score 3, 4 or 5)

**First line:**
Co-amoxiclav
Dose: 1.2g - intravenous injection – tds (three times a day) for 7 days

PLUS
Clarithromycin
Dose: 500mg - oral – bd (twice a day) for 7 days
or if unable to take orally, 500mg - intravenous infusion over 60 minutes – bd (twice a day) for 7 days
NB: Duration of antibiotics will need to be extended if proven atypical infection. Discuss with medical microbiologist.

<table>
<thead>
<tr>
<th>Second line: (penicillin allergy):</th>
</tr>
</thead>
<tbody>
<tr>
<td>Moxifloxacin</td>
</tr>
<tr>
<td>Dose: 400mg – oral – od (once a day) for 7 days.</td>
</tr>
<tr>
<td>(If patient unable to take medication orally: 400mg – intravenous infusion over 60 minutes – od (once a day). Switch to oral as soon as patient able to swallow medication.</td>
</tr>
<tr>
<td>NB: Duration of antibiotics will need to be extended if proven atypical infection. Discuss with medical microbiologist.</td>
</tr>
</tbody>
</table>

Comment:
- The use of broader spectrum penicillins (eg, piperacillin/tazobactam), or meropenem, provides no advantages over benzylpenicillin or co-amoxiclav in the treatment the majority of community-acquired pneumonias, since they are are no more active against pneumococci.
- Moxifloxacin has activity against *Mycobacterium tuberculosis*; it may modify clinical picture and microbiological diagnosis of tuberculosis, if used in a patient with tuberculosis who presents with ‘community-acquired pneumonia’.
HOSPITAL ACQUIRED PNEUMONIA (HAP)

Practice points:
- Hospital-acquired infection is defined as the onset of infection more than 48 hours after admission (excluding that which was incubating / developing at admission – see CAP guidelines).
- A diagnosis of hospital acquired pneumonia requires radiographic evidence of chest X-ray infiltrates plus one or more of the following:
  - Neutrophil count above 8x10^9/L
  - Temperature >38°C or <35°C on more than two occasions, at least one hour apart
- Send sputum for culture
- Review all other Microbiology results. Bacterial colonisation at sites other than the respiratory tract may indicate organisms from which post-ventilation pneumonia may result; discuss these with the Medical Microbiologist if required.
- Presence of any of the following indicates a severe illness:
  - Respiratory failure (PaO2 <8 kPa and/or PaCO2 >6 kPa)
  - Respiratory rate >25 breaths/min
  - Rapid radiographic progression, multilobar pneumonia, or cavitation of lung infiltrate
  - Diastolic BP <60 mmHg
  - WBC low (<4x10^9/L) or very high (>20x10^9/L)
  - Poor urine output or rising serum creatinine
  - Metabolic acidosis
- It is important to exclude UTIs in patients with a clinical diagnosis of ‘chest infection’ but no infiltrates on chest X-ray.
- Organisms: Streptococcus pneumoniae, Haemophilus influenzae, coliforms, Pseudomonas aeruginosa, Staphylococcus aureus (including MRSA).

Mild / moderate HAP

<table>
<thead>
<tr>
<th>First line:</th>
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<tbody>
<tr>
<td>Co-amoxiclav</td>
</tr>
<tr>
<td>Dose: 625mg - oral – tds (three times a day) for 7 days</td>
</tr>
<tr>
<td>Dose (intravenous and unable to swallow medication): 1.2g - tds (three times a day). Review at 48hrs and switch to oral if can swallow medication.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Second line (penicillin allergy):</th>
</tr>
</thead>
<tbody>
<tr>
<td>Doxycycline</td>
</tr>
<tr>
<td>Dose: 200mg - oral - stat</td>
</tr>
<tr>
<td>followed by 100mg - oral – od (once a day) for 7 days</td>
</tr>
<tr>
<td>If patient unable to swallow medication treat with:</td>
</tr>
<tr>
<td>Moxifloxacin</td>
</tr>
<tr>
<td>Dose: 400mg – intravenous infusion over 60 minutes – od. Review at 48hrs and switch to oral agent above if can swallow medication.</td>
</tr>
</tbody>
</table>
Severe HAP
( Including patients on the ward who have recently had invasive ventilation on Critical Care - Post-ventilatory pneumonia)

First line:
Piperacillin/tazobactam
Dose: 4.5g - intravenous infusion over 30 minutes – tds (three times a day) for 7 days

Second line (penicillin allergy):
Moxifloxacin
Dose: 400mg – oral – od (once a day) for 7 days
(if unable to take orally: 400mg – intravenous infusion over 60 minutes – od (once a day) for 7 days)

ASPIRATION PNEUMONIA (COMMUNITY ACQUIRED)

Practice points:
- Pneumonia following aspiration prior to hospitalisation or in patients hospitalised for < 48 hours.
- As the gastric contents are sterile, bacterial infection does not have an important role in the early stages of acute lung injury following aspiration, though subsequent bacterial infection is possible.
- Antibiotics should be reserved for patients who develop radiological changes or who do not improve 48 hours after the aspiration event.
- Organisms: Gram-positive aerobic and anaerobic bacteria from the mouth.
- Please see guidelines for CAP and add metronidazole to the CAP antibiotic regime to cover aspiration pneumonia (except when co-amoxiclav is indicated, in which case the addition of metronidazole is not required).

ASPIRATION PNEUMONIA (HOSPITAL ACQUIRED)

Practice points:
- Pneumonia following aspiration in patients hospitalised for > 48 hours
- Not all patients who aspirate develop pneumonia.
- Antibiotics should be reserved for patients who develop radiological changes or who do not improve 48 hours after the aspiration event.
- Organisms: Gram-positive aerobic and anaerobic bacteria from the mouth and Gram-negative bacteria from the gut.
- Please see guidelines for HAP.
EXACERBATION OF COPD
(Chronic obstructive pulmonary disease)

Practice points:
• Definition – Sustained worsening of symptoms from their usual stable state which is beyond normal day to day variation and is acute in onset. Commonly reported symptoms are:
  o Worsening breathlessness
  o Cough
  o Increased sputum production
  o Change in sputum colour
• In all patients referred to the hospital the following investigations are recommended – CXR, ABG, ECG, FBC, theophylline level on admission if on it, sputum culture, blood culture if pyrexial
• Antibiotics are recommended to treat exacerbations of COPD associated with history of more purulent sputum OR if consolidation on CXR / clinical signs of pneumonia without more purulent sputum
• Ensure previous cultures and sensitivities are checked prior to starting antimicrobial therapy

Organisms: Mostly viral, Haemophilus influenzae, Streptococcus pneumoniae
• Apparent failures of GP treatment for exacerbation of COPD should be discussed with a Medical Microbiologist once the diagnosis is confirmed; when discussing the patient the antibiotic(s) used, dose and duration are required.

First line (including penicillin allergy):
Doxycycline
Dose: 200mg - oral - stat
followed by 100mg - oral – od (once a day) for 5 - 7 days

Second line:
Co-amoxiclav
Dose (oral): 625mg oral – tds (three times a day) for 5 - 7 days
Dose (intravenous, if unable to take oral medication): 1.2g – intravenous – tds (three times a day) for 5 - 7 days

Third line (if doxycycline or co-amoxiclav has been used in the community):
Moxifloxacin
Dose (oral): 400mg – od (once a day) for 7 days
Dose (intravenous, if unable to take oral medication): 400mg – intravenous – od (once a day) for 7 days

Comments:
• Antibiotics reduce treatment failures compared with placebo in hospitalised patients with severe exacerbations. The rather small and inconsistent effects of antibiotics on treatment failure suggest that antibiotics are effective in some patients but not in all inpatients and outpatients. (Vollenweider et al. Cochrane Database of Systematic Reviews Dec 2012. Art. No.: CD010257).
• Broad spectrum antibiotics offer no advantage over the narrow spectrum agents recommended. Available guidelines (NICE CG101 Chronic obstructive pulmonary disease (2010 update): guideline/ BTS, Am Col Chest Phys, Eur Resp Soc and ATS), supported by local susceptibility data, suggest amoxicillin or a tetracycline. A maximum of 7 days is recommended (British Thoracic Society Guidelines for the management of COPD Thorax 1997:52; Suppl. 5).
BRONCHIECTASIS EXACERBATION

Practice points
- Empirical treatment depends on past cultures and severity of illness
- Sputum should be sent for culture and sensitivity testing before antibiotics are commenced
- In patients on oral theophylline, levels may be increased by the concomitant administration of ciprofloxacin – the dose of theophylline may need to be reduced in such circumstances.
- Duration of treatment minimum 7 days, usually 10-14 days, to be decided in discussion with respiratory consultant.

A. Non-severe exacerbation – patients colonised with *H. influenzae*, *S. pneumoniae*, *M. catarrhalis* and no previous *Pseudomonas sp.* isolated from respiratory sample

<table>
<thead>
<tr>
<th>First line:</th>
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<tbody>
<tr>
<td>Stable state, sputum mucoid:</td>
</tr>
<tr>
<td>Amoxicillin (if organism susceptible)</td>
</tr>
<tr>
<td>Dose: 1g – oral - tds (three times a day)</td>
</tr>
<tr>
<td>Stable state, sputum purulent:</td>
</tr>
<tr>
<td>Amoxicillin (if organism susceptible)</td>
</tr>
<tr>
<td>Dose: 3g – oral – bd (twice a day)</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Second line (penicillin allergic):</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ciprofloxacin</td>
</tr>
<tr>
<td>Dose: 500mg - oral – bd (twice a day)*</td>
</tr>
</tbody>
</table>

B. Non-severe exacerbation – previous *Pseudomonas aeruginosa* regardless of in vitro susceptibility):

<table>
<thead>
<tr>
<th>Ciprofloxacin</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dose: 500mg – oral – bd (twice a day)*</td>
</tr>
</tbody>
</table>

* In patients on oral theophylline, levels may be increased by the concomitant administration of ciprofloxacin – the dose of theophylline may need to be reduced in such circumstances.

C. Severe exacerbation: therapy should be guided by recent sputum results, but generally consider combination therapy such as:

<table>
<thead>
<tr>
<th>Ceftazidime</th>
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</thead>
<tbody>
<tr>
<td>Dose: 2g - intravenous - three times a day</td>
</tr>
</tbody>
</table>

*| Tobramycin intravenous |
<table>
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<th></th>
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<tbody>
<tr>
<td>Dose: See tobramycin guideline for dosing and monitoring</td>
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</table>

Comments:
- For patients with no organisms isolated in culture, the antibiotics that have previously proven to be effective for them, should be employed for the acute exacerbation
EMPYEMA

**Practice points**

- Discuss all patients suspected of empyema with the Respiratory consultant. Send pleural fluid sample to Microbiology Laboratory for Microscopy Cultures and Sensitivities (MCS).
- Previous Microbiology results should be reviewed before prescribing empirical antibiotics. If in doubt, discuss with the Medical Microbiologist.
- Antibiotics to cover anaerobic infection should be used in all patients except those with culture proven pneumococcal infection.
- Macrolide antibiotics are not indicated unless there is objective evidence for or a high clinical index of suspicion of 'atypical' pathogens.
- Consider adding vancomycin if patient is at risk of being, or known to be, MRSA positive.
- Presence of frankly purulent or turbid/cloudy fluid on pleural aspiration or low pleural pH<7.2 indicates the need for prompt chest tube drainage.
- Intravenous antibiotics should be changed to oral therapy once there is clinical and objective evidence of improvement.
- Intrapleural antibiotics are not recommended.
- Prolonged courses of antibiotics (up to 4 weeks) may be necessary. Organisms: *Staphylococcus aureus*, *Streptococcus pneumoniae*, *Streptococcus milleri* group. Polymicrobial flora implicated in hospital acquired infections.

<table>
<thead>
<tr>
<th>First line:</th>
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<tbody>
<tr>
<td>Co-amoxiclav</td>
</tr>
<tr>
<td>Dose: 1.2g - intravenous injection – tds (three times a day) for 3 weeks depending on clinical response</td>
</tr>
</tbody>
</table>

**NB:** If patient at risk for *Pseudomonas* infection, discuss with Medical Microbiology.

<table>
<thead>
<tr>
<th>Second line (penicillin allergy):</th>
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</thead>
<tbody>
<tr>
<td>Clindamycin</td>
</tr>
<tr>
<td>Dose: 450 - 600 mg - oral – qds (four times a day) for 3 weeks depending on clinical response</td>
</tr>
</tbody>
</table>

**Consider adding if at risk of Gram negative infection (e.g. Pseudomonas):**

<table>
<thead>
<tr>
<th>Ciprofloxacin</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dose: 500 mg – oral – bd (twice a day) for 3 weeks depending on clinical response</td>
</tr>
</tbody>
</table>

**Reference**

PVL Staphylococcus aureus pneumonia

Practice points:
- Panton-Valentine Leukocidin (PVL) is a toxin that destroys white blood cells and is a virulence factor in some strains of Staphylococcus aureus. Strains of PVL-SA producing a new pattern of disease have emerged in the UK and worldwide. In the UK the genes encoding for PVL are carried by < 2% of clinical isolates of S. aureus, whether methicillin sensitive (MSSA) or meticillin-resistant (MRSA).
- Consult Respiratory Physician or Medical Microbiologist if features suggestive of PVL-positive S. aureus pneumonia (such as extensive necrotizing pneumonia, influenza-like prodrome, haemoptysis).
- Infection with PVL Staphylococcus aureus must be notified to Public Health England.
- Discuss with microbiologist to review antimicrobial choice and infection control regarding isolation.
- Duration: Continue antibiotic therapy for 48-72 hours or until culture results finalised.

<table>
<thead>
<tr>
<th>Empirical treatment:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Linezolid</td>
</tr>
<tr>
<td>Dose: 600mg – oral – bd (twice a day)</td>
</tr>
<tr>
<td>PLUS</td>
</tr>
<tr>
<td>Clindamycin</td>
</tr>
<tr>
<td>Dose: 1.2g – intravenous infusion – qds (four times a day)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>If deteriorating or evidence of severe disease:</th>
</tr>
</thead>
<tbody>
<tr>
<td>ADD (to above regimen)</td>
</tr>
<tr>
<td>Rifampicin</td>
</tr>
<tr>
<td>Dose: 600mg – twice a day – oral/enteral</td>
</tr>
<tr>
<td>PLUS</td>
</tr>
<tr>
<td>Human immunoglobulin</td>
</tr>
<tr>
<td>Dose: 2g/kg – intravenous injection – one dose (consider repeating after 48-72h if no improvement of symptoms and/or ventilatory failure)</td>
</tr>
</tbody>
</table>

Reference:
- Recommendations from Public Health England (formerly HPA) (last accessed 14/10/17)
PULMONARY TUBERCULOSIS (TB)

**Practice points:**
- All patients with suspected / confirmed pulmonary tuberculosis should be tested for HIV infection.
- In general anti-TB treatment should only be started on the advice of a Respiratory Physician, or for patients with HIV, a GUM physician. Patients must be referred to Respiratory Medicine or GUM.
- On-going tuberculosis management should be supervised by a Respiratory Physician or GUM Physician.
- Patients with TB and renal impairment should be managed by Respiratory Medicine/Renal Medicine using the Renal Medicine departmental guideline for ‘Treatment of tuberculosis in renal failure’.
- Tuberculosis is a notifiable infection: The Public Health England Local Health Protection team must be notified. [Complete form](#).
- Organisms: *Mycobacterium tuberculosis*, *Mycobacterium bovis*

### First Line (when using combined preparations):

<table>
<thead>
<tr>
<th>For 2 months initial phase use (Quadruple therapy)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Rifater®</strong> <em>(rifampicin, isoniazid and pyrazinamide)</em></td>
</tr>
<tr>
<td><strong>Dose:</strong></td>
</tr>
<tr>
<td>- Under 40kg = 3 tablets ONCE daily</td>
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<td>- 40-49kg = 4 tablets ONCE daily</td>
</tr>
<tr>
<td>- 50-64kg = 5 tablets ONCE daily</td>
</tr>
<tr>
<td>- Over 65kg = 6 tablets ONCE daily</td>
</tr>
</tbody>
</table>

**PLUS**

Ethambutol

**Dose:** 15mg / kg –oral – od (once daily)

*Note: patients to be treated with Ethambutol need a baseline visual acuity test prior to starting treatment*

**PLUS**

Pyridoxine

**Dose:** 10mg – oral – od (once daily)

### For 4 months continuation phase use (double therapy)

<table>
<thead>
<tr>
<th><strong>Rifinah® 150 or 300</strong> <em>(rifampicin &amp; isoniazid)</em></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Dose:</strong></td>
</tr>
<tr>
<td>- Under 50kg = 3 tablets ONCE daily of Rifinah 150</td>
</tr>
<tr>
<td>- Over 50kg = 2 tablets ONCE daily of Rifinah 300</td>
</tr>
</tbody>
</table>

**PLUS**

Pyridoxine

**Dose:** 10mg – oral – od (once daily)
Second line (where combination preparations are not appropriate e.g. swallowing difficulties):

Rifampicin (for 2 month initial phase and 4 month continuation phase)
Dose:
- Under 50kg = 450mg ONCE daily
- Over 50kg = 600mg ONCE daily

PLUS
Isoniazid (for 2 month initial phase and 4 month continuation phase)
Dose: 300mg – oral – od (once daily)

PLUS
Pyridoxine (for 2 month initial phase and 4 month continuation phase)
Dose: 10mg – oral – od (once daily)

PLUS
Pyrazinamide (for 2 month initial phase only)
Dose:
- Under 50kg = 1.5g ONCE daily
- Over 50kg = 2g ONCE daily

PLUS
Ethambutol (for 2 month initial phase only)
Dose: 15mg/kg (round dose to nearest 100mg) – oral – od (once daily)
INFLUENZA (FLU)

Practice points:
- This guidance is to be used in patients admitted to secondary/tertiary care when influenza is suspected or confirmed.
- Oseltamivir or zanamivir are recommended to treat ‘at risk’ patients who can start treatment within 48 hours of onset of symptoms, or for prophylaxis within 48 hours of contact of a case of influenza.
- PHE guidelines for influenza prophylaxis and treatment

Note: Discuss cases of resistance with consultant virologist.

Criteria for use of anti-influenza drugs:
- Patients presenting with fever (>38°C), coryza, generalised symptoms (headache, malaise, myalgia, arthralgia) and sometimes GI symptoms
- Been exposed or been symptomatic with flu symptoms for less than 48 hours.
- Symptoms and signs of lower respiratory tract infection (hypoxaemia, dyspnoea, lung infiltrate) possibly due to ‘flu, central nervous system involvement and/or a significant exacerbation of an underlying medical condition
- Risk of severe complicated influenza (See below)

Risk of severe complicated influenza:
- Neurological, hepatic, renal, pulmonary and chronic cardiac disease
- Diabetes mellitus
• Age over 65 years
• Pregnancy (including up to 2 weeks post partum)
• Morbid obesity (BMI >=40)
• Severe Immunosuppression (defined as):
  o Severe primary immunodeficiency
  o Current or recent (within six months) chemotherapy or radiotherapy for malignancy
  o Solid organ transplant recipients on immunosuppressive therapy
  o Bone marrow transplant recipients currently receiving immunosuppressive treatment, or who received it within the last 12 months (longer with graft versus host disease).
  o Patients currently receiving high dose systematic corticosteroids (equivalent to >= 40 mg prednisolone per day for ≥1 week in an adult or ≥2mg/kg/day for ≥1 week in a child), and for at least three months after treatment has stopped)
  o Patients currently or recently (within six months) on other types of immunosuppressive therapy
  o HIV infected patients with severe immunosuppression (CD4<200/µl or <15% of total lymphocytes in an adult or child over five.
  o Patients currently or recently (within six months) on other types of highly immunosuppressive therapy or where the patient’s specialist regards them as severely immunosuppressed.

**Treatment:**

**First line:**

Oseltamivir  
Dose: 75 mg - oral – bd (twice a day) for 5 days

**Note:**

- Treatment of complicated influenza is sometimes extended to 10 days or longer, (e.g. patients on Critical Care): contact Consultant Medical Virologist
- Treatment of pregnant women or of patients on Critical Care for whom NG/PO oseltamivir cannot be used: contact Consultant Medical Virologist
- Dose of oseltamivir must be adjusted in renal impairment (see appendix for treatment)

**Second line (on advice of Medical Virologist):**

Zanamivir (treatment – see criteria and algorithm above)  
Dose: 10 mg - inhaler – bd (twice a day) for 5 days (may cause bronchospasm)

**Note:**

- Inhaled Zanamivir not suitable for patients on critical care: See PHE guidance on seasonal influenza: managing cases in critical care units [last accessed 12 December 2017]
- In immunocompromised patients when epidemiology indicates high prevalence of circulating influenza virus strain which is oseltamivir resistant, or which has increased likelihood to develop resistance during treatment.
- Infection with known oseltamivir-resistant virus

**Zamivir (Nebulised or Intravenous administration)**

On advice of Medical Virologist only
Prophylaxis

Hospital patients or staff contacts of influenza:
Contact Consultant Medical Virologist
Guidance on oral oseltamivir dosing in renal failure (see appendix for prophylaxis)

Comment:
- In Primary Care oseltamivir (or zanamivir) are only recommended for influenza treatment when seasonal influenza activity in the community reaches a certain threshold (In these circumstances, antivirals may be prescribed for patients in "clinical at-risk groups" as well as any who are at risk of severe illness and/or complications from influenza if not treated.)
4. Central Nervous System

**MENINGITIS (COMMUNITY-ACQUIRED)**

**Practice points:**

- **Meningitis and encephalitis (whether suspected or proven) are notifiable infections:**
  Public Health England Local Health Protection team must be notified on suspicion of meningitis.
  - **Lumbar puncture is mandatory unless contraindicated.** If LP cannot be done in the first hour, antibiotics must be given immediately after blood cultures have been taken.
  - Further investigations include Blood cultures, throat swab for bacterial culture and EDTA blood for pneumococcal and meningococcal PCR.

- Therapy should be modified according to microscopy and culture results.

- **Initial adjunctive therapy with steroids should be given in all suspected meningitis cases** at the time of commencement of antibiotics and continued for 4 days in confirmed/probable pneumococcal meningitis.

- **Listeria meningitis** is most common in those over 60 years old, but is also associated (irrespective of age) with diabetes mellitus, pregnancy, immunosuppression and steroid administration (equivalent to over 40mg prednisolone per day for more than 1 week in an adult, and for at least three months after treatment has stopped).

- For meningitis in the immunosuppressed or those with a recent history of travel abroad, please contact a Medical Microbiologist.

- If encephalitis is suspected (altered mental state, confusion, focal neurology, lymphocytic CSF) add high dose aciclovir to meningitis antibiotics (see below).
  - **Aciclovir should not be started for meningitis.**

- Duration of treatment depends on the pathogen isolated and clinical progress; from 5 days (uncomplicated meningococcal infection) and 21 days (listeria infection). Discuss with microbiologist.

- Commonest organisms: *Neisseria meningitidis*, *Streptococcus pneumoniae*, *Listeria monocytogenes*

<table>
<thead>
<tr>
<th>First line (empiric treatment):</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ceftriaxone</td>
</tr>
<tr>
<td>Dose: 2g - intravenous injection – bd (twice a day)</td>
</tr>
</tbody>
</table>

**PLUS**

| Dexamethasone                  |
| Dose: 8.3mg - intravenous injection - every 6 hours for 4 days (if confirmed/probable pneumococcal meningitis, stop dexamethasone if another cause identified) |

**PLUS amoxicillin to cover Listeria if the patient is >60 years of age, pregnant or immunocompromised (including alcohol dependency and diabetes)**

| Amoxicillin                   |
| Dose: 2g - intravenous injection - every 4 hours |

<table>
<thead>
<tr>
<th>Second line (non-severe penicillin allergy):</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ceftriaxone</td>
</tr>
<tr>
<td>Dose: 2g - intravenous injection – bd (twice a day)</td>
</tr>
</tbody>
</table>

**PLUS**

| Dexamethasone                  |
| Dose: 8.3mg - intravenous injection - every 6 hours for 4 days (if confirmed/probable |
pneumococcal meningitis, stop dexamethasone if another cause identified)

PLUS co-trimoxazole to cover Listeria if the patient is >60 years of age, pregnant or immunocompromised (including alcohol dependency and diabetes)

Co-trimoxazole
Dose: 20mg/kg/day (based on trimethoprim component, max 2.8g in 24 hours) - intravenous injection - in 4 divided doses
(Exception: If patient is pregnant discuss with microbiology)

Second line (allergy to cephalosporins or severe penicillin allergy):

Chloramphenicol
Dose: 25mg/kg - intravenous injection - every 6 hours

PLUS
Dexamethasone
Dose: 8.3mg - intravenous injection - every 6 hours for 4 days (if confirmed/probable pneumococcal meningitis, stop dexamethasone if another cause identified)

PLUS co-trimoxazole to cover Listeria if the patient is >60 years of age, pregnant or immunocompromised (including alcohol dependency and diabetes)

Co-trimoxazole
Dose: 20mg/kg/day (based on trimethoprim component, max 2.8g in 24 hours) - intravenous injection - in 4 divided doses
(Exception: If patient is pregnant discuss with microbiology)

• Note: 8.3mg dexamethasone base is approximately equivalent to 10mg dexamethasone sodium phosphate which was the dose used in the original NEJM study. This also reflects current BNF recommended dosing.

Organism-specific definitive antibiotic therapy for meningitis

<table>
<thead>
<tr>
<th>Organism</th>
<th>Treatment</th>
</tr>
</thead>
</table>
| *Neisseria meningitidis* (If the patient does not receive ceftriaxone as treatment, ensure that patient is given either ciprofloxacin or rifampicin to eliminate carriage) | **First line:**  
  Ceftriaxone  
  Dose: 2g - intravenous injection - twice a day for 5 days  
  For cases of close patient contact requiring prophylaxis see guideline  
  **Second line (cephalosporin allergy or severe penicillin allergy):**  
  Chloramphenicol  
  Dose: 15 to 25mg/kg - intravenous injection - every 6 hours (usually 1g every 6 hour)  
  PLUS to eradicate carriage:  
  Ciprofloxacin  
  Dose: 500mg – oral - one dose  
  OR  
  Rifampicin  
  Dose: 600mg - oral - twice a day - 2 days |
| *Streptococcus*         | **First line**                                                                                                                                |
| **Streptococcus pneumoniae** (Penicillin and cephalosporin resistant) | Ceftriaxone  
Dose: 2g - intravenous injection - twice a day - 10 to 14 days  

If severe (immediate) penicillin or cephalosporin allergy: Discuss with microbiologist  
Antibiotic treatment according to sensitivity results - options:  
Chloramphenicol  
Dose: 25mg/kg - intravenous injection - every 6 hours - 10 to 14 days  
OR  
Linezolid  
Dose: 600mg – oral / IV - twice a day - 10 to 14 days  
PLUS  
Rifampicin  
Dose: 600mg - oral - twice a day - 10 to 14 days |
| --- | --- |
| **Haemophilus influenzae**  
(If the patient does not receive ceftriaxone as treatment, discuss with microbiologist elimination of carriage) | Ceftriaxone  
Dose: 2g - intravenous injection - twice a day - 14 days  
PLUS  
Vancomycin for 14 days  
Dose: See Vancomycin guidelines for dosing and monitoring. Aim pre-dose levels between 15-20mg/L  
PLUS  
Rifampicin  
Dose: 600mg - oral - twice a day - 14 days  
If severe (immediate) penicillin or cephalosporin allergy: Discuss with microbiologist  
Antibiotic treatment according to sensitivity results - options:  
Chloramphenicol  
Dose: 25mg/kg - intravenous injection - every 6 hours - 14 days |
| **Listeria monocytogenes** | Amoxicillin  
Dose: 2g - intravenous injection - every 4 hours for 21 days  
In case of penicillin allergy:  
(Except: If patient is pregnant discuss with microbiology)  
Co-trimoxazole  
Dose: 20 mg/kg daily (based on the trimethoprim component) - |
VIRAL ENCEPHALITIS

Practice points:

- **Meningitis and encephalitis (whether suspected or proven) are notifiable infections:** Public Health England Local Health Protection team must be notified on suspicion of meningitis.
- **Lumbar puncture is mandatory unless contraindicated (please ensure viral PCR is requested on the CSF sample).**
- **Treatment for patients suspected of viral encephalitis should be immediately instituted and not withheld for results of diagnostic tests to be available**
- **Organisms: Herpes simplex virus (HSV), varicella-zoster virus (VZV)**

**First line (empirical therapy):**

Aciclovir
Dose: 10 mg per kg - intravenous injection - three times a day (round dose to nearest 25mg)

For patients with confirmed herpes simplex virus (HSV) encephalitis, intravenous aciclovir treatment should be continued for 14-21 days (at least 21 days in immunocompromised patients), and a repeat LP performed at this time to confirm the CSF is negative for HSV by PCR; if the CSF is still positive, aciclovir should continue intravenously, with weekly PCR until it is negative.

**Comment:**

- There is no oral treatment for viral encephalitis.
- Mortality in untreated patients is in excess of 70% and fewer than 10% of patients are left without significant neurological sequelae.

**Reference:**

Practice points:

- **Empirical antibiotics must be reviewed when microbiology results are known.**

- **POST-NEUROSURGICAL OPERATION MENINGITIS**
  
  - Aseptic meningitis (manifested by persisting or increasing headache, with or without pyrexia and associated with CSF pleocytosis) is very common in the early post-operative period, following intracranial or spinal intradural procedures and is most often due to chemical irritation of the meninges (i.e. chemical meningitis).
  
  - Aseptic meningitis is especially likely if the CSF mononuclear count is elevated to a greater extent than the polymorphonuclear count. Each patient should therefore be evaluated on an individual basis, taking into account both clinical features and laboratory markers, such as CRP and white cell count. In some cases, if the patient is not unduly ill, it may be appropriate to consider withholding antibiotics, pending results of culture. Discuss with senior member of the neurosurgical team.

- **EVD - ASSOCIATED MENINGITIS AND VENTRICULITIS**
  
  - Prevention:
    - Antibiotic-impregnated catheters should be used whenever possible
    - The apparatus should be interfered with (e.g. by sampling) to the minimum degree possible
    - EVD should be removed as soon as possible
  
  - Treatment
    - In patients with established EVD infections, timing of re-sampling to assess response to treatment should be at the discretion of the Consultant Neurosurgeon in charge of the patient

- **CSF SHUNT- ASSOCIATED INFECTIONS**
  
  - Infected shunts cannot be treated effectively with antibiotics alone. In most instances, the shunt will need removing.
  
  - At the time the apparatus is removed a single dose of an intraventricular antibiotic can be administered. If the patient is dependent on CSF diversion an external drainage system may need to be inserted to replace the implanted shunt system.
  
  - Thereafter, empirical antibiotic therapy should be commenced
  
  - Shunt re-implantation should be undertaken as decided by the Consultant Neurosurgeon supervising the patient's care.

### First line (empirical therapy):

**Meropenem**

Dose: 2g - intravenous injection – tds (every 8 hours)

**PLUS**

**Vancomycin**

Dose: see [intravenous vancomycin – intermittent infusion](#) guideline for dosing and monitoring. Aim pre-dose levels between 15-20mg/L

### Second line (Severe penicillin allergy):

**Ciprofloxacin**

Dose: 600mg – intravenous injection – bd (every 12 hours)

**PLUS**

**Vancomycin**

Dose: see [intravenous vancomycin – intermittent infusion](#) guideline for dosing and monitoring. Aim pre-dose levels between 15-20mg/L
If bacterial ventriculitis is confirmed, consider using intraventricular antibiotics under the direction of the Consultant Neurosurgeon in charge of the patient. Dose to be determined according to the total daily volume of CSF draining and ventricle size.

Organism-specific antibiotic therapy for post-operative meningitis

<table>
<thead>
<tr>
<th>Organism</th>
<th>Treatment</th>
</tr>
</thead>
</table>
| Enterobacteriaceae ("coli forms") eg. E. coli, Enterobacter sp. Klebsiella sp. | **First line:** Meropenem  
Dose: 2 g - intravenous injection – tds (three times a day) for 10 to 21 days  

**Second line (penicillin allergy):**  
Discuss with microbiologist. **Antibiotic treatment according to antimicrobial sensitivity results - option:**  
Ciprofloxacin  
Dose: 600mg - intravenous infusion over 60 minutes - every 12 hours for 10 to 21 days |
| Pseudomonas aeruginosa                            | **First line:** Ceftazidime  
Dose : 2g - intravenous injection – tds (three times a day)  
Duration: 10 to 21 days  

If severe (immediate) penicillin or cephalosporin allergy: according to antimicrobial sensitivity  
Discuss with microbiologist  
Ciprofloxacin  
Dose: 600mg - intravenous infusion over 60 minutes - every 12 hours for 10 to 21 days |
| Meticillin sensitive S. aureus (MSSA)            | Flucloxacillin  
Dose: 2 to 3g - intravenous injection - four times a day for 10 to 21 days  

+/-  
Rifampicin  
Dose: 600mg - oral – bd (twice a day)  

**Second line (penicillin allergy):**  
Vancomycin  
Dose: see intravenous vancomycin – intermittent infusion guideline for dosing and monitoring. Aim pre-dose levels between 15-20mg/L)  

PLUS  
Rifampicin  
Dose: 600mg - oral – bd (twice a day) |
| MRSA Or Coagulase negative staphylococci         | Vancomycin  
Dose: see intravenous vancomycin – intermittent infusion guideline for dosing and monitoring. Aim pre-dose levels between 15-20mg/L) for 10 to 21 days |
<table>
<thead>
<tr>
<th>PLUS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rifampicin</td>
</tr>
<tr>
<td>Dose: 600mg - oral – bd (twice a day) for 10 to 21 days</td>
</tr>
</tbody>
</table>

**Second line (Discuss with microbiologist. Antibiotic treatment according to sensitivity results – options):**

Co-trimoxazole
Dose: 20 mg/kg daily (based on trimethoprim dose) - intravenous injection - split into 6 to 12 hourly doses

OR

Linezolid
Dose: intravenous infusion over 60 minutes - 600mg - twice a day

Reference:
INTRAVENTRICULAR and LUMBAR INTRATHECAL ADMINISTRATION OF ANTIBIOTICS

Practice points
- The decision to administer intraventricular antibiotics is made by the Consultant Neurosurgeon since it requires authorisation to access the EVD.
- Administration of antibiotics into the EVD or Intrathecally must only be done by members of the neurosurgical medical team and by trained members of staff only.

### Reconstitution:

**Vancomycin** is available as dry powder; always use the 1g vial (to avoid CSF irritants present in other strengths available).
- Always use a new vial of vancomycin for each patient dose.
- Use preservative-free normal saline 0.9% to reconstitute as follow:
  - **Preparation:**
    - Must be done aseptically using sterile gloves
    - Add 20ml of sterile water for injection to the sterile powder in 1g vial (resulting concentration of the solution is 50mg/ml)
    - Prepare final dose by drawing up 0.4ml (20mg) and dilute with 1.6ml of preservative free normal saline 0.9% to give a total volume of 2ml.
    - Each ml of the diluent is equivalent to 10 mg of sterile vancomycin.
    - Reconstituted vials are for immediate use only. The remaining unused vial portion must be discarded.

**Gentamicin intrathecal solution for injection** (5mg/ml) vials are preservative free and do not require dilution. DO NOT use intravenous preparation for reconstitution.
- Each ml of vial contains 5mg of gentamicin
- Once opened vials are for immediate use only. The remaining unused vial portion must be discarded. Use a new vial of gentamicin for each patient dosing.

<table>
<thead>
<tr>
<th>Antibiotic</th>
<th>DOSE (According to ventricle size)</th>
<th>ANTIMICROBIAL FREQUENCY (According to CSF drainage since previous dose)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Ventricles less than normal size</td>
<td>Ventricles normal size</td>
</tr>
<tr>
<td><strong>Vancomycin</strong></td>
<td>5mg</td>
<td>10mg</td>
</tr>
<tr>
<td><strong>Gentamicin</strong></td>
<td>2mg</td>
<td>3mg</td>
</tr>
<tr>
<td><strong>Colistin</strong></td>
<td>50,000 units</td>
<td>100,000 units</td>
</tr>
</tbody>
</table>
Practice points:
- Tuberculosis is a notifiable infection: The Public Health England Local Health Protection team must be notified.
- All patients with suspected / confirmed pulmonary tuberculosis should be tested for HIV infection.
- In general anti-TB treatment should only be started on the advice of a Respiratory Physician, or for patients with HIV, a GUM physician. Patients must be referred to Respiratory Medicine or GUM.
- On-going tuberculosis management should be supervised by a Respiratory Physician or GUM Physician.

A) Patients with active meningeval TB should be given 12 months treatment:

First Line (when using combined preparations):

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</tr>
<tr>
<td>Dose: 15mg / kg –oral – od (once daily)</td>
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<td>Note: patients to be treated with Ethambutol need a baseline visual acuity test prior to starting treatment</td>
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<td>PLUS</td>
</tr>
<tr>
<td>Pyridoxine</td>
</tr>
<tr>
<td>Dose: 10mg – oral – od (once daily)</td>
</tr>
</tbody>
</table>

followed by

<table>
<thead>
<tr>
<th>For 10 month continuation phase use (double therapy)</th>
</tr>
</thead>
<tbody>
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<td>Rifinah® 150 or 300 (rifampicin &amp; isoniazid)</td>
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<tr>
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<tr>
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</tr>
<tr>
<td>• Over 50kg = 2 tablets ONCE daily of Rifinah 300</td>
</tr>
<tr>
<td>PLUS</td>
</tr>
<tr>
<td>Pyridoxine</td>
</tr>
<tr>
<td>Dose: 10mg – oral – od (once daily)</td>
</tr>
</tbody>
</table>
Second line (where combination preparations are not appropriate e.g. swallowing difficulties):

Rifampicin (for 2 month initial phase and 10 month continuation phase)
Dose:
- Under 50kg = 450mg ONCE daily
- Over 50kg = 600mg ONCE daily

PLUS
Isoniazid (for 2 month initial phase and 10 month continuation phase)
Dose: 300mg – oral – od (once daily)

PLUS
Pyridoxine (for 2 month initial phase and 10 month continuation phase)
Dose: 10mg – oral – od (once daily)

PLUS
Pyrazinamide (for 2 month initial phase only)
Dose:
- Under 50kg = 1.5g ONCE daily
- Over 50kg = 2g ONCE daily

PLUS
Ethambutol (for 2 month initial phase only)
Dose: 15mg/kg (round dose to nearest 100mg) – oral – od (once daily)

PLUS
Prednisolone
Dose: 20 to 40 mg - orally – od (once a day). With gradual withdrawal of the glucocorticoid considered, starting within 2 to 3 weeks of initiation.

B) Patients with active spinal TB should be given with 6 months treatment:

First Line (when using combined preparations):

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<th>For 2 month initial phase use (Quadruple therapy)</th>
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</tr>
<tr>
<td>- 50-64kg = 5 tablets ONCE daily</td>
</tr>
<tr>
<td>- Over 65kg = 6 tablets ONCE daily</td>
</tr>
</tbody>
</table>

PLUS
Ethambutol
Dose: 15mg / kg –oral – od (once daily)
Note: patients to be treated with Ethambutol need a baseline visual acuity test prior to starting treatment

PLUS
Pyridoxine
Dose: 10mg – oral – od (once daily)

PLUS
Prednisolone
Dose: 20 to 40 mg - orally – od (once a day). With gradual withdrawal of the glucocorticoid considered, starting within 2 to 3 weeks of initiation.

followed by

For 4 month continuation phase use (double therapy)

Rifinah® 150 or 300 (rifampicin & isoniazid)
Dose:
  - Under 50kg = 3 tablets ONCE daily of Rifinah 150
  - Over 50kg = 2 tablets ONCE daily of Rifinah 300

PLUS
Pyridoxine
Dose: 10mg – oral – od (once daily)

Second line (where combination preparations are not appropriate e.g. swallowing difficulties):

Rifampicin (for 2 month initial phase and 4 month continuation phase)
Dose:
  - Under 50kg = 450mg ONCE daily
  - Over 50kg = 600mg ONCE daily

PLUS
Isoniazid (for 2 month initial phase and 4 month continuation phase)
Dose: 300mg – oral – od (once daily)

PLUS
Pyridoxine (for 2 month initial phase and 4 month continuation phase)
Dose: 10mg – oral – od (once daily)

PLUS
Pyrazinamide (for 2 month initial phase only)
Dose:
  - Under 50kg = 1.5g ONCE daily
  - Over 50kg = 2g ONCE daily

PLUS
Ethambutol (for 2 month initial phase only)
Dose: 15mg/kg (round dose to nearest 100mg) – oral – od (once daily)

PLUS
Prednisolone
Dose: 20 to 40 mg - orally – od (once a day). With gradual withdrawal of the glucocorticoid considered, starting within 2 to 3 weeks of initiation.

Comment:
  - CT or MRI scan should be performed on patients with active spinal TB who have neurological signs or symptoms.
  - If there is direct spinal cord involvement (for example, a spinal cord tuberculoma), management should be as for meningeal TB.
  - Many cases of spinal TB can be managed medically but there may be a case for surgery and individual cases should be discussed with Consultant Neurosurgeon.
BRAIN ABSCESS

Practice points:
- Surgical drainage is normally required to reduce the local space-occupying effect, to improve blood perfusion of the abscess capsule and to obtain a sample prior to initiation of antibiotic therapy
- The microbial investigation of the pus is one of the most important factors in the management of a brain abscess.
- If it is considered safe to postpone surgery for any period at all - and this would only be a matter of hours at most - then initiation of antibiotics should also be deferred, until the microbiology specimen is obtained at the time surgery is performed.
- There may be occasions when aspiration of an abscess is deemed unduly risky, e.g. a small, deep-seated lesion but with multiple abscesses at least one lesion can normally be accessed, using image guidance.
- A brain abscess is almost always secondary to a focus of sepsis elsewhere in the body and may develop either by spread from a contiguous focus of infection, by direct inoculation (such as after neurosurgery or penetrating head trauma) or by haematogenous spread from a distant focus, such as infective endocarditis or infective pulmonary pathology.
- The commonest pathogens are bacteria (such as staphylococci, streptococci, anaerobes, Nocardia sp.), but fungi are also encountered and the aetiology is polymicrobial in over 40% of cases.
- Haematogenous spread may also be facilitated by right to left heart shunts
- Specific therapy is subsequently guided by culture results and antibiotic sensitivities
- Total duration of therapy is usually 6 weeks, depending on clinical and radiological progress
- Always discuss the antibiotic choices with microbiologist but initial empiric therapy should be:

<table>
<thead>
<tr>
<th>First line:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ceftriaxone</td>
</tr>
<tr>
<td>Dose: 2g - intravenous injection – bd (twice a day)</td>
</tr>
</tbody>
</table>

PLUS

| Metronidazole |
| Dose: 500mg - intravenous injection – tds (three times a day) or 400mg – orally – three times a day (when patient able to take oral tablets) |

<table>
<thead>
<tr>
<th>Second line (severe penicillin allergy / MRSA positive):</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vancomycin</td>
</tr>
<tr>
<td>Dose: see intravenous vancomycin – intermittent infusion guideline for dosing and monitoring. Aim pre-dose levels between 15-20mg/L)</td>
</tr>
</tbody>
</table>

PLUS

| Ciprofloxacin |
| Dose: 600mg – intravenous – bd (twice daily) |

PLUS

| Metronidazole |
| Dose: 500mg – intravenous – bd (twice daily) |
SPINAL EPIDURAL ABSCESS (SEA)

See Guideline

NEUROSUGICAL WOUND INFECTIONS
(cranial or spinal)

A. Early infections (within 4 weeks of surgery)

- Superficial infections may respond to antibiotics alone. Deep infections may require surgical drainage or debridement, as determined by the surgical team. The extent of infection should be assessed with appropriate imaging such as CT head or MRI spine.
- Normal duration of treatment 1 to 2 weeks, according to clinical response

<table>
<thead>
<tr>
<th>First choice:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flucloxacillin</td>
</tr>
<tr>
<td>Dose: 1g to 2g (depending on severity) - intravenous injection – qds (four times a day) for 7 - 14 days (review clinical response) or 500mg to 1g – orally – four times a day.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Second line (penicillin allergy):</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clindamycin</td>
</tr>
<tr>
<td>Dose: 300mg to 600mg (depending on severity) - intravenous injection – qds (four times a day). Switch to oral if patient can swallow as clindamycin has the same bioavailability IV and oral - 300mg to 450mg – orally – four times a day.</td>
</tr>
<tr>
<td>Duration: 7 to 14 days (review clinical response)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Second line (MRSA positive):</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oral options:</td>
</tr>
<tr>
<td>Doxycycline (only use if MRSA is tetracycline sensitive)</td>
</tr>
<tr>
<td>Dose: 200mg STAT dose followed by 100mg - oral - once a day thereafter (review clinical response).</td>
</tr>
</tbody>
</table>

OR

| Clindamycin (only use if MRSA is erythromycin or clindamycin sensitive) |
| Dose: 300mg to 450mg (depending on severity) - oral - four times a day (review clinical response). |

<table>
<thead>
<tr>
<th>For more severe infections:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vancomycin</td>
</tr>
<tr>
<td>Dose: see intravenous vancomycin – intermittent infusion guideline for dosing and monitoring. Aim pre-dose levels between 15-20mg/L)</td>
</tr>
</tbody>
</table>

PLUS
Rifampicin
Dose: 300mg – oral - bd (twice a day) for 7-14 days (review clinical response). |
B. Chronic infections

The extent of infection should, once again, be assessed with appropriate imaging such as CT head or MRI spine.

i. **Bone flap infections:** normally an infected bone flap should be removed. Bone flap infections (osteomyelitis) require at least 6 weeks antibiotics (pending response). To guide antibiotic use for this long period, samples should be sent to the laboratory, preferably before initiation of antibiotic therapy.

<table>
<thead>
<tr>
<th>Empirical treatment:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vancomycin</td>
</tr>
<tr>
<td>Dose: see <a href="#">intravenous vancomycin – intermittent infusion</a> guideline for dosing and monitoring. Aim pre-dose levels between 15-20mg/L)</td>
</tr>
<tr>
<td><strong>PLUS</strong></td>
</tr>
<tr>
<td>Rifampicin</td>
</tr>
<tr>
<td>Dose: 300mg - oral - twice a day</td>
</tr>
</tbody>
</table>

ii. **Deep post-operative spinal infections:** commonly require drainage, debridement and microbiological sampling prior to antibiotic therapy is vital

<table>
<thead>
<tr>
<th>Empirical treatment:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Meropenem</td>
</tr>
<tr>
<td>Dose: 1g – intravenous – three times a day</td>
</tr>
<tr>
<td><strong>PLUS</strong></td>
</tr>
<tr>
<td>Vancomycin</td>
</tr>
<tr>
<td>Dose: see <a href="#">intravenous vancomycin – intermittent infusion</a> guideline for dosing and monitoring. Aim pre-dose levels between 15-20mg/L)</td>
</tr>
</tbody>
</table>
5. Genito-urinary System

UNCOMPPLICATED Lower UTI

Practice points:
- Organisms: *Escherichia coli*, *Enterococcus spp.*, *Proteus spp*, *Klebsiella spp*, *Staphylococcus saprophyticus*
- Send urine sample for MCS
- Check previous cultures and sensitivities including alert organisms
- A positive urine dipstick test is not an indication for antibiotics, particularly in older adults
- Nitrofurantoin is only to be used in the ABSENCE of systemic illness
- Consider a pregnancy test is females of childbearing ages prior to starting therapy

First line:

Nitrofurantoin modified release (MR) capsules
Dose: 100mg - oral – bd (twice daily), dose to be taken with food
Duration: 3 days non-pregnant woman OR 7 days in male patients
Note: Do not use in patients with an eGFR or CrCl <45 ml/min

Second line:

Trimethoprim
Dose: 200mg - oral – bd (twice a day)
Duration: 3 days non-pregnant woman OR 7 days in male patients.

In pregnancy:

Non-severe:

<table>
<thead>
<tr>
<th>1st and 2nd trimester (0 – 26 weeks)</th>
<th>Nitrofurantoin modified release (MR) capsules (AVOID IN THIRD TRIMESTER because of risk of neonatal haemolysis)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dose: 100mg - oral – bd (twice daily), dose to be taken with food for 7 days</td>
<td>Do not use in patients with an eGFR&lt;45 ml/min</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>2nd and 3rd trimester (14 – 40 weeks)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trimethoprim (AVOID IN FIRST TRIMESTER)</td>
</tr>
<tr>
<td>Dose 200mg - oral – bd (twice a day) for 7 days</td>
</tr>
<tr>
<td>Contraindicated if folate deficient</td>
</tr>
</tbody>
</table>

Severe / second line:

<table>
<thead>
<tr>
<th>All trimesters</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cefotaxime</td>
</tr>
<tr>
<td>Dose: 1g – intravenous – bd (twice a day) until stable</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Oral switch</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cefalexin</td>
</tr>
<tr>
<td>Dose: 500mg – oral – bd (twice a day) for 7 days</td>
</tr>
</tbody>
</table>

Reference:
### COMPLICATED UTI / PYELONEPHRITIS / UTI IN A CATHETERISED PATIENT

**Practice points:**
- For patient with RED FLAG SEPSIS associated with UTI in a catheterised patient, see [sepsis guideline](#).
- **Organisms:** *Escherichia coli, Klebsiella spp., Proteus spp., Pseudomonas spp.* and rarely *Staphylococcus aureus* (includes MRSA).
- Check previous cultures and sensitivities including alert organisms.
- Urinary dipsticks will be positive in the majority of elderly patients and those with a catheter. This should **NOT** be an indication for therapy.
- Ensure MSU / CSU sample sent at onset of symptoms.
- All urinary catheters will become colonised, therefore bacterial growth from CSU samples must be interpreted in the context of clinical urinary tract symptoms:
  - New costovertebral (renal angle) tenderness
  - Rigors
  - New onset delirium
  - Fever (greater than 38°C, or 1.5°C above baseline on two occasions during 12 hours)
- Long term urinary catheters (suprapubic or urethral) should be changed early in the treatment course for a symptomatic CA-UTI.
- **Fever in patients with pyelonephritis can be protracted last up to 3-4 days post starting of antibiotics**
- **Duration:**
  - Complicated UTI or UTI in catheterised patients require 7 days total of antimicrobial therapy. If prompt resolution of symptoms consider oral switch at 48 hours.
  - Pyelonephritis: Patients require 14 days treatment with a consideration to an oral switch once the patient has clinically improved (unless oral ciprofloxacin is used for treatment, in which case a 7 day-course is adequate).

<table>
<thead>
<tr>
<th><strong>First line:</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Piperacillin / tazobactam</td>
</tr>
<tr>
<td>Dose: 4.5g – Intravenous – tds (thrice daily)</td>
</tr>
<tr>
<td><strong>NB:</strong> Review therapy after 48-72hrs and check MSU / CSU results and adjust treatment accordingly</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Oral switch (see IV to oral guideline for advice on switching):</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Check MSU / CSU results and adjust treatment accordingly. Consider following for oral switch:</td>
</tr>
<tr>
<td>Co-amoxiclav</td>
</tr>
<tr>
<td>Dose: 625mg – oral – tds (three times daily)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Second line (penicillin allergy):</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Ciprofloxacin</td>
</tr>
<tr>
<td>Dose (oral) : 500mg – bd (twice a day)</td>
</tr>
<tr>
<td>Dose (intravenous if patient unable to swallow medication): 400mg – bd (twice a day)</td>
</tr>
<tr>
<td><strong>NB:</strong> Review therapy after 48-72hrs and check MSU / CSU results and adjust treatment accordingly.</td>
</tr>
</tbody>
</table>
Patient with history / suspected MRSA

Add to above regimen
Vancomycin
Dose: see intravenous vancomycin – intermittent infusion guideline for dosing and monitoring.

Reference:

PELVIC INFLAMMATORY DISEASE (PID)

Practice points:
- Referral to GU Medicine for initial assessment, extensive STI screen testing, contact tracing and follow up.
- Use endocervical swab for NAAT. Send for Gram stain, culture and sensitivity.
- Perform a pregnancy test and HIV screening.
- Organisms: Neisseria gonorrhoeae, Chlamydia trachomatis, anaerobes

Outpatient Treatment (Mild Disease)

First line:
Ceftriaxone (SINGLE DOSE)
Dose: 500mg – IM (intramuscular injection) - stat (if intra-muscular route is contraindicated, give intravenously instead)

Followed by:
- Doxycycline
  Dose: 100mg - oral – bd (twice a day) for 14 days
- PLUS
  Metronidazole
  Dose: 400mg - oral – bd (twice a day) for 14 days

Second line (severe penicillin allergy or cephalosporin allergy):
Levofloxacin
Dose: 500mg - oral – od (once a day) for 14 days

PLUS
Metronidazole
Dose: 400mg - oral – bd (twice a day) for 14 days
**Inpatient Treatment (Severe Disease)**

**First line:**

Ceftriaxone  
Dose: 2g – IV (intravenous injection) – od (once a day)  
Duration: Until suitable clinical response

**PLUS**

Metronidazole  
Dose: 500mg – IV (intravenous injection) – tds (three times a day) for 3 doses followed by 400mg - orally – bd (twice a day) for 14 days in total

**PLUS**

Doxycycline  
Dose: 100mg - oral - twice a day  
Duration: 14 days

**Second line (severe penicillin allergy):**

Clindamycin  
Dose: 900mg – IV (intravenous injection) – tds (three times a day)

**PLUS**

Gentamicin  
Dose: See gentamicin prescribing guideline

---

**TO BE FOLLOWED AFTER SUITABLE CLINICAL RESPONSE BY**

Clindamycin  
Dose: 450mg - oral – qds (four times a day) for 14 days

**PLUS**

Metronidazole  
Dose: 400mg - oral – bd (twice a day) for 14 days in total

---

**Reference:**

- British Association for Sexual Health and HIV guideline, UK National Guideline for the Management of Pelvic Inflammatory Disease 2011
- See also [http://www.uhb.nhs.uk/Downloads/pdf/umbrella-guidelines/PelvicInflammatoryDisease.pdf](http://www.uhb.nhs.uk/Downloads/pdf/umbrella-guidelines/PelvicInflammatoryDisease.pdf)
EPIDIDYMO-ORCHITIS

Practice points:
- **EXCLUDE TESTICULAR TORSION**
- Organisms: *Neisseria gonorrhoeae, Chlamydia trachomatis, coliforms*
- Send MSU
- Send urine specimen for *Chlamydia trachomatis* and gonorrhoea NAAT.
- Review therapy once results available
- Consider mumps as part of the differential diagnosis and send serology for diagnosis if clinically appropriate
- Although rare, consider tuberculosis in subacute presentations of epididymo-orchitis in populations with epidemiological risk factors

A) STI considered likely from the history.

<table>
<thead>
<tr>
<th>Ceftriaxone (SINGLE DOSE)</th>
<th>Dose: 500mg – IM (intramuscular injection) – stat (if intra-muscular route is contraindicated, give intravenously instead at 2g STAT)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>PLUS</strong></td>
<td>Doxycycline</td>
</tr>
<tr>
<td>Dose: 100mg - oral – bd (twice a day) for 10-14 days</td>
<td></td>
</tr>
</tbody>
</table>

B) STI considered highly unlikely from the history.

| Ciprofloxacin            | Dose: 500mg - oral – bd (twice a day) for 10-14 days |

Reference:

ACUTE PROSTATITIS

Practice points:
- Organisms: Coliforms, *Pseudomonas aeruginosa, enterococci, Staphylococcus aureus*
- Take blood cultures and MSU.
- Do not perform prostatic massage as this is very painful and may precipitate bacteraemia.

Requiring IV treatment (unable to swallow medication):

| Ceftriaxone | Dose: 1g – IV (intravenous injection) – bd (twice a day). Review to oral once patient able to swallow. |

Oral treatment / oral switch

| Ciprofloxacin | Dose: 500mg - oral – bd (twice a day) for 28 days (review microbiology results) |

Reference:
- Recommendations are from the previous British Association for Sexual Health and HIV guideline (www.bashh.org/documents/1844.doc), 2008.
6. Musculo-skeletal System

NATIVE JOINT SEPTIC ARTHRITIS

Practice points:
- Blood cultures should be taken before treatment in all cases
- Joint aspiration for microscopy and culture (prior to treatment if possible)
- Orthopaedic referral for consideration of washout
- Joints must be aspirated to dryness or surgically washed out, may require repeat procedure
- Immunocompromised patients, previous joint surgery, people who inject drugs, recurrent UTIs – seek Microbiologist opinion re antibiotics
- Treatment duration minimum 3 weeks, but guided by expert review and clinical progress
- Organisms (typical): *Staphylococcus aureus*, beta-haemolytic streptococci

<table>
<thead>
<tr>
<th>First line</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Total minimum duration of antibiotics is 3 weeks - patient needs review by experienced clinician before stopping antibiotics</strong></td>
</tr>
<tr>
<td>Flucloxacillin</td>
</tr>
<tr>
<td>Dose: 2g - intravenous injection – qds (four times a day) for minimum of 2 weeks</td>
</tr>
<tr>
<td>(Use benzylpenicillin 1.8g - intravenous injection - four times a day as an alternative to IV flucloxacillin, if the organism is sensitive to penicillin)</td>
</tr>
<tr>
<td><strong>Oral switch option:</strong></td>
</tr>
<tr>
<td>(based on clinical response, see Comment below) to complete minimum three weeks therapy:</td>
</tr>
<tr>
<td>Clindamycin (check sensitivities; can also use clindamycin if organism is erythromycin sensitive)</td>
</tr>
<tr>
<td>Dose: 450mg - oral – qds (four times a day)</td>
</tr>
<tr>
<td><strong>NB: Switch to oral flucloxacillin must not be made, since flucloxacillin GI absorption is unpredictable and may not provide adequate tissue levels.</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Second line (penicillin allergy):</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Total minimum duration of antibiotics is 3 weeks - patient needs review by experienced clinician before stopping antibiotics</strong></td>
</tr>
<tr>
<td>Clindamycin</td>
</tr>
<tr>
<td>Dose: 600mg - intravenous injection – qds (four times a day) for minimum of 2 weeks</td>
</tr>
<tr>
<td><strong>Oral switch option:</strong></td>
</tr>
<tr>
<td>(based on clinical response, see Comment below) to complete minimum of three weeks:</td>
</tr>
<tr>
<td>Clindamycin (check sensitivities; can also use clindamycin if organism is erythromycin sensitive)</td>
</tr>
<tr>
<td>Dose: 450mg - oral – qds (four times a day)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Second line (If current or past MRSA – check erythromycin / clindamycin / rifampicin and fusidic acid susceptibilities):</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Total minimum duration of antibiotics is 3 weeks (patient needs review by experienced clinician before stopping antibiotics)</strong></td>
</tr>
<tr>
<td>Clindamycin (if erythromycin or clindamycin sensitive) for minimum of 2 weeks</td>
</tr>
<tr>
<td>Dose: 600mg - intravenous injection - four times a day</td>
</tr>
<tr>
<td><strong>OR</strong></td>
</tr>
<tr>
<td>Vancomycin</td>
</tr>
</tbody>
</table>
Dose: see *intravenous vancomycin – intermittent infusion* guideline for dosing and monitoring. Aim pre-dose levels between 15-20mg/L)

**PLUS**
Rifampicin
Dose: 300mg - oral – bd (twice a day) for minimum of 2 weeks

**OR**

**(If resistance to rifampicin or patient unable to tolerate)**

Vancomycin
Dose: see *intravenous vancomycin – intermittent infusion* guideline for dosing and monitoring. Aim pre-dose levels between 15-20mg/L)

**PLUS**
Sodium fusidate
Dose: 500mg - oral - three times a day for minimum of 2 weeks

Oral switch option:
**(Based on clinical response, see Comment below) to complete minimum of three weeks. Patient needs review by experienced clinician before stopping antibiotics):**

Clindamycin (check sensitivities; can use clindamycin if organism is erythromycin or clindamycin sensitive)
Dose: 450mg - oral - four times a day

For other options consult Medical Microbiologist

**Comment:**
- The optimum duration of antibiotic therapy is not clearly established.
- A pragmatic approach of intravenous antibiotics for 2 weeks followed by at least a week further of oral antibiotics seems appropriate as long as there is clinical resolution of the infection. Guidelines from a joint working party from the British Society for Rheumatology, the British Orthopaedic Association and the British Society of Antimicrobial Chemotherapy recommend up to 2 weeks of intravenous antibiotics then oral antibiotics for a further 4 weeks. (Mathews et al, *Rheumatology* 2006, 45:1039-1041) available from the British Society of Antimicrobial Chemotherapy (www.bsac.org.uk).
- A cohort study (Syrogiannopoulos & Nelson *Lancet* 1988:37-40) has shown that the majority of septic arthritis is cured by 3 weeks of antibiotic therapy.
- After a minimum of 14 days of intravenous therapy, treatment can be converted to a suitable oral regime if response is rapid but should be more prolonged if response is slow. Optimal oral regimes should be guided by antibiotic susceptibility results.
- Patients should be reviewed by an experienced clinician before antibiotics are stopped.
ACUTE OSTEOMYELITIS  
(HAEMATOGENOUS AND NOT TRAUMA-RELATED)  
(excluding vertebral osteomyelitis, osteomyelitis in diabetic foot or skull)

Practice points:
- Refer to Orthopaedics
- Take blood cultures and discuss sampling with Orthopaedics or Musculo-Skeletal radiologists prior to antibiotic treatment
- Surgical debridement usually required in adults
- **Total minimum duration of antibiotics is 6 weeks**
- Organisms: *Staphylococcus aureus*, beta-haemolytic streptococci

### First line – total minimum duration of antibiotics is 6 weeks:

Flucloxacillin  
Dose: 2g - intravenous injection – qds (four times a day) for minimum of 2 weeks

(Use benzylpenicillin 1.8g - intravenous injection - four times a day as an alternative to IV flucloxacillin, if the organism is sensitive to penicillin)

**Oral switch options**: see below. Switch to oral flucloxacillin must not be made, since flucloxacillin GI absorption is unpredictable and may not provide adequate tissue levels.

### Second line (penicillin allergic):

<table>
<thead>
<tr>
<th>Total minimum duration of antibiotics is 6 weeks</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Clindamycin</strong></td>
</tr>
<tr>
<td>Dose: 600mg - intravenous injection - four times a day - 2 weeks minimum</td>
</tr>
</tbody>
</table>

**Oral switch options**: see below.

### Second line (If current or past MRSA – check erythromycin / clindamycin / rifampicin and fusidic acid susceptibilities):

<table>
<thead>
<tr>
<th>Total minimum duration of antibiotics is 6 weeks</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Clindamycin (if erythromycin or clindamycin sensitive) for minimum of 2 weeks</strong></td>
</tr>
<tr>
<td>Dose: 600mg - intravenous injection - four times a day</td>
</tr>
</tbody>
</table>

**OR**

<table>
<thead>
<tr>
<th>Total minimum duration of antibiotics is 6 weeks</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Vancomycin</strong></td>
</tr>
<tr>
<td>Dose: see intravenous vancomycin – intermittent infusion guideline for dosing and monitoring. Aim pre-dose levels between 15-20mg/L</td>
</tr>
</tbody>
</table>

**PLUS**

<table>
<thead>
<tr>
<th>Total minimum duration of antibiotics is 6 weeks</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Rifampicin</strong></td>
</tr>
<tr>
<td>Dose: 300mg - oral – bd (twice a day) for minimum of 2 weeks</td>
</tr>
</tbody>
</table>

**OR**

<table>
<thead>
<tr>
<th>Total minimum duration of antibiotics is 6 weeks</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Vancomycin</strong></td>
</tr>
<tr>
<td>Dose: see intravenous vancomycin – intermittent infusion guideline for dosing and monitoring. Aim pre-dose levels between 15-20mg/L</td>
</tr>
</tbody>
</table>

**PLUS**
Oral switch options:
- Timing of switch and duration of oral follow-on antibiotics dependant on thoroughness of surgical debridement, but a minimum total course of antibiotics of 6 weeks is usual.
- Choice of oral antibiotics depends on susceptibilities of organisms grown. Discuss with microbiology

For *Staphylococcus aureus* with confirmed susceptibilities:

Ciprofloxacin  
Dose: 500mg – oral – bd (twice a day)

**PLUS**

Rifampicin  
Dose 300mg – oral – bd (twice a day)

OR

Clindamycin  
Dose: 450mg – oral – qds (four times a day)  
Dose (if BMI > 30): 600mg – oral – qds (four times a day)

OR

Doxycycline  
Dose: 200mg - oral on first day, **followed** by 100mg - oral – bd (twice daily)

**PLUS**

Rifampicin  
Dose 300mg – oral – twice a day

For Gram negative organisms (*Enterobacteriaces*), if susceptible:

Ciprofloxacin  
Dose: 750mg – oral – bd (twice a day)

Comment:
- Acute osteomyelitis in the adult in the UK is very rare. Deep surgical samples must be obtained in order to guide the antibiotic choices. Intravenous antibiotics should be given for at least 2 weeks. The patient can then finish the course with oral antibiotics if there has been a good clinical response and serial CRP measurements show a downward trend (Lew & Waldvogel *NEJM* 1997; 336; 999-1007)
TRAUMA-RELATED AND/OR CHRONIC OSTEOMYELITIS

Antibiotic treatment should be delayed until specimens have been obtained if possible, since this is usually a chronic process. However, in the acutely unwell septic patient antibiotics should be administered as soon as the essential microbiological specimens (such as blood cultures and where possible aspirate or biopsy) have been collected.

Refer to Bone Infection MDT
Discuss microbiological sampling with Musculo-skeletal Radiologist or Orthopaedic Surgeon

Reference:
- Cochrane review po vs iv abx in chronic om – no evidence of difference, but 20 years old and poor quality data

PROSTHETIC JOINT INFECTION

Referral to orthopaedic surgeons is essential. Antibiotic treatment should be delayed until specimens have been obtained if possible, since this is usually a chronic process. However, in the acutely unwell septic patient antibiotics should be administered as soon as the essential microbiological specimens have been collected (i.e. blood cultures and where possible aspirate or biopsy done in operating theatre or strict asepsis)

Discuss with Orthopaedic Surgeons and Medical Microbiologist

Organisms: A wide range of organisms but most commonly *Staphylococcus aureus*, coagulase-negative staphylococci. Treatment should be decided in the light of culture results.
VERTEBRAL OSTEOMYELITIS /  
DISCITIS /  
SPINAL EPIDURAL ABSCESS (SEA)

Practice points:
- Spinal surgical referral is essential
- MRI of spine is usually the imaging of choice
- Whether to initiate empiric treatment or hold antibiotics until biopsy can be performed depends on the stability of the patient and the associated balance of risk and benefit.
- In patients with neurologic compromise with or without impending sepsis or hemodynamic instability, immediate surgical intervention and initiation of empiric antimicrobial therapy is recommended
- In patients with normal and stable neurologic examination and stable hemodynamics, the empiric antimicrobial therapy should be withheld until a microbiologic diagnosis is established
- Organisms: *Staphylococcus aureus (commonest)*, Gram negative organisms, anaerobes or TB.
- A total duration of 6 weeks of parenteral or highly bioavailable oral antimicrobial therapy for most patients with bacterial NVO or discitis

A. Empirical treatment for native vertebral osteomyelitis, discitis or SEA

<table>
<thead>
<tr>
<th>First line:</th>
</tr>
</thead>
</table>
| **Flucloxacillin**  
Dose: 2g – intravenous – qds (four times daily) |
| **In lumbar infection** |
| PLUS  
**Metronidazole**  
Dose: 500mg – intravenous – tds (three times daily). Switch to oral once stable |

<table>
<thead>
<tr>
<th>Second line (non-severe penicillin allergy):</th>
</tr>
</thead>
</table>
| **Ceftriaxone**  
Dose: 2g - intravenous infusion – bd (twice daily) |
| **In lumbar infection** |
| PLUS  
**Metronidazole**  
Dose: 500mg – intravenous – tds (three times daily). Switch to oral once stable |

<table>
<thead>
<tr>
<th>Second line (severe penicillin allergy):</th>
</tr>
</thead>
</table>
| **Vancomycin**  
Dose: see [intravenous vancomycin – intermittent infusion](#) guideline for dosing and monitoring. Aim pre-dose levels between 15-20mg/L) |
| **In lumbar infection** |
| PLUS  
**Rifampicin**  
Dose: 300mg – oral – bd (twice daily) |
| PLUS  
**Metronidazole**  
Dose: 500mg – intravenous – tds (three times daily). Switch to oral once stable |
B. **Post-operative (i.e. infection at contiguous anatomical site / including metal work at site of infection)**

<table>
<thead>
<tr>
<th>Drug</th>
<th>Dose Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Meropenem</td>
<td>Dose: 1g – intravenous – tds (three times daily)</td>
</tr>
<tr>
<td><strong>PLUS</strong></td>
<td></td>
</tr>
<tr>
<td>Vancomycin</td>
<td>Dose: see intravenous vancomycin – intermittent infusion guideline for dosing and monitoring. Aim pre-dose levels between 15-20mg/L</td>
</tr>
</tbody>
</table>

**References:**
- BMJ best practice – epidural abscess (September 2016)
7. Eye

BACTERIAL CONJUNCTIVITIS

Practice points:
- Contact lenses should **NOT** be worn until infection has resolved and the treatment has been completed for 24 hours
- Organisms: *Staphylococcus aureus*, *Streptococcus pneumoniae*, *Haemophilus influenzae*, *Moraxella catarrhalis*

<table>
<thead>
<tr>
<th>First line:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chloramphenicol 0.5% eye drops</td>
</tr>
<tr>
<td>Dose: 1 drop in affected eye(s) - every 2 hours until infection controlled then reduce frequency to qds (four times daily)</td>
</tr>
<tr>
<td>Duration: Continue for 48 hours after healing.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Second line:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ofloxacin 0.3% eye drops</td>
</tr>
<tr>
<td>1 drop in affected eye(s) - every 2 hours until infection controlled then reduce frequency to qds (four times daily)</td>
</tr>
<tr>
<td>Duration: Continue for 48 hours after healing.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Second line / alternative:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chloramphenicol 1% eye ointment</td>
</tr>
<tr>
<td>Apply to the lower eye lid of the affected eye(s) qds (four times daily) - continue for 48hrs after healing.</td>
</tr>
<tr>
<td>Duration: Continue for 48 hours after healing.</td>
</tr>
</tbody>
</table>

Reference:
- A Cochrane review found that although bacterial conjunctivitis is self-limiting, antibiotics improved the speed of clinical and bacteriological remission (Sheikh et al. The Cochrane Library, Issue 2, 2002). No antibiotic agent has been found to be superior to any other for the treatment of bacterial conjunctivitis. There is no evidence that topical short-term use of chloramphenicol can cause aplastic anaemia. (Clinical Evidence 9, BMJ Publishing, 2003).
ORBITAL CELLULITIS

Practice points:
- Orbital cellulitis is a medical emergency that, if left untreated, can lead to loss of sight and potentially fatal cerebral complications. It can progress rapidly and requires urgent admission. Contact Ophthalmologist.
- Orbital cellulitis is different from pre-septal cellulitis. Treat pre-septal cellulitis as general cellulitis.
- Organisms: *Staphylococcus aureus*, *Streptococcus* spp., including *Streptococcus pneumoniae* and beta-haemolytic *Streptococcus* spp. group A, *Haemophilus influenzae*, anaerobes, *Neisseria meningitidis*

<table>
<thead>
<tr>
<th>First line:</th>
</tr>
</thead>
</table>
| Ceftriaxone  
Dose: 1g - intravenous injection – bd (twice a day) |

**PLUS**

| Metronidazole  
Dose: 400mg – oral – tds (three times a day)  
(if unable to use oral route, dose: 500 mg - intravenous injection - three times a day) |

<table>
<thead>
<tr>
<th>Second line (severe penicillin allergy):</th>
</tr>
</thead>
</table>
| Moxifloxacin  
Dose: 400mg – oral – od (once a day)  
(if unable to use oral route, dose: 400mg – intravenous infusion over 60 minutes – once a day) |

**PLUS**

| Metronidazole  
Dose: 400mg – oral – tds (three times a day)  
(if unable to use oral route, dose: 500 mg - intravenous injection - three times a day) |
8. Ear, Nose and Oropharynx

ACUTE EPIGLOTTITIS

Organisms: Group A Streptococci, *H influenzae* type b.

**First choice:**
- Ceftriaxone
  - Dose: 1g - intravenous injection - twice a day - 10 days.

**Second choice (cephalosporin allergy or severe penicillin allergic):**
- Chloramphenicol
  - Dose: 50 mg/kg per day - intravenous injection in 4 divided doses - 10 days
  - (switch to oral therapy when clinically indicated)

**Comment:** Epiglottitis is predominantly a disease of children which is uncommon since the introduction of Hib vaccine. Adult cases are rare and can be life threatening due to the potential to cause complete airway obstruction. ENT surgeons should be involved early in the management of these patients. For those in extremis, samples for laboratory tests should not be drawn (except for taking blood cultures) and epiglottic swab culture should not be obtained until the airway has been secured. Most adults present in a less acute fashion, and immediate testing is appropriate.

OTITIS EXTERNA (ACUTE)

Organisms: Predominant organism *Pseudomonas aeruginosa*. *Staphylococcus aureus* may also be involved.

**First choice:**
- Clioquinol 1% + Flumetasone pivalate 0.02% (Locorten-Vioform ®) ear drops
  - Dose: 2 to 3 ear drops - topically - twice a day - 7 days.

**Second choice:**
- Ciprofloxacin 0.3% (Ciloxan ®) eye drops for ear application
  - Dose: 2 to 3 ear drops - topically - twice a day - 7 days.

In case of malignant otitis externa, contact ENT Surgeon and Medical Microbiologist for advice.
OTITIS MEDIA (ACUTE)

Practice points:
- Acute otitis media is a self-limiting infection of the middle ear mainly affecting children.
- It can be caused by viruses and bacteria, and both are often present at the same time.
- Symptoms last for about 3 days, but can last for up to 7 or 8 – most children get better within 3 days without antibiotics.
- Antibiotics do not improve pain at 24 hours, and at later time points the number of children improving with antibiotics is similar to the number with adverse effects, such as diarrhoea.
- When used, narrow spectrum antibiotics have been shown to be as effective as broad spectrum agents and also produce fewer side effects.
- Organisms: Most cases are viral. Group A streptococci, Streptococcus pneumoniae, Haemophilus influenzae, Moraxella catarrhalis

First line:
Paracetamol or ibuprofen
Dose: See BNF for dosing advice

Most need analgesia only.

If symptoms do not improve after 3 days consider antibiotics therapy below:

Second line:
Amoxicillin
Dose: 500mg - oral – tds (three times a day) for 5 days.

Second line (penicillin allergic):
Clarithromycin
Dose: 500mg - oral – bd (twice a day) for 5 days.

Comment:
- There is conflicting evidence from systematic reviews about the efficacy of antibiotics in reducing the duration of symptoms in acute otitis media. (Clinical Evidence 9, BMJ Publishing, 2003)
- Given that 80% resolve without antibiotic and that the risk of side effects is high, it is recommended that analgesia be used alone where possible.
**ACUTE PHARYNGEAL ABSCESS**

Organisms: *Streptococcus pyogenes*, Gram negative bacilli and anaerobes.

Pharyngeal space infections are a medical emergency and urgent ENT surgical referral is required.

<table>
<thead>
<tr>
<th>First choice:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Co-amoxiclav</td>
</tr>
<tr>
<td>Dose: 1.2g - intravenous injection – tds (three times a day) for 14 to 21 days.</td>
</tr>
</tbody>
</table>

**In failure to respond despite surgical management change to:**

<table>
<thead>
<tr>
<th>Ceftriaxone</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dose: 1g - intravenous injection – bd (twice a day)</td>
</tr>
</tbody>
</table>

**PLUS**

<table>
<thead>
<tr>
<th>Metronidazole</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dose: 500 mg - intravenous injection – tds (three times a day)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Second choice (non-severe penicillin allergy):</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ceftriaxone</td>
</tr>
<tr>
<td>Dose: 1g - intravenous injection – bd (twice a day)</td>
</tr>
</tbody>
</table>

**PLUS**

<table>
<thead>
<tr>
<th>Metronidazole</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dose: 500 mg - intravenous injection – tds (three times a day)</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Second choice (SEVERE penicillin allergy):</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vancomycin</td>
</tr>
<tr>
<td>Dose: see <a href="#">intravenous vancomycin – intermittent infusion</a> guideline for dosing and monitoring. Treat for 14 to 21 days</td>
</tr>
</tbody>
</table>

**PLUS**

<table>
<thead>
<tr>
<th>Ciprofloxacin</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dose: 400mg - intravenous infusion over 60 minutes – bd (twice a day) for 14 to 21 days</td>
</tr>
</tbody>
</table>

**PLUS**

<table>
<thead>
<tr>
<th>Metronidazole</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dose: 500mg - intravenous injection – tds (three times a day) for 14 to 21 days</td>
</tr>
</tbody>
</table>

**Comment:**

- Pharyngeal space infections are a medical emergency and urgent surgical referral is required.
ACUTE PHARYNGITIS/TONSILLITIS

Organism: 80% caused by viruses, Group A *streptococci*

**First choice:**

<table>
<thead>
<tr>
<th>Most need no antibiotic, analgesia only.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Penicillin V</td>
</tr>
<tr>
<td>Dose: 500mg - oral – qds (four times a day) for 10 days</td>
</tr>
</tbody>
</table>

**Second choice (penicillin allergic):**

| Clarithromycin                         |
| Dose: 500mg - oral – bd (twice a day) for 5 days |

**Comment:**

Antibiotics should not be used to secure symptomatic relief in sore throat. The Centor clinical prediction score may help the decision on whether to prescribe an antibiotic. The score is probably of most use in the General Practice-type patients (in whom it was validated), such as those that may be seen in the Emergency Department. This score is not validated in immunocompromised patients and therefore should not be used in such patients.

The Centor criteria were developed to predict bacterial infection (Group A streptococcal infection) in people with acute sore throat. The four Centor criteria are:

1. presence of tonsillar exudate.
2. presence of tender anterior cervical lymphadenopathy or lymphadenitis.
3. history of fever.
4. absence of cough.

The presence of three or four of these clinical signs (Centor score 3 or 4) suggests that the person may have GABHS (40–60% chance) and may benefit from antibiotic treatment. The absence of three or four of these signs suggests that the person is unlikely to have an infection (80% chance), and antibiotic treatment is unlikely to be necessary. (NICE Clinical Knowledge Summary. Management of acute sore throat. Last revised July 2015)

Severe suppurative complications (e.g. peri-tonsillar abscess or cellulitis, parapharyngeal abscess, retropharyngeal abscess, or Lemierre syndrome) will need antibiotics and possibly surgery; see relevant sections of these guidelines.

Evidence from a systematic review has shown that antibiotics only reduce the duration of symptoms in sore throat by 8 hours. There is a decrease in the incidence of otitis media (NNT 145), quinsy and rheumatic fever but not sinusitis or glomerulonephritis. (Clinical Evidence 9, BMJ Publishing, 2003).

Since patients with EBV infection who are treated with amoxicillin often develop a rash (which may be confused with penicillin allergy), amoxicillin should not be given to young adults.

**References:**

DEEP NECK SPACE ODONTOGENIC INFECTION
(including orofacial, dental, dental-alveolar infections and Ludwig’s angina)

Consult Maxillo-Facial Surgeons urgently, since incision and drainage are essential for management.

Organisms: primarily oral streptococci and anaerobes; less commonly *S. aureus*. In immunocompromised patients additional organisms that may be present include coliforms and *Pseudomonas* spp. More chronic infections may be caused by actinomycetes, for which this guideline does not apply.

Empirical antibiotic treatment choice for immediate use is dependent on severity of infection, whether the patient is immunocompromised, and the nature of penicillin allergy:

1. **Non-severe** – without severe local infection or systemic sepsis
2. **Severe** – with signs of severe local infection (progressive dysphagia, change of voice, parapharyngeal collections, clinical appearances consistent with Ludwig’s angina) and/or systemic sepsis.
3. **Immunocompromised patients** – disease of whatever severity in immunocompromised patients: (including recent/current chemotherapy or radiotherapy, HIV or uncontrolled diabetes)

Use microbiological culture results to guide antibiotic choice(s). The suggested follow-on antibiotics below are empirical and may be used in the absence of microbiological culture results.

Continue IV antibiotic until after incision and drainage and no pyrexia for 24 hours. Assuming that incision and drainage has been satisfactorily performed, switch to oral antibiotic if no other contraindications; continue for 5 - 10 days.

<table>
<thead>
<tr>
<th>Non-severe</th>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td><strong>First choice:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Co-amoxiclav</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dose: 1.2g - intravenous injection - three times a day</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(oral follow-on: 625mg - oral - three times a day)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Second Line (penicillin allergy):</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Clindamycin</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dose: 600mg – intravenous infusion – four times a day</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(oral follow-on: 450mg - oral - four times a day)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>PLUS</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Metronidazole</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dose: 500 mg - intravenous injection - three times a day</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(oral follow-on: 400mg – oral – three times a day)</td>
<td></td>
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</table>

<table>
<thead>
<tr>
<th>Severe infection</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>First line:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Co-amoxiclav</td>
<td></td>
<td></td>
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<tr>
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<td></td>
</tr>
<tr>
<td>(oral follow-on: 625mg - oral - three times a day)</td>
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<td></td>
</tr>
<tr>
<td><strong>PLUS</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Metronidazole</td>
<td></td>
<td></td>
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<tr>
<td>Dose: 500 mg - intravenous injection - three times a day</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(oral follow-on: 400mg – oral – three times a day)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Second line (non-severe penicillin allergy):

<table>
<thead>
<tr>
<th>Drug</th>
<th>Dose</th>
<th>Route</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Meropenem</td>
<td>1g - intravenous injection</td>
<td>tds</td>
<td>(three times a day)</td>
</tr>
</tbody>
</table>

**Oral switch (check microbiology sensitivities):**

<table>
<thead>
<tr>
<th>Drug</th>
<th>Dose</th>
<th>Route</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clindamycin</td>
<td>450mg - oral</td>
<td>qds</td>
<td>(four times a day)</td>
</tr>
</tbody>
</table>

**PLUS**

<table>
<thead>
<tr>
<th>Drug</th>
<th>Dose</th>
<th>Route</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Metronidazole</td>
<td>400mg - oral</td>
<td>tds</td>
<td>(three times a day)</td>
</tr>
</tbody>
</table>

### Second line (severe penicillin allergy):

<table>
<thead>
<tr>
<th>Drug</th>
<th>Dose</th>
<th>Route</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vancomycin</td>
<td>see intravenous vancomycin</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Dose: intermittent infusion guideline for dosing and monitoring. Aim pre-dose levels between 15-20mg/L

**PLUS**

<table>
<thead>
<tr>
<th>Drug</th>
<th>Dose</th>
<th>Route</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Metronidazole</td>
<td>500 mg - intravenous injection</td>
<td></td>
<td>(three times a day)</td>
</tr>
</tbody>
</table>

**Oral switch (check microbiology sensitivities):**

<table>
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<tr>
<th>Drug</th>
<th>Dose</th>
<th>Route</th>
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</thead>
<tbody>
<tr>
<td>Clindamycin</td>
<td>450mg - oral</td>
<td>qds</td>
<td>(four times a day)</td>
</tr>
</tbody>
</table>

**PLUS**

<table>
<thead>
<tr>
<th>Drug</th>
<th>Dose</th>
<th>Route</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ciprofloxacin</td>
<td>500mg – oral</td>
<td>bd</td>
<td>(twice daily)</td>
</tr>
</tbody>
</table>

**PLUS**

<table>
<thead>
<tr>
<th>Drug</th>
<th>Dose</th>
<th>Route</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Metronidazole</td>
<td>400mg – oral</td>
<td>tds</td>
<td>(three times a day)</td>
</tr>
</tbody>
</table>

### Immunocompromised patient

#### First line:

<table>
<thead>
<tr>
<th>Drug</th>
<th>Dose</th>
<th>Route</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Piperacillin-tazobactam</td>
<td>4.5 g - intravenous infusion</td>
<td></td>
<td>over 30 minutes – tds (three times a day)</td>
</tr>
</tbody>
</table>

**Oral switch (check microbiology sensitivities):**

<table>
<thead>
<tr>
<th>Drug</th>
<th>Dose</th>
<th>Route</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Co-amoxiclav</td>
<td>625mg - oral</td>
<td>tds</td>
<td>(three times a day)</td>
</tr>
</tbody>
</table>

#### Second choice (non-severe penicillin allergy):

<table>
<thead>
<tr>
<th>Drug</th>
<th>Dose</th>
<th>Route</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Meropenem</td>
<td>1g - intravenous injection</td>
<td>tds</td>
<td>(three times a day)</td>
</tr>
</tbody>
</table>

**Oral switch (check microbiology sensitivities):**

<table>
<thead>
<tr>
<th>Drug</th>
<th>Dose</th>
<th>Route</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clindamycin</td>
<td>450 - 600mg - oral</td>
<td>qds</td>
<td>(four times a day)</td>
</tr>
</tbody>
</table>
Ciprofloxacin  
Dose: 500mg – oral – bd (twice a day)  

PLUS  
Metronidazole  
Dose: 400mg – oral – tds (three times a day)  

Third choice (severe penicillin allergy):  
Vancomycin  
Dose: see intravenous vancomycin – intermittent infusion guideline for dosing and monitoring. Aim pre-dose levels between 15-20mg/L)  

PLUS  
Gentamicin  
Dose: See intravenous gentamicin – multiple daily dosing guideline for prescribing and monitoring  

PLUS  
Metronidazole  
Dose: 500 mg - intravenous injection - three times a day  

Oral switch (check microbiology sensitivities):  
Clindamycin  
Dose: 450 - 600mg - oral – qds (four times a day)  

PLUS  
Ciprofloxacin  
Dose: 500mg – oral – bd (twice a day)  

PLUS  
Metronidazole  
Dose: 400mg – oral – tds (three times a day)  

References:  
ACUTE BACTERIAL SINUSITIS

- Organisms: Most are viral. Group A *streptococci*, *Streptococcus pneumoniae*, *Haemophilus influenzae*, *Moraxella catarrhalis*

**First choice:**

<table>
<thead>
<tr>
<th>Most need analgesia only</th>
</tr>
</thead>
<tbody>
<tr>
<td>Doxycycline</td>
</tr>
<tr>
<td>Dose: 200mg - oral - stat</td>
</tr>
<tr>
<td>followed by 100mg - oral – od (once a day) – total course, including ‘stat’ dose, 5-7 days</td>
</tr>
</tbody>
</table>

**Second choice:**

- Amoxicillin
- Dose: 500mg - oral – tds (three times a day) for 5-7 days.

**Reference:**

INVASIVE COMPLICATIONS OF ACUTE OTITIS MEDIA (including ACUTE MASTOIDITIS)

- This guideline does not include chronic otitis or chronic mastoiditis.
- Consult ENT surgeons.
- Organisms: Predominant organism *Streptococcus pneumoniae*, *Streptococcus pyogenes* and *Staphylococcus aureus*. Occasionally, Gram negatives may also be involved.

**First line:**

- Ceftriaxone
- Dose: 1g - intravenous injection – bd (twice a day) - 14 days

**PLUS**

- Metronidazole
- Dose: 400mg - oral – tds (three times a day) - 14 days.

**Second line (severe penicillin allergic):**

- Ciprofloxacin
- Dose: 500mg - oral – bd (twice a day) for 14 days

**PLUS**

- Clindamycin
- Dose: 450mg - oral – qds (four times a day) for 14 days.
## QUINSY (Peritonsillar abscess)

**Practice points:**
- Refer to ENT surgeons
- Organisms: Predominant organism – Group A beta-haemolytic streptococci

### First Choice:

<table>
<thead>
<tr>
<th>Benzylpenicillin</th>
<th>Dose: 1.2g - intravenous injection - four times a day - 10 days.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>When clinical condition improves, the regime can be converted to oral amoxicillin</strong></td>
<td>Amoxicillin dose: 1g - oral - three times a day in order to complete the course.</td>
</tr>
</tbody>
</table>

### Second choice (penicillin allergic):

<table>
<thead>
<tr>
<th>Clindamycin</th>
<th>Dose: 600mg - intravenous infusion QDS - 10 days.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>When clinical condition improves, the regime can be converted to oral clarithromycin</strong></td>
<td>Clarithromycin dose: 450mg - oral - qds in order to complete the course</td>
</tr>
<tr>
<td>Dose (if BMI &gt; 30): 600mg - oral - qds in order to complete the course</td>
<td></td>
</tr>
</tbody>
</table>
### 9. Skin and Soft Tissue infections (SSTI)

**CELLULITIS / WOUND INFECTIONS / INFECTED VENOUS ULCERS / INFECTED PRESSURE ULCERS**

- Organisms: Group A beta-haemolytic *streptococci* (*Streptococcus pyogenes*), *Staphylococcus aureus*.

**Practice points (cellulitis / wound infection):**
- Ensure blood cultures and appropriate culture and swabs taken and sent prior to starting antibiotics therapy.

**Practice points (infected venous ulcers / infected pressure ulcers):**
- Colonisation with faecal organisms that do not cause infection is common and many superficial wound swabs reflect this.
- Antibiotics are only needed if there is cellulitis around the ulcer or purulent discharge.
- Consultation with Tissue Viability Team may be appropriate.

<table>
<thead>
<tr>
<th>First line:</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Flucloxacillin</strong></td>
</tr>
<tr>
<td>Dose: 1-2g (dose depending on severity) - intravenous injection – qds (four times a day) for 7 to 14 days</td>
</tr>
</tbody>
</table>

**NB: Review clinical response and switch to oral after 24-48hours as long as patient can swallow medication**

<table>
<thead>
<tr>
<th>Oral switch</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Flucloxacillin</strong></td>
</tr>
<tr>
<td>Dose: 500mg to 1g – orally – qds (four times a day).</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Second line (penicillin allergic):</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Clindamycin</strong></td>
</tr>
<tr>
<td>Dose: 300mg to 600mg (depending on severity) – oral / intravenous injection – qds (four times a day) for 7 to 14 days</td>
</tr>
</tbody>
</table>

**NB: Review clinical response and switch to oral after 24hours as long as patient can swallow medication**

<table>
<thead>
<tr>
<th>Oral switch</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Clindamycin</strong></td>
</tr>
<tr>
<td>Dose: 300mg to 450mg – orally – qds (four times a day)</td>
</tr>
<tr>
<td>Dose (if BMI &gt; 30): 450mg to 600mg – orally – qds (four times a day)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Second line (MRSA positive):</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Mild / moderate infection / oral option:</strong></td>
</tr>
<tr>
<td><strong>Doxycycline (only use if MRSA is tetracycline sensitive)</strong></td>
</tr>
<tr>
<td>Dose: 200mg - oral on first day <strong>followed</strong> by 100mg - oral - once a day thereafter (review clinical response)</td>
</tr>
</tbody>
</table>
Clindamycin (only use if MRSA is erythromycin or clindamycin sensitive)
Dose: 300mg to 450mg – orally – qds (four times a day)
Dose (if BMI > 30): 450mg to 600mg – orally – qds (four times a day)

Severe infection:
Vancomycin
Dose: see intravenous vancomycin – intermittent infusion guideline for dosing and monitoring. Aim pre-dose levels between 10 - 15mg/L)
PLUS
Rifampicin
Dose: 300mg - oral – bd (twice a day). Review clinical response and microbiology sensitivities

Comment:
- There is little evidence on the treatment of cellulitis. (Clinical Evidence 9, BMJ Publishing, 2003) Expert opinion is that patients with severe cellulitis should have about 7 days of intravenous therapy before oral switch to minimise the chances of relapse.
- Flucloxacillin is used as a single agent for empirical therapy as it covers both Staphylococcus aureus and the Group A beta-haemolytic streptococcus (Streptococcus pyogenes). Infections known to be caused by the Group A streptococcus can be treated with benzylpenicillin.
- Any patient known to be colonised with MRSA in the past should be treated as though this is the cause of the wound infection unless there is evidence to the contrary.
- For diabetic foot infections please refer to the relevant section in these Guidelines.
- Patients who are deemed clinically suitable to be discharged home from CDU, but need to continue with iv antibiotics for cellulitis, can be prescribed intravenous ceftriaxone 2g once a day as OPAT, providing there are no contraindications
ERYSIPELAS AND GROUP A BETA-HAEMOLYTIC STREPTOCOCCUS WOUND INFECTIONS

Practice points:
• Organisms: Group A beta-haemolytic streptococcus (*Streptococcus pyogenes*)
• Isolate patient in side room until 48 hours therapy given.

<table>
<thead>
<tr>
<th>First line:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Benzylpenicillin</td>
<td></td>
</tr>
<tr>
<td>Dose: 1.2 - 2.4g - intravenous injection – qds (four times a day) for 7 to 14 days (depending on severity and response).</td>
<td></td>
</tr>
</tbody>
</table>

When clinical condition improves, the regime can be converted to oral

Patients with severe erysipelas should have about 7 days of intravenous therapy before oral switch to minimise the chances of relapse.

<table>
<thead>
<tr>
<th>Oral switch:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Amoxicillin</td>
<td></td>
</tr>
<tr>
<td>Dose: 1g - oral – tds (three times a day) to complete 7 to 14 day course (including IV therapy given)</td>
<td></td>
</tr>
</tbody>
</table>

Second line (penicillin allergic):

<table>
<thead>
<tr>
<th>Clindamycin</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Dose: 600mg - intravenous injection – qds (four times a day) for 7 to 14 days (depending on severity and response).</td>
<td></td>
</tr>
</tbody>
</table>

Convert to oral after 48hours if patient swallowing as bioavailability same for IV and oral

<table>
<thead>
<tr>
<th>Oral switch:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Clindamycin</td>
<td></td>
</tr>
<tr>
<td>Dose: 450mg - oral – qds (four times a day) to complete 7 to 14 day course (including IV therapy given)</td>
<td></td>
</tr>
<tr>
<td>Dose (if BMI &gt; 30): 600mg - oral – qds (four times a day) to complete 7 to 14 day course (including IV therapy given)</td>
<td></td>
</tr>
</tbody>
</table>
HUMAN AND ANIMAL BITES (excluding insects)

Practice points:
- Surgical toilet is most important but antibiotic administration is recommended especially if:
  - Over 50 years
  - Skin is punctured
  - Hand wound
- Consider need for tetanus prophylaxis and risk of blood-borne virus infection (HIV, hepatitis B and C).
- If bite occurred overseas or a bat bite is suspected consult the Medical Virologist to assess risk of rabies, and therefore need for post-exposure vaccination.
- For insect bites see cellulitis / wound infection guideline

A) Minor infections and/or patients presenting within the first 24hrs after the bite

<table>
<thead>
<tr>
<th>First line:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Co-amoxiclav</td>
</tr>
<tr>
<td>Dose: 625mg – oral - tds (three times a day) for 7 days</td>
</tr>
</tbody>
</table>

OR (if patient unable to swallow)

| Co-amoxiclav |
| Dose: 1.2g - intravenous injection – tds (three times a day) for 7 days |

Second line (penicillin allergy):

| Doxycycline |
| Dose: 200mg STAT followed by 100mg - oral – od (once a day) for total 7 days |

PLUS

| Metronidazole |
| Dose: 400 mg - oral – tds (three times a day) for 7 days |

B) Severe infections and/or patients presenting 24hrs or more after the bite

<table>
<thead>
<tr>
<th>First line:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flucloxacillin</td>
</tr>
<tr>
<td>Dose: 2g - intravenous injection – qds (four times a day) for 7 days</td>
</tr>
</tbody>
</table>

PLUS

| Ciprofloxacin |
| Dose: 500mg - oral – bd (twice a day) for 7 days |

PLUS

| Metronidazole |
| Dose: 400mg - oral – tds (three times a day) for 7 days |

Second line (penicillin allergy):

| Tigecycline |
| Dose: 100mg - intravenous infusion over 60 minutes - stat as loading dose. Followed by 50mg – bd (twice a day) for 7 days (including ‘stat dose) |
DIABETIC FOOT INFECTIONS

- Diabetic foot infections are amongst the most serious and costly complications of diabetes mellitus. They represent a significant threat to the affected limb and should be evaluated and treated promptly.
- Microbiological culture results may be useful in informing antibiotic choice. However, culture results do not make the decision whether antibiotic treatment is required or not.
- Superficial swabs, other than perhaps those growing beta-haemolytic streptococci or Staphylococcus aureus (including MRSA) are of limited use in deciding what antibiotics to use.

Practice points
- All patients should have appropriate microbiological sampling before antibiotics are started (e.g. blood cultures in a pyrexial patient and wound swabs in the presence of an infected ulcer).
- Awaiting for culture results should not preclude commencement of antibiotics if these are clinically required for immediate treatment.
- Antibiotics used for empirical treatment depend upon the clinical classification below:

<table>
<thead>
<tr>
<th>Infection severity IWGDF grade (IDSA classification)</th>
<th>Clinical classification of infection (IDSA), with definitions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grade 1 (Uninfected)</td>
<td>Uninfected:</td>
</tr>
<tr>
<td></td>
<td>• No systemic or local symptoms or signs of infection</td>
</tr>
<tr>
<td>Grade 2 (Mild infection)</td>
<td>Infected</td>
</tr>
<tr>
<td></td>
<td>• At least 2 of the following items are present:</td>
</tr>
<tr>
<td></td>
<td>o Local swelling or induration</td>
</tr>
<tr>
<td></td>
<td>o Erythema &gt;0.5 cm but &lt;2cm (in any direction) around the ulcer</td>
</tr>
<tr>
<td></td>
<td>o Local tenderness or pain</td>
</tr>
<tr>
<td></td>
<td>o Local warmth</td>
</tr>
<tr>
<td></td>
<td>o Purulent discharge</td>
</tr>
<tr>
<td></td>
<td>• Other causes of an inflammatory response of the skin should be excluded (e.g. trauma, gout, acute Charcot neuro-osteoarthropathy, fracture, thrombosis, venous stasis)</td>
</tr>
<tr>
<td></td>
<td>• Infection involving the skin/ or subcutaneous tissue only (without involvement of deeper tissues and without systemic signs as described below). Any erythema present extends &lt; 2cm (in any direction) around the wound</td>
</tr>
<tr>
<td></td>
<td>• No systemic signs or symptoms of infection</td>
</tr>
<tr>
<td>Grade 3 (Moderate infection)</td>
<td>Infection involving structures deeper than skin and subcutaneous tissues (e.g. bone, joint, tendon) or erythema extending &gt;2cm from the wound margin</td>
</tr>
<tr>
<td></td>
<td>• No systemic signs or symptoms of infection</td>
</tr>
<tr>
<td>Grade 4 (Severe infection)</td>
<td>Any foot infection with the following signs of a systemic inflammatory response syndrome (SIRS). This response is manifested by two or more of the following conditions:</td>
</tr>
<tr>
<td></td>
<td>o Temperature &gt;38°C or &lt;36°C</td>
</tr>
<tr>
<td></td>
<td>o Heart rate &gt;100/min</td>
</tr>
<tr>
<td></td>
<td>o Respiratory rate &gt;24 breaths/min or $p_{a}CO_2$&lt;4.26kPa</td>
</tr>
<tr>
<td></td>
<td>o WBC &gt;12 cells/mm$^3$ or &lt;4cells/mm$^3$ or 10% immature (band) forms</td>
</tr>
</tbody>
</table>

Clinical classification of a diabetic foot infection (Based on the IDSA$^1$ and IWGDF$^2$ classifications)

Osteomyelitis in the diabetic foot – link to empirical antibiotics
**DIABETIC FOOT INFECTION**  
**Grade 2 (Mild infection)**

**Practice points:**
- Patient must be referred to the Diabetes Foot Team via PICS  
- Treatment usually required for 1 to 2 weeks; may extend up to 4 weeks if slow to resolve  
- Usually caused by aerobic gram positive cocci.  
- Microbiological sampling not routinely required unless recent antimicrobial therapy or previous antibiotic resistant organisms

<table>
<thead>
<tr>
<th>First line:</th>
</tr>
</thead>
</table>
| **Flucloxacillin**  
Dose: 1g - oral – qds (four times a day) |

<table>
<thead>
<tr>
<th>Second line (penicillin allergy):</th>
</tr>
</thead>
</table>
| **Clindamycin**  
Dose: 450mg - oral – qds (four times a day) |

<table>
<thead>
<tr>
<th>Second line (MRSA positive):</th>
</tr>
</thead>
</table>
| **Vancomycin**  
Dose: see [intravenous vancomycin – intermittent infusion](#) guideline for dosing and monitoring.  
Aim pre-dose levels between 15-20mg/L)  
**OR**  
**Doxycycline**  
Dose: 200mg - oral - stat followed by 100mg - twice a day |

**NB. Antibiotic susceptibilities for MRSA to be reviewed. Tetracycline sensitive = doxycycline sensitive**
**DIABETIC FOOT INFECTIONS**

**Grade 3 (Moderate infection)**

**Practice points:**
- **Patient must be referred to the Diabetes Foot Team via PICS**
- Treatment by oral or parenteral route should be based on clinical assessment and choice of agent; if patient requires hospital admission, treatment usually should be commenced with intravenous antibiotics, to be converted to oral preparations when clinical improvement allows
- **Treatment duration usually 2 to 4 weeks**

### First line:

Co-amoxiclav  
Dose (oral): 625mg - oral – tds (three times a day)  
Dose (intravenous): 1.2 g - intravenous injection – tds (three times a day)

### Second line (penicillin allergy):

Ceftriaxone  
Dose (oral): 300 to 450mg oral – qds (four times a day)  
Dose (if BMI > 30): 450 to 600mg oral – qds (four times a day)  
Dose (intravenous): 300 to 600mg intravenous injection – qds (four times a day)

**PLUS**  
Ciprofloxacin  
Dose (oral): 500mg - oral – qds (four times a day)  
Dose (intravenous): 400mg - intravenous infusion over 60 minutes – qds (four times a day)

**NB:** This combination antibiotic regime presents high risk for *Clostridium difficile* infection, therefore monitor patient closely for diarrhoea.

### Second line (if current or past MRSA – check susceptibilities for erythromycin / clindamycin / rifampicin and fusidic acid)

Clindamycin (if MRSA erythromycin and/or clindamycin sensitive)  
Dose (oral): 300 to 450mg oral – qds (four times a day)  
Dose (if BMI > 30): 450 to 600mg oral – qds (four times a day)  
Dose (intravenous): 300 to 600mg intravenous injection – qds (four times a day)

**PLUS**  
Ciprofloxacin  
Dose: 500mg - oral – bd (twice a day)  
(or 400mg - intravenous infusion over 60 minutes - twice a day)

**OR**

Vancomycin  
Dose: see [intravenous vancomycin – intermittent infusion](#) guideline for dosing and monitoring. Aim pre-dose levels between 15-20mg/L

**PLUS**  
Rifampicin  
Dose: 600mg - oral - twice a day - 3 weeks
| PLUS | **Ciprofloxacin**  
Dose: 500mg - oral - twice a day  
or 400mg - intravenous infusion over 60 minutes - twice a day |

**OR (if organism rifampicin resistant or patient not tolerating)**

| PLUS | **Vancomycin**  
Dose: see [intravenous vancomycin – intermittent infusion](#) guideline for dosing and monitoring.  
Aim pre-dose levels between 15-20mg/L |

| PLUS | **Sodium fusidate**  
Dose: 500mg - oral - three times a day - 3 weeks |

| PLUS | **Ciprofloxacin**  
Dose: 500mg - oral - twice a day  
(or 400mg - intravenous infusion over 60 minutes - twice a day) |
DIABETIC FOOT INFECTIONS
Grade 4 (Severe infection - including those with underlying osteomyelitis)

Practice points:
• Patient must be referred to the Diabetes Foot Team via PICS
• Patient must also have requested appropriate investigations (e.g. radiological imaging) and surgical management if appropriate.
• Antibiotic treatment IV at least initially, as an inpatient; switch to oral when possible and adjust after tissue culture results
• Treatment duration 2 to 4 weeks in the absence of osteomyelitis

<table>
<thead>
<tr>
<th>First line:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Meropenem</td>
</tr>
<tr>
<td>Dose: 1g - intravenous injection – tds (three times a day)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Second line (carbapenem allergy or severe penicillin allergy):</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clindamycin</td>
</tr>
<tr>
<td>Dose: 600mg - intravenous injection – qds (four times a day)</td>
</tr>
</tbody>
</table>

PLUS
Ciprofloxacin
Dose: 400mg - intravenous infusion over 60 minutes – bd (twice a day)

NB: This combination antibiotic regime presents high risk for Clostridium difficile infection, therefore monitor patient closely for diarrhoea.

<table>
<thead>
<tr>
<th>Alternative choice if MRSA positive:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Meropenem</td>
</tr>
<tr>
<td>Dose: 1g - intravenous injection – tds (three times a day)</td>
</tr>
</tbody>
</table>

PLUS
Vancomycin
Dose: see intravenous vancomycin – intermittent infusion guideline for dosing and monitoring. Aim pre-dose levels between 15-20mg/L)

PLUS
Rifampicin
Dose: 300mg - oral – bd (twice a day)

The choice and duration of oral step-down antibiotics to be discussed with Medical Microbiologist.
DIABETIC FOOT INFECTIONS
(Osteomyelitis)

Practice points:
- Patient must be referred to the Diabetes Foot Team via PICS
- If the patient is clinically stable, starting antibiotics is best delayed until appropriate surgical or radiological sampling has been done.
- The patient should be urgently referred for appropriate investigations (such as radiological imaging) and management. Surgical debridement should always be considered; the appropriate surgical input (vascular surgery) should always be consulted.
- Definitive choice of antibiotics should be guided by appropriate tissue sampling (usually via bone biopsy) and should be discussed with a Medical Microbiologist.
- Duration of treatment depends on the extent of surgical management (whether amputation is undertaken or not and in the former whether is any remaining bone or soft tissue likely to be infected).
- Complex cases should be reviewed and assessed in collaboration with the Diabetic Foot Team and Medical Microbiologists prior to the formulation of treatment plan.

**First line:**
Flucloxacillin
Dose: 2g - intravenous injection – qds (four times a day)

PLUS
Ciprofloxacin
Dose: 750mg - oral – bd (twice a day)

PLUS
Metronidazole
Dose: 400mg - oral – tds (three times a day)

**Alternative choice in penicillin allergy:**
Clindamycin
Dose (intravenous): 600mg intravenous injection – qds (four times a day). Consider oral therapy if clinically improves after two weeks of IV therapy

**Oral Switch:**
Dose (oral): 450mg oral – qds (four times a day)
Dose (if BMI > 30): 600mg oral – qds (four times a day)

PLUS
Ciprofloxacin
Dose: 750mg - oral – bd (twice a day)

**NB:** This combination antibiotic regime presents high risk for *Clostridium difficile* infection, therefore monitor patient closely for diarrhoea.

**Alternative choice (if MRSA positive):**
Vancomycin
Dose: see [intravenous vancomycin – intermittent infusion](#) guideline for dosing and monitoring. Aim pre-dose levels between 15-20mg/L

PLUS
Ciprofloxacin
Dose: 750mg - oral – bd (twice a day)

PLUS
Metronidazole
Dose: 400mg - oral – tds (three times a day)
Reference:

- Lipsky BA et al. Diagnosis and treatment of diabetic foot infections Infectious Disease Society of America (IDSA) guidelines Clin Infect Dis 2012; 54 :e132-e173
- International Working Group for the Treatment of Diabetic Foot Infections. Specific guidelines for the Treatment of Diabetic Foot Infections
- NICE. Diabetic foot problems Inpatient management of diabetic foot problems CG119 March 2011
- University Hospital Birmingham NHS Foundation Trust. Sepsis, severe sepsis and septic shock West Mercia/ Bedside Clinical guideline
GAS GANGRENE

Practice points:
- Refer to surgeons ASAP. Gas gangrene is a clinical diagnosis and surgical debridement is the first and most essential element of life-saving treatment.
- Organisms: Clostridium perfringens.
- **Duration:**
  - Discuss with microbiologist

<table>
<thead>
<tr>
<th>First line:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Benzylpenicillin</td>
</tr>
<tr>
<td>Dose: 2.4g - intravenous injection – qds (four times a day)</td>
</tr>
</tbody>
</table>

**PLUS**

<table>
<thead>
<tr>
<th>Metronidazole</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dose: 500mg - intravenous injection – tds (three times a day)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Second line (penicillin allergy):</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clindamycin</td>
</tr>
<tr>
<td>Dose: 600mg to 900mg - intravenous injection – tds (three times a day)</td>
</tr>
</tbody>
</table>

Reference:
- IDSA - Practice Guidelines for the Diagnosis and Management of Skin and Soft Tissue Infections: 2014 Update by the Infectious Diseases Society of America. Clinical Infectious Diseases; 2014 ; 59 : 10-52
NECROTISING FASCIITIS / SYNERGISTIC GANGRENE
(Including Fournier's gangrene)

Practice points:
- Refer to surgeons ASAP. Necrotising fasciitis or synergistic gangrene is a clinical diagnosis and surgical debridement is the first and most essential element of life-saving treatment.
- Organisms: Group A streptococci or mixed coliforms and anaerobes.

<table>
<thead>
<tr>
<th>First line:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Meropenem</td>
</tr>
<tr>
<td>Dose: 1g - intravenous injection – tds (three times a day)</td>
</tr>
<tr>
<td>PLUS</td>
</tr>
<tr>
<td>Clindamycin</td>
</tr>
<tr>
<td>Dose: 600 - 1200mg - intravenous infusion – qds (four times a day)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Second line (MRSA carrier):</th>
</tr>
</thead>
<tbody>
<tr>
<td>Meropenem</td>
</tr>
<tr>
<td>Dose: 1g - intravenous injection – tds (three times a day)</td>
</tr>
<tr>
<td>PLUS</td>
</tr>
<tr>
<td>Linezolid</td>
</tr>
<tr>
<td>Dose: 600mg – oral or intravenous injection – bd (twice daily)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Second line (severe penicillin allergy):</th>
</tr>
</thead>
<tbody>
<tr>
<td>Contact medical microbiologist</td>
</tr>
</tbody>
</table>

Reference:
CHICKEN POX (VARICELLA ZOSTER) IN IMMUNOCOMPETENT PATIENTS

Practice points:
- **Does not apply to VZV encephalitis**
- Notify the Infection Prevention & Control Team and isolate into side-room. Varicella zoster is highly contagious ensure good hand hygiene to avoid spreading to other patients.
- Treatment indicated if patient presents within the first 48 hours of the onset of rash.
- If severe infection or presentation after 48 hrs, or infection in immunocompromised patient, **discuss with Medical Virologist**.
- Organisms: Varicella zoster virus

<table>
<thead>
<tr>
<th>First line:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aciclovir</td>
</tr>
<tr>
<td>Dose: 800mg - oral - five times a day for 7 days</td>
</tr>
</tbody>
</table>

HERPES ZOSTER (SHINGLES) IN IMMUNOCOMPETENT PATIENTS

Practice points:
- **Discuss an immunocompromised patient with Medical Virologist.**
- Notify the Infection Prevention & Control Team.
- There is no clear evidence that treatment below reduces the incidence of post-herpetic neuralgia (Clinical Evidence 9, BMJ Publications, 2003).
- **Treatment should only be given to the below patients:**
  - >60 years
  - Patients with ophthalmic zoster
  - Immunocompromised
- The incidence of post-herpetic neuralgia under 60 years is <7%, but 21-34% for those over 60 years (Prodigy guidelines).
- Treatment should be started within the first 72 hours.
- Organisms: Varicella zoster virus

<table>
<thead>
<tr>
<th>First line:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Valaciclovir</td>
</tr>
<tr>
<td>Dose: 1g - oral - three times a day for 7 days</td>
</tr>
</tbody>
</table>
10. SEPSIS

RED FLAG SEPSIS / SEPSIS OF UNKNOWN ORIGIN

Practice points:
- See SEPSIS TRUST GUIDELINE for definition, assessment and management including sepsis six
- The guidelines below are intended for use in when no source of infection is identified.
- Use appropriate antimicrobial guideline for when source of infection is known (e.g. complicated UTI, severe pneumonia, Meningitis).
- Ensure PICS is checked to look for alert organisms (e.g. MRSA, ESBL) and at previous cultures and sensitives. See below for guideline specific treatment.
- Patients with multidrug resistant organisms, such as MDR Acinetobacter, Vancomycin resistant Enterococci, Carbapenemase producing Enterobacteriaceae: Contact medical microbiologist for advice.

First line:
Meropenem
Dose: 1000mg – intravenous – tds (three times a day)

PLUS
Vancomycin
Dose: See Vancomycin guideline for dosing and monitoring

Second line (Severe penicillin allergy / anaphylaxis):
Amikacin
Dose: See Amikacin guideline for dosing and monitoring

PLUS
Vancomycin
Dose: See Vancomycin guideline for dosing and monitoring
SUSPECTED INFECTION IN NEUTROPENIC OR IMMUNOCOMPROMISED PATIENTS
(INCLUDING FEBRILE NEUTROPENIA)

These represent a medical emergency. Contact the relevant Haematology or Oncology Registrar or Consultant on-call. *Antibiotics should be commenced within 30 minutes of arrival*

See management guideline for treating infection in neutropenic/immunocompromised patients – of which these antimicrobial-use guidelines are a summary

**Definitions:**

*Fever:* A single oral or tympanic temperature reading of $\geq 38^\circ$C. Patient on steroids may not display a fever.

*Neutropenia:* absolute neutrophil count of $<0.5 \times 10^9/L$ (or $\leq 1 \times 10^9/L$ and expected to fall further).

*Immunocompromised patients:*
- Patients receiving chemotherapy within last 6 weeks
- Patients on high dose steroids
- Patients post-allograft
- Patients who have received extensive field radiotherapy (eg, hemibody) in the last 6 weeks

**Initial investigation:** blood cultures via Hickman line (if present) and peripherally, urine, sputum and other appropriate specimens (e.g. central line exit swab).

Algorithms for empirical treatment with no localising symptoms:

- **Haematology patients - no penicillin allergy**
- **Oncology patients - no penicillin allergy**
- **Haematology and Oncology patients - non-severe penicillin allergy**
- **Haematology and Oncology patients - severe penicillin allergy**

Additional circumstances/infections to consider and when localising symptoms/signs may be present

1. **Haematology patients - no penicillin allergy**

   ![Algorithm Diagram]

   Line in-situ AND obvious tunnel infection or known *Staph. aureus* infection

   - **Yes**
     - Meropenem *(can be given by PGD)*
     - Dose: 1g - intravenous injection - three times a day
     - PLUS
     - Vancomycin
     - Dose: see [intravenous vancomycin – intermittent infusion](#) guideline for dosing and monitoring. Aim pre-dose levels between 15-20mg/L
     - In case of vancomycin allergy discuss with Medical Microbiologist
   - **No**
     - Meropenem *(can be given by PGD)*
     - Dose: 1g - intravenous injection - three times a day
2. **Oncology patients - no penicillin allergy**

Meropenem *(can be given by PGD)*  
Dose: 1g - intravenous injection – one STAT dose  

Further antibiotics as below  
Check previous blood culture results

- **Low risk** – no co-mobidity, neutropenia expected to be <7 days.
- **High risk** – co-mobidity, neutropenia expected to be >7 days. Concomitant condition of significance (e.g., shock, hypoxia, pneumonia or other deep organ infection)

- **Meropenem** *(can be given by PGD)*  
  Dose: 1g - intravenous injection – three times a day

- **Vancomycin**  
  Dose: see *intravenous vancomycin – intermittent infusion* guideline for dosing and monitoring. Aim pre-dose levels between 15-20mg/L

- **Piperacillin-tazobactam** *(monotherapy)*  
  Dose: 4.5 g - intravenous infusion over 30 minutes – qds

  **UNLESS**  
  Previous multiply-resistant Gram negative organism on previous blood culture when use instead of piperacillin-tazobactam:  
  Meropenem  
  Dose: 1g - intravenous injection - three times a day

- **Patients with clinically suspected line infection or MRSA colonisation**  
  **ADD:**  
  Vancomycin  
  Dose: see *intravenous vancomycin – intermittent infusion* guideline for dosing and monitoring. Aim pre-dose levels between 15-20mg/L
3. ALL patients - non-severe penicillin allergy

**Low risk** – no co-mobidity, neutropenia expected to be <7 days.

| Meropenem *(can be given by PGD)*  
|-----------------------------  
| Dose: 1g - intravenous injection - three times a day |

**Patients with clinically suspected line infection or MRSA colonisation ADD:**

| Vancomycin  
|-----------------------------  
| Dose: see *intravenous vancomycin – intermittent infusion* guideline for dosing and monitoring. Aim pre-dose levels between 15-20mg/L) |

**High risk** – co-mobidity, neutropenia expected to be >7 days. Concomitant condition of significance (eg, shock, hypoxia, pneumonia or other deep organ infection

| Meropenem *(can be given by PGD)*  
|-----------------------------  
| Dose: 1g - intravenous injection - three times a day |

**AND**

| Vancomycin  
|-----------------------------  
| Dose: see *intravenous vancomycin – intermittent infusion* guideline for dosing and monitoring. Aim pre-dose levels between 15-20mg/L) |
4. **ALL patients - SEVERE penicillin allergy**

**Low risk** – no co-mobidity, neutropenia expected to be <7 days.

**Clinical Indications**
- Clinical or microbiological evidence of fungal infection; ‘failure’ of empirical antibiotics after 72h - seek advice from Consultant in Haematology/Oncology as appropriate.
- Clinical evidence of lower respiratory infection.
- Clinical evidence/suspicion of influenza
- Clinical or microbiological evidence of intra-abdominal or pelvic sepsis.
- Evidence of *Pneumocystis carinii* (Pneumocystis jirovecii) pneumonia.

**Antimicrobials**
- Ciprofloxacin: 400mg - intravenous infusion over 60 minutes - twice a day (change to 500mg – oral – twice a day – as soon as possible)
- Clarithromycin: Dose: 500mg - oral - twice a day
- Zanamivir or oseltamivir as per influenza guideline
- Metronidazole: Dose: 400mg - oral - three times a day
- Co-trimoxazole: Dose: 120mg per kg /day - oral or intravenous injection - divided in 2 to 4 doses per day

**High risk** – co-mobidity, neutropenia expected to be >7 days. Concomitant condition of significance (eg, shock, hypoxia, pneumonia or other deep organ infection

**Clinical Indications**
- Clinical or microbiological evidence of fungal infection; ‘failure’ of empirical antibiotics after 72h - seek advice from Consultant in Haematology/Oncology as appropriate.
- Clinical evidence of lower respiratory infection.
- Clinical evidence/suspicion of influenza
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**Antimicrobials**
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- Metronidazole: Dose: 400mg - oral - three times a day
- Co-trimoxazole: Dose: 120mg per kg /day - oral or intravenous injection - divided in 2 to 4 doses per day

**Additional circumstances/infections to consider**

The above recommendations are for febrile episodes or suspected infection in the absence of a specific pathogen or diagnosis.

The following can be added at any stage if the clinical picture is suggestive:

<table>
<thead>
<tr>
<th>Clinical Indications</th>
<th>Antimicrobials</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clinical or microbiological evidence of fungal infection; ‘failure’ of empirical antibiotics after 72h - seek advice from Consultant in Haematology/Oncology as appropriate.</td>
<td>An antifungal agent <em>(See below)</em></td>
</tr>
<tr>
<td>Clinical evidence of lower respiratory infection.</td>
<td>Clarithromycin: Dose: 500mg - oral - twice a day</td>
</tr>
<tr>
<td>Clinical evidence/suspicion of influenza</td>
<td>Zanamivir or oseltamivir as per influenza guideline</td>
</tr>
<tr>
<td>Clinical or microbiological evidence of intra-abdominal or pelvic sepsis.</td>
<td>Metronidazole: Dose: 400mg - oral - three times a day</td>
</tr>
<tr>
<td>Evidence of <em>Pneumocystis carinii</em> <em>(Pneumocystis jirovecii)</em> pneumonia.</td>
<td>Co-trimoxazole: Dose: 120mg per kg /day - oral or intravenous injection - divided in 2 to 4 doses per day</td>
</tr>
</tbody>
</table>
11. Antifungal treatment

This guidance on therapy for superficial mucosal (excluding genital) and commonly encountered invasive fungal infections. For specific patient groups refer to the respective unit protocol or seek advice from Medical Microbiologists.

CANDIDA INFECTIONS

- Persistent or repeated infection may indicate underlying immunocompromise, including HIV, which should be tested for.
- Refractory infection or infection in immunocompromised patients may be due to resistant *Candida albicans* or intrinsically-resistant candida of other species. Discuss with Medical Microbiologist to ensure that patient sampling occurs so that candida identification and antifungal drug susceptibility testing take place, to guide therapy.

OROPHARYNGEAL CANDIDIASIS

**First line:**

<table>
<thead>
<tr>
<th>Miconazole oral gel (24mg/ml)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dose: 5-10ml in the mouth after food - four times a day, retained near oral lesions before swallowing - usually 7-10 days, continued for 48h after lesions have healed.</td>
</tr>
</tbody>
</table>

 Or

<table>
<thead>
<tr>
<th>Nystatin oral suspension (100,000 units/ml)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dose: 100,000units (1ml) – four times a day, use pipette as per packaging instructions - usually 7-10 days, continued for 48h after lesions have healed.</td>
</tr>
</tbody>
</table>

**Patients who cannot tolerate topical treatment:**

<table>
<thead>
<tr>
<th>Fluconazole</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dose: 50 - 100mg – oral – od (once a day) for 7-14 days depending on clinical response.</td>
</tr>
</tbody>
</table>

**Severe or refractory infection or immunocompromised patients:**

<table>
<thead>
<tr>
<th>Fluconazole</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dose: 100mg – oral or (intravenous infusion, if cannot tolerate oral) – once a day – for 7-14 days depending on clinical response.</td>
</tr>
</tbody>
</table>

**Comments:**

- BNF
OESOPHAGEAL CANDIDIASIS

- Evidence of infection may be a marker of immunosuppression. Ensure HIV testing advised.

**First line:**

Fluconazole  
Dose: 200-400mg (3–6 mg/kg) – oral – once a day – for 14-21 days.

Consider intravenous infusion if cannot tolerate oral capsules / liquid

**Reference:**

- British National Formulary

CANDIDA UTI (URINARY TRACT INFECTION)

**Practice points:**

- common risk factors for candiduria: increased age, female sex, antibiotic use, urinary catheterisation, previous surgery, diabetes mellitus.  
- most candiduria is colonisation and dose not need antifungal drug treatment.  
- removing predisposing factors (catheter removal, stopping antibiotics, correcting hyperglycaemia) clears candiduria in about 50% of cases.  
- after correction of predisposing factors, repeat urine culture (and treat bacterial infection if present). If symptoms persist and candiduria remains, rule out anatomical abnormalities of urinary tract and start antifungals.  
- in neutropenic patients, critically ill patients and transplant recipients, candiduria may indicate disseminated candidiasis  
- treat asymptomatic candiduria in neutropenic patients, patients undergoing urological procedures, and allograft recipients.  
- Echinocandins (caspofungin, anidulafungin, micafungin) do not achieve high urinary concentrations and therefore should not be used for treating candiduria

**Symptomatic cystitis:**

Fluconazole  
Dose: 200mg – oral or (intravenous infusion, if cannot tolerate oral) – od (once a day) for 14 days.

**Pyelonephritis:**

Fluconazole  
Dose: 200-400mg – oral or (intravenous infusion, if cannot tolerate oral) – od (once a day) for 14 days

**Patients undergoing urological procedures (asymptomatic or symptomatic candiduria):**

Fluconazole  
Dose: 200-400mg – oral or (intravenous infusion, if cannot tolerate oral) – od (once a day) for 7 days before and 7 days after the operation
**Asymptomatic candiduria in neutropenic patients or allograft recipients (may indicate disseminated candidiasis):**

**First line:**

Fluconazole  
Dose: 200-400mg – oral or (intravenous infusion, if cannot tolerate oral) – once a day - for 14 days after the last positive blood/urine culture and resolution of signs and symptoms and resolved neutropenia.

**Second line:**

Ambisome  
Dose: 3mg/kg – intravenous infusion – once a day - for 14 days after the last positive blood/urine culture and resolution of signs and symptoms and resolved neutropenia.

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*Expert Rev Anti Infect Ther* 2007; 5(2) 277-284

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**CANDIDAEMIA AND INVASIVE CANDIDIASIS**

- remove all intravascular catheters if possible, or change as soon as possible after starting treatment.  
- repeat blood cultures should be taken 24-48h after starting antifungal treatment, and then daily, to help assess duration of treatment (see below)

- changes in anti-candida drug may be possible, guided by patient response and antifungal drug susceptibility testing.

- Echocardiography (preferably TOE) and ophthalmological examination recommended in all patients to determine if infection is ‘disseminated’

- in leukaemic patients, following neutrophil recovery, echocardiography (preferably TOE), ophthalmological examination and abdominal imaging for disseminated infection recommended

---

**First line:**

Anidulafungin  
Dose – 200mg on first day - intravenous infusion; followed by 100mg the next day, and subsequently – intravenous infusion – once a day.

Duration: for uncomplicated candidaemia (without organ involvement), 14 days after the first negative repeat blood culture (clearance) and resolution of signs and symptoms associated with candidaemia.

---

**Second line:**

Ambisome  
Dose: 3mg/kg – intravenous infusion – once a day - for 14 days after the last positive blood culture and resolution of signs and symptoms and resolved neutropenia.
Duration: for uncomplicated candidaemia (without organ involvement), 14 days after the first negative repeat blood culture (clearance) and resolution of signs and symptoms associated with candidaemia.

Spellberg *et al.*. Current strategies for disseminated candidiasis. *CID* 2006; 42: 244-251

**CANDIDA OSTEOMYELITIS**

- Surgical debridement is frequently necessary. Discuss orthopaedic management with surgeons
- Antifungal choice should be guided by susceptibility tests on candida isolates when possible

**First choice:**

Fluconazole
Dose: 400mg – oral or (intravenous infusion, if cannot tolerate oral) – once a day – for prolonged period (6-12 months)

**Second choices:**

Ambisome
Dose: 3mg/kg – intravenous infusion – once a day - for prolonged period (6-12 months)

OR

Anidulafungin
Dose – 200mg on first day - intravenous infusion; followed by 100mg the next day, and subsequently – intravenous infusion – once a day.

**Reference:**

CANDIDA SEPTIC ARTHRITIS IN NATIVE JOINT

- Surgical debridement is frequently necessary; removal of infected prosthetic joints is recommended in most cases. Discuss orthopaedic management with surgeons

- Antifungal choice should be guided by susceptibility tests on candida isolates when possible

**First choice:**

Fluconazole  
Dose: 400mg – oral or (intravenous infusion, if cannot tolerate oral) – once a day – for a minimum of 6 weeks

**Second choices:**

Ambisome  
Dose: 3mg/kg – intravenous infusion – once a day - for a minimum of 6 weeks

OR

Anidulafungin  
Dose – 200mg on first day - intravenous infusion; followed by 100mg the next day, and subsequently – intravenous infusion – once a day – for a minimum of 6 weeks

Reference:

- IDSA guidelines 2016: Clinical Infectious Diseases, Volume 62, Issue 4, 15 February 2016, Pages e1–e50,
CENTRAL NERVOUS SYSTEM CANDIDIASIS

- Removal of prosthetic devices in the CNS, that may be colonised, is recommended
- Echinocandins (anidulafungin, caspofungin, micafungin) have poor penetration into the Central Nervous System
- Duration of Ambisome and flucytosine for several weeks

<table>
<thead>
<tr>
<th>First line:</th>
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<tbody>
<tr>
<td>Ambisome</td>
</tr>
<tr>
<td>Dose: 3mg/kg – intravenous infusion – once a day</td>
</tr>
</tbody>
</table>

**PLUS**

Flucytosine
Dose: See flucytosine guideline. Adjust dose in renal impairment

Monitor flucytosine levels

<table>
<thead>
<tr>
<th>Follow-on treatment:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fluconazole</td>
</tr>
<tr>
<td>Dose: 400-800mg – oral or (intravenous infusion, if cannot tolerate oral) – once a day</td>
</tr>
</tbody>
</table>

Continue until all clinical features, CSF abnormalities and radiological abnormalities have resolved.

**Comments:**
- IDSA guidelines 2016: Clinical Infectious Diseases, Volume 62, Issue 4, 15 February 2016, Pages e1–e50
CANDIDA ENDOCARDITIS

- Valve replacement is strongly recommended although there may not be increased survival when associated with combined surgical and medical management
- Long-term suppressive therapy is recommended for patients with prosthetic valves that are unsuitable for surgery

**First choices:**
*Should be guided by isolate species/susceptibility tests*

<table>
<thead>
<tr>
<th>Anidulafungin</th>
<th>Dose – 200mg – intravenous infusion – once a day – for a minimum of 6 weeks</th>
</tr>
</thead>
<tbody>
<tr>
<td>OR</td>
<td></td>
</tr>
<tr>
<td>Ambisome</td>
<td>Dose: 3mg/kg – intravenous infusion – once a day – for at least 4 weeks</td>
</tr>
<tr>
<td>PLUS</td>
<td>Flucytosine</td>
</tr>
<tr>
<td></td>
<td>Dose: See <a href="#">flucytosine guideline</a>. Adjust dose in renal impairment</td>
</tr>
<tr>
<td></td>
<td>Monitor flucytosine levels</td>
</tr>
</tbody>
</table>

**Step down therapy (for susceptible organism in a stable patient with negative blood culture results)**

Fluconazole
- Dose: 400-800mg – oral or (intravenous infusion, if cannot tolerate oral) – once a day

**Comments:**
- IDSA guidelines 2016: Clinical Infectious Diseases, Volume 62, Issue 4, 15 February 2016, Pages e1–e50
EMPIRICAL ANTIFUNGAL THERAPY FOR FEBRILE NEUTROPENIA

All patients with febrile neutropenia where the temperature has persisted, despite 72 hours of broad spectrum antibiotic therapy, and in the absence of an identifiable infective cause, should commence on systemic antifungal therapy. In addition, such patients should undergo an HRCT scan of the chest within 24 hours of commencement of antifungal therapy to exclude invasive fungal infection.

Follow specific unit policy for haematology patients.

ASPERGILLOSIS
(Pulmonary and extrapulmonary infections)

- population at greatest risk for invasive aspergillosis are solid organ and haematopoietic stemcell transplant recipients
- reversal of immunosuppression and/or reversal of neutropenia are essential for successful treatment
- primary combination therapy is not routinely recommended because of lack of clinical data. However, addition of a second antifungal drug to the current therapy or combination antifungal drugs from different classes other than those in the initial therapy may be used for salvage therapy. No report of randomised controlled trial of combination therapy is yet available.

**Primary therapy:**

Voriconazole (note BNF warnings for drug interactions and LFT monitoring)
Dose: 6 mg/kg body weight every 12 hours for two doses – intravenous infusion; followed by 4mg/kg body weight – intravenous infusion – twice a day – for first two weeks of therapy.

Dose – for oral switch: 4mg/kg body weight, rounded up to dose of whole tablet size – oral – twice a day – after fist two weeks of intravenous therapy.

Duration: until complete response and recovery from immunocompromised condition (minimum of 6-12 week generally recommended)

**Voriconazole therapeutic drug monitoring:** Measurement of serum levels, especially in patients receiving oral therapy, may be useful either to evaluate potential toxicity or to document adequate drug level especially in progressive disease. See Voriconazole dosing for advice on monitoring.

**Salvage therapy/Alternative therapy**

| Ambisome | Dose: 3mg/kg body weight (to a maximum of 5mg/kg) – intravenous infusion – once daily – for 14 days |

OR

<p>| Caspofungin | Dose – body weight less than 80kg: 70mg on first day - intravenous infusion; followed by 50mg the next day, and subsequently – intravenous infusion – once a day. Dose – body weight 80kg or more: 70mg – intravenous infusion – once a day |</p>
<table>
<thead>
<tr>
<th>OR</th>
</tr>
</thead>
</table>
| **Posaconazole**  
Dose: 300mg – intravenous injection - two times a day on first day, followed by 300mg – intravenous injection - once a day |

Or Dose: 300mg – oral, gastro resistant tablets - two times a day on first day, followed by 300mg – oral, delayed release tablets - once a day. After stabilisation of disease.

**Posaconazole therapeutic drug monitoring:** absorption and metabolism of posaconazole will vary from patient to patient. Steady-state levels may not be achieved for up to a week for oral dosing. See posaconazole dosing for advice on monitoring

<table>
<thead>
<tr>
<th>OR</th>
</tr>
</thead>
</table>
| **Combination therapy – not recommended as first choice**  
Caspofungin plus voriconazole (dosed as above; see levels below) |

Caspofungin plus Ambisome (dosed as above)

**Voriconazole therapeutic drug monitoring:** Measurement of serum levels, especially in patients receiving oral therapy, may be useful either to evaluate potential toxicity or to document adequate drug level especially in progressive disease. See Voriconazole dosing for advice on monitoring.

**References:**
- Mandel, Douglas and Bennett’s Principles and Practice of Infectious Diseases; sixth edition 2005 ; volume 2: 2973- 2984
- Cornely O *et al.* Liposomal amphotericin B as initial therapy for invasive mold infection: A randomised trial comparing a high-loading dose regimen with standard dosing (AmbiLoad Trial). *CID* 2007; 44:1289- 1297
MUCORMYCOSIS

Practice points:
• risk factors: severe immunocompromise, diabetes mellitus, iron overload treated with desferoxamine, injecting drug abuses
• rapid invasive infections with high mortality
• voriconazole and caspofungin are not active against mucorales

Management
• correction of hyperglycaemia and acidosis
• reduction or stopping of immunosuppression, including steroids
• prompt surgical debridement
• prompt antifungal therapy

First line:
Ambisome
Dose: 5-10mg/kg body weight– intravenous infusion. No other lipid formulation of amphotericin B is recommended.

Maintenance therapy:
Posaconazole
Dose: 300mg – oral, delayed-release tablets - two times a day on first day, followed by 300mg – oral, delayed release tablets - once a day. Note that steady-state levels may not be achieved for up to a week.

Duration of drugs dependent on clinical response and success in resolving underlying predisposing condition.

Salvage therapy:
Ambisome
Dose: 5-10mg/kg body weight– intravenous infusion. No other lipid formulation of amphotericin B is recommended.

PLUS
Posaconazole
Dose: 300mg – intravenous injection - two times a day on first day, followed by 300mg – intravenous injection - once a day

Or Dose: 300mg – oral, delayed-release tablets - two times a day on first day, followed by 300mg – oral, delayed release tablets - once a day. After stabilisation of disease.

Duration of drugs dependent on clinical response and success in resolving underlying predisposing condition.

Posaconazole therapeutic drug monitoring: absorption and metabolism of posaconazole will vary from patient to patient. Steady-state levels may not be achieved for up to a week for oral dosing. See posaconazole dosing for advice on monitoring.

References:
• Pagano L et al. Mucor mycosis in hematologic patients. Haematologica 2004;89:207-214
• Kauffman K et al. Zygomycosis; An emerging fungal infection with new options for management. Curr InfectDis Rep 2007; 9; 435-440


INVASIVE FUNGAL SOFT TISSUE INFECTIONS (MILITARY PATIENTS WITH BLAST INJURY)

This guideline may be relevant for patients who have blast injuries when there has been extensive exposure to decaying vegetation and 'implantation' of such vegetation, carrying fungi and spores, into soft tissues. This guideline is intended for use at Role 4 (UHB). Injuries acquired in other locations may be contaminated with species of potentially invasive fungi, other than those found in Afghanistan. However, the broad spectrum of fungi covered by the suggested combination of Ambisome and posaconazole is a reasonable empirical choice, until an individual patient’s microbiology, or the more general fungal epidemiology of the injury location, is known.

Surgery is crucial for the prevention and management of invasive fungal soft tissue infections, since it removes damaged host tissue and environmental contamination. Antifungal drugs should not be thought of as an alternative to adequate surgical debridement.

History of guideline

The guideline was originally written in August 2009 for use in patients returning from Afghanistan with major trauma acquired in the ‘Green Zone’, Helmand province. Major blast injuries of soldiers patrolling on foot in the Green Zone, often resulted in the embedding of large amounts environmental material containing fungi and fungal spores in soft tissues. Surgical debridement of wounds and pre-emptive antifungals were found to have drastically reduced the number of invasive fungal soft tissue infections encountered from August 2009 onwards.

The guideline was developed from basic principles and local experience, since trauma-related invasive fungal soft tissue infection are rare and there no established guidelines. Dr EM Johnston, Director, National Mycology Reference Laboratory, Public Health England, Bristol, also advised on the choice of antifungal drugs used in this guideline; her laboratory performed drug susceptibility tests on fungal isolates associated with invasive soft tissue infections that were grown from patients that returned from Afghanistan (2008-14). These antifungal susceptibilities confirmed the use of Ambisome and posaconazole as broad-spectrum cover for the potentially invasive species encountered in Afghanistan.

The original guideline used posaconazole as an oral suspension, which was the only available formulation at that time. Posaconazole oral suspension had to be given four times a day (best with food/feeding when possible, as absorption may be increased 4 fold with food). The current guideline has been updated to include the IV and delayed release tablets now available. Likewise, the latest guidance on posaconazole level monitoring has included; this was not available when the guideline was originally written.

Criteria for pre-emptive therapy with antifungals

Pre-emptive therapy might be given to those patients who fulfil ALL of the following criteria:

- Injury occurring in place where there is extensive exposure to decaying vegetation
- IED blast or other injury, usually in a soldier on foot, that results in major contamination with environmental debris/vegetation in deep wounds
- Massive blood transfusion (>8 units; a marker of severe injury)

Patients who are injured by IED blasts when in vehicles, or who have simple gun shot, or fragmentation wounds, should not normally have pre-emptive therapy as they do not usually have the environmental contamination that is a risk factor for invasive fungal infection.

a. Regime for pre-emptive therapy

To be started as soon as practically possible in Role 4 when the patient’s initial assessment upon arrival indicates the criteria for this therapy have been fulfilled.
Ambisome
Dose: 5mg/kg body weight – intravenous infusion – once a day
Use patient’s current body weight, allowing for limb loss. Note that the Ambisome dose is higher than licensed dose to ensure activity against relevant fungi. Other formulations of amphotericin B (Abelcet and Fungizone) MUST NOT be substituted for Ambisome.

PLUS
Posaconazole
Dose: 300mg – intravenous injection - two times a day on first day, followed by 300mg – intravenous injection - once a day

OR

Posaconazole
Dose: 300mg – oral, gastro-resistant tablets - two times a day on first day, followed by 300mg – oral, delayed release tablets - once a day

OR

Posaconazole
Dose: 200mg – oral suspension – four times a day (best with food/feeding when possible, as absorption may be increased 4 fold)

Duration: Treat with Ambisome PLUS posaconazole for 14 days, assuming patient’s general clinical progress is satisfactory and the surgeons have no concerns about wound and/or graft healing.

b. Treatment of invasive fungal soft tissue infection

- if invasive fungal soft tissue infection is suspected in a patient not fulfilling the criteria for pre-emptive therapy, and the patient is not antifungals, Ambisome and posaconazole (see below) should be started and an urgent Orthopaedic/Plastics opinion sought.
- invasive fungal soft tissue infection may occur in patients that fulfil the criteria for pre-emptive antifungal treatment (above), even if they are on such treatment.
- prompt and extensive surgical debridement is essential for management of infection even if the patient is on antifungal drug treatment.
- if the patient is already on Ambisome and posaconazole (above) for pre-emptive treatment, this combination must continue.
- if invasive fungal soft tissue infection is suspected Ambisome and posaconazole should be continued until the patient’s general clinical progress is satisfactory and the surgeons have no concerns about wound and/or graft healing.
- fungi associated with invasive soft tissue infection have occasionally been grown from injury sites that have also grown Aeromonas spp. In these instances, it is impossible to determine whether the fungi or Aeromonas are causing infection. Such cases should therefore be treated antifungals, and an antibiotic active against aeromonas.
Ambisome
Dose: 5mg/kg body weight – intravenous infusion – once a day
Use patient’s current body weight, allowing for limb loss. Note that the Ambisome dose is higher than licensed dose to ensure activity against relevant fungi. Other formulations of amphotericin B (Abelcet and Fungizone) MUST NOT be substituted for Ambisome.

**PLUS**
Posaconazole
Dose: 300mg – **intravenous injection** - two times a day on first day, followed by 300mg – intravenous injection - once a day

OR

Posaconazole
Dose: 300mg – oral, gastro-resistant tablets - two times a day on first day, followed by 300mg – oral, delayed release tablets - once a day

OR

Posaconazole
Dose: 200mg – oral suspension – four times a day (best with food/feeding when possible, as absorption may be increased 4 fold)

Duration: Treat with Ambisome **PLUS** posaconazole for 14 days, assuming patient’s general clinical progress is satisfactory and the surgeons have no concerns about wound and/or graft healing.

**Monitoring for antifungal drug toxicity**
- LFTs and U&Es (including [Mg^{2+}]) performed every 2 days.

**Posaconazole therapeutic drug monitoring:**
- Measure serum [posaconazole](https://example.com) levels as per dosing guideline.

Experience of using Ambisome and posaconazole in young, previously fit soldiers with severe traumatic amputations from IED blasts in Afghanistan showed little toxicity. Significant changes LFTs and/or U&Es were rare and almost invariably related to ultimately fatal multi-organ failure.
CRYPTOCOCCAL MENINGITIS

- May be an AIDS-defining infection. Patients should be tested for HIV, if HIV status is unknown.

**Induction phase**

Ambisome  
Dose: 4mg/kg body weight – intravenous infusion – once daily

**PLUS**

Flucytosine  
Dose: See [flucytosine guideline](#). Adjust dose in renal impairment

Monitor flucytosine levels

**Duration of Ambisome and Flucytosine:**

- HIV patient – minimum 14 days  
- Non-HIV, non-transplant patient – minimum 28 days (patient with meningoencephalitis without neurological complications and CSF culture negative after 14 days treatment); extend to 6 weeks in patient with neurological complications.

**Consolidation phase**

Fluconazole  
Dose: 400mg – oral – od (once a day) – for prolonged period (at least 8 weeks)

**Maintenance phase**

Fluconazole  
Dose: 200-400mg – oral – once a day – for prolonged period (at least 6-12 months)

**References:**

12. Infestations

HEAD LICE

- See Trust procedure for head lice for more information including isolation and infection control precaution
- Note: products below are flammable keep away from naked flames and burning cigarettes.

First Line:

Dimeticone 4% lotion

- Apply sufficient lotion to cover dry hair from the base to the tip to ensure that no part of the scalp is left uncovered.
- Work into the hair spreading the liquid evenly from roots to tips. Allow hair to dry naturally. Leave on hair for a minimum of 8 hours or overnight.
- Wash out with normal shampoo, rinsing thoroughly with water.
- Repeat the treatment after seven days

Second line:

Malathion 0.5%

- Apply sufficient lotion to cover dry hair from the base to the tip to ensure that no part of the scalp is left uncovered.
- Work into the hair spreading the liquid evenly from roots to tips.
- Allow hair to dry naturally. Leave on hair for 12 hours or overnight.
- Wash out with normal shampoo, rinsing thoroughly with water.
- Repeat the treatment after seven days

References:

- NICE clinical knowledge summaries – Head lice (accessed 06/12/2017)
- Specific product characteristics (SPC) – dimeticone 4% (accessed 06/12/2017)
- Specific product characteristics (SPC) – Malathion 0.5% (accessed 06/12/2017)
- Uptodate: Head lice: Epidemiology, clinical features, and diagnosis (accessed 13/12/2017)
**BODY & PUBIC LICE**

- See Trust [procedure for Body & Pubic lice](#) for more information including isolation and infection control precaution
- Note: products below are flammable keep away from naked flames and burning cigarettes.

### Body Lice:

**Permethrin 5% cream**

- Apply to skin which is clean, dry and cool. It should not be used immediately after a hot bath.
- Apply cream to whole body. Do NOT apply to head or face.
- The whole body should be washed thoroughly 12 hours after application.
- Repeat the treatment after seven days

### Pubic Lice:

**Malathion 0.5%**

- Ensure sufficient product is applied to cover the pubic region, peri-anal region, inner thighs down to the knees, and any hair that grows up from the pubic area to the chest/stomach.
- Work into the hair spreading the liquid evenly from roots to tips.
- Allow hair to dry naturally. Leave on hair for 12 hours or overnight.
- Wash out with normal shampoo, rinsing thoroughly with water.
- Repeat the treatment after seven days

### References:

- NICE clinical knowledge summaries – Pubic lice lice (accessed 06/12/2017)
- Specific product characteristics (SPC) – Permethrin 5% cream (accessed 06/12/2017)
- Specific product characteristics (SPC) – Malathion 0.5% (accessed 06/12/2017)
- Uptodate: pediculosis pubis (accessed 13/12/2017)
• See Trust procedure for Scabies for more information including isolation and infection control precaution
• Note: products below are flammable keep away from naked flames and burning cigarettes.

First Line:

Permethrin 5% cream
• Apply to skin which is clean dry and cool. It should not be used immediately after a hot bath.
• Apply cream to whole body including hands and feet. Do NOT apply to head or face. Pay particular attention to the areas between fingers and toes, under nails, wrists, armpits, external genitalia, breasts and buttocks.
• The whole body should be washed thoroughly 8-12 hours after application. If hands are washed within 8 hours ensure cream is re-applied.
• Repeat the treatment after seven days

Second line:

Malathion 0.5%
• Apply sufficient lotion to cover dry hair from the base to the tip to ensure that no part of the scalp is left uncovered.
• Work into the hair spreading the liquid evenly from roots to tips.
• Allow hair to dry naturally. Leave on hair for 12 hours or overnight.
• Wash out with normal shampoo, rinsing thoroughly with water.
• Repeat the treatment after seven days

References:
• NICE clinical knowledge summaries – Scabies (accessed 13/12/2017)
• Specific product characteristics (SPC) – permethrin 5% (accessed 13/12/2017)
• Specific product characteristics (SPC) – Malathion 0.5% (accessed 06/12/2017)
• Uptodate: Scabies: Epidemiology, clinical features, and diagnosis (accessed 13/12/2017)
Part C. Surgical Prophylaxis

General guidance

- Screen patient for MRSA prior to surgery according to the UHB MRSA policy
- Review previous Microbiology results and PICS alerts for other multi-drug resistant organisms
- For best efficacy antibiotics should be given within 30 minutes before incision (SIGN Guideline 104, 2008); for practical reasons, doses are usually given at induction.
- In the event of major intra-operative blood loss in adults (>1,500 ml) additional dosage of prophylactic antibiotic should be considered after fluid replacement
- All aspects of antibiotic prophylaxis, for example, where prophylaxis is not given when recommended, should be clearly recorded in the case records.

Endocarditis prophylaxis

- For detailed recommendations please refer to the BNF
- Antibiotic prophylaxis against infective endocarditis is NOT recommended:
  - for people undergoing dental procedures
  - for people undergoing non-dental procedures at the following sites:
    - upper and lower gastrointestinal tract
    - genitourinary tract; this includes urological, gynaecological and obstetric procedures, and childbirth
    - Upper and lower respiratory tract; this includes ear, nose and throat procedures and bronchoscopy.
- Note - Chlorhexidine mouthwash should not be offered as prophylaxis against infective endocarditis to people at risk of infective endocarditis undergoing dental procedures.
- If a person at risk of infective endocarditis is receiving antimicrobial therapy because he/she is undergoing a gastrointestinal or genitourinary procedure at a site where there is a suspected infection, the person should receive an antibiotic that covers organisms that cause infective endocarditis.
- These guidelines are based on recommendations from the National Institute for Health and Clinical Excellence (NICE) on “Antimicrobial prophylaxis against infective endocarditis”; (first published March 2008; reviewed August 2015 – no changes made from 2008 guideline)
i. Cardiology-cardiothoracic - SURGICAL PROPHYLAXIS

PACEMAKER INSERTION PROPHYLAXIS

- Screen patient for MRSA prior to surgery according to the UHB MRSA policy
- Review previous Microbiology results and PICS alerts for other multi-drug resistant organisms
- For best efficacy antibiotics should be given within 30 minutes before incision (SIGN Guideline 104, 2008); for practical reasons, doses are usually given at induction.

**First line (includes MRSA cover):**

Teicoplanin
Dose (Weight <70 kg): 600 mg - intravenous injection over 3 to 5 minutes
Dose (Weight ≥70 kg): 800 mg - intravenous infusion over 30mins

PLUS
Gentamicin
Dose: 1.5mg/kg (Ideal Body Weight) - intravenous injection over 3 to 5 minutes

No further doses of antibiotic to be given after skin closure

The thorax/neck of patients with tracheostomies or other forms of invasive ventilation may become colonised with Gram negative bacteria that may require different or additional antibiotics for prophylaxis. In such patients, review sputum and other microbiology for colonising flora, and discuss with a Medical Microbiologist when planning for pacemaker insertion.

This guideline is based upon the BSAC Guidelines for the diagnosis, prevention and management of implantable cardiac electronic device infection (J Antimicrob Chemother (2015), 70: 325-359)

**ROUTINE CARDIAC SURGERY (Including orthotopic heart transplantation)**

- Screen patient for MRSA prior to surgery according to the UHB MRSA policy
- Review previous Microbiology results and PICS alerts for other multi-drug resistant organisms
- For best efficacy antibiotics should be given within 30 minutes before incision (SIGN Guideline 104, 2008); for practical reasons, doses are usually given at induction.
- In the event of major intra-operative blood loss in adults (>1,500 ml) additional dosage of prophylactic antibiotic should be considered after fluid replacement
- All aspects of antibiotic prophylaxis, for example, where prophylaxis is not given when recommended, should be clearly recorded in the case records.

**First choice:**

Co-amoxiclav
Dose: 1.2 g - intravenous injection - three times a day - 24 hours

**Second choice (MRSA positive patients or high risk of MRSA positive):**

Vancomycin - intravenous infusion for 100 minutes before procedure
Dose: As per protocol - 24 hours
**PLUS**
Co-amoxiclav
Dose: 1.2 g - intravenous injection - three times a day - 24 hours

**Second choice (penicillin allergic):**

Ciprofloxacin
Dose: 400mg - intravenous infusion over 60 minutes - twice a day - 24 hours

**PLUS**
Vancomycin - intravenous infusion for 100 minutes before procedure
Dose: As per protocol - 24 hours

**Comment:** No adjustment for IABP or prolonged ICD use.

"HIGH RISK OF INFECTION" CARDIAC SURGERY (RE-EXPLORATION ETC)

**First line:**
Piperacillin-tazobactam
Dose: 4.5 g - intravenous infusion over 30 minutes - three times a day - 3 days

**PLUS**
Vancomycin - intravenous infusion for 100 minutes before procedure
Dose: As per protocol - 3 days

**Second line (penicillin allergy):**

Ciprofloxacin
Dose: 400mg - intravenous infusion over 60 minutes - twice a day or 500mg – enterally (oral/NG) – twice a day; total 3 days of ciprofloxacin dosing

**PLUS**
Vancomycin - intravenous infusion for 100 minutes before procedure
Dose: As per protocol - 3 days

LUNG TRANSPLANTATION

Piperacillin-tazobactam
Dose: 4.5 g - intravenous infusion over 30 minutes - three times a day - until peroperative BAL cultures return

**PLUS** (if at high risk of MRSA)
Vancomycin
intravenous infusion for 100 minutes before procedure
Dose: As per protocol - until preoperative BAL cultures return

**Comment:** Recipients with a documented history of antibiotic resistances should have targeted regimes prescribed until peroperative BAL cultures return
"HIGH RISK OF INFECTION" LUNG TRANSPLANTATION (RE-EXPLORATION ETC)

<table>
<thead>
<tr>
<th>Drug</th>
<th>Dose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Piperacillin-tazobactam</td>
<td>4.5 g - intravenous infusion over 30 minutes - three times a day - 5 days</td>
</tr>
<tr>
<td>PLUS</td>
<td></td>
</tr>
<tr>
<td>Vancomycin</td>
<td>intravenous infusion for 100 minutes before procedure</td>
</tr>
<tr>
<td>Dose:</td>
<td>As per protocol - 5 days</td>
</tr>
</tbody>
</table>
ii. Ear, Nose and Throat (ENT) - SURGICAL PROPHYLAXIS

COCHLEAR IMPLANT INSERTION PROPHYLAXIS

- Screen patient for MRSA prior to surgery according to the UHB MRSA policy
- Review previous Microbiology results and PICS alerts for other multi-drug resistant organisms
- For best efficacy antibiotics should be given within 30 minutes before incision (SIGN Guideline 104, 2008); for practical reasons, doses are usually given at induction.
- In the event of major intra-operative blood loss in adults (>1,500 ml) additional dosage of prophylactic antibiotic should be considered after fluid replacement
- All aspects of antibiotic prophylaxis, for example, where prophylaxis is not given when recommended, should be clearly recorded in the case records.
- Organisms: Staphylococci inc. MRSA and streptococci

<table>
<thead>
<tr>
<th>First choice:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flucloxacillin</td>
</tr>
<tr>
<td>Dose: 1g - intravenous injection - one dose within 30 minutes before incision.</td>
</tr>
<tr>
<td>PLUS</td>
</tr>
<tr>
<td>Gentamicin</td>
</tr>
<tr>
<td>Dose: 1.5mg/kg (Ideal Body Weight) - intravenous injection - one dose within 30 minutes before incision.</td>
</tr>
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</table>

<table>
<thead>
<tr>
<th>Second choice (penicillin allergic or colonised with MRSA):</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teicoplanin</td>
</tr>
<tr>
<td>Dose (Weight &lt; 70 kg): 600 mg - intravenous injection over 3 to 5 minutes</td>
</tr>
<tr>
<td>Dose (Weight ≥ 70 kg): 800 mg - intravenous infusion over 30 mins</td>
</tr>
<tr>
<td>PLUS</td>
</tr>
<tr>
<td>Gentamicin</td>
</tr>
<tr>
<td>Dose: 1.5mg/kg (Ideal Body Weight) - intravenous injection - one dose within 30 minutes before incision.</td>
</tr>
</tbody>
</table>

Immunisations

Pneumococcal polysaccharide vaccine (PPV23) should be given to all existing and prospective cochlear implant recipients.
SURGERY TO THE BASE OF THE SKULL PROPHYLAXIS

- Screen patient for MRSA prior to surgery according to the UHB MRSA policy
- Review previous Microbiology results and PICS alerts for other multi-drug resistant organisms

- For best efficacy antibiotics should be given within 30 minutes before incision (SIGN Guideline 104, 2008); for practical reasons, doses are usually given at induction.
- In the event of major intra-operative blood loss in adults (>1,500 ml) additional dosage of prophylactic antibiotic should be considered after fluid replacement
- All aspects of antibiotic prophylaxis, for example, where prophylaxis is not given when recommended, should be clearly recorded in the case records.
- Organisms: *Streptococcus pneumoniae, Haemophilus influenzae* and other streptococci.

**First choice:**

Co-amoxiclav
Dose: 1.2g - intravenous injection - one dose within 30 minutes before incision.

**Second choice (penicillin allergic or colonised with MRSA):**

Teicoplanin
Dose (Weight <70 kg): 600 mg - intravenous injection over 3 to 5 minutes
Dose (Weight ≥70 kg): 800 mg - intravenous infusion over 30mins

PLUS
Gentamicin
Dose: 1.5mg/kg (Ideal Body Weight) - intravenous injection - one dose within 30 minutes before incision.
iii. GASTRO-INTESTINAL SURGERY - SURGICAL PROPHYLAXIS

1. ‘Clean’ surgery:

   **HERNIA REPAIR WITH OR WITHOUT MESH / BENIGN LAPAROSCOPIC OESOPHAGEAL SURGERY (ALL) / LAPAROSCOPIC VENTRAL RECTOPEXY**

   - No antibiotic prophylaxis recommended

2. ‘Clean contaminated’ or ‘contaminated’ surgery:

   **APPENDICECTOMY WITHOUT PERFORATION / OESOPHAGEAL, DUODENAL, GASTRIC SURGERY**

   - Screen patient for MRSA prior to surgery according to the UHB MRSA policy
   - Review previous Microbiology results and PICS alerts for other multi-drug resistant organisms
   - For best efficacy antibiotics should be given within 30 minutes before incision (SIGN Guideline 104, 2008); for practical reasons, doses are usually given at induction.
   - In the event of major intra-operative blood loss in adults (>1,500 ml) additional dosage of prophylactic antibiotic should be considered after fluid replacement
   - All aspects of antibiotic prophylaxis, for example, where prophylaxis is not given when recommended, should be clearly recorded in the case records.
   - RCTs and meta-analysis indicate that in the absence of established infection one dose of antibiotics is sufficient prophylaxis for all types of surgery (DTB 2003:41;83)

<table>
<thead>
<tr>
<th>First choice:</th>
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</thead>
<tbody>
<tr>
<td>Co-amoxiclav</td>
</tr>
<tr>
<td>Dose: 1.2g - intravenous injection – one dose within 30 minutes before incision.</td>
</tr>
<tr>
<td>If procedure lasts more that 4h, a second dose should be given</td>
</tr>
</tbody>
</table>

Comment: If ESBL positive Gram negative organisms have been previously isolated in a patient, the antibiotic prophylaxis should include adequate cover, e.g, such as Meropenem.

<table>
<thead>
<tr>
<th>Second choice (penicillin allergic or MRSA positive):</th>
</tr>
</thead>
<tbody>
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<td>Teicoplanin</td>
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<tr>
<td>Dose (Weight &lt;70 kg): 600 mg - intravenous injection over 3 to 5 minutes</td>
</tr>
<tr>
<td>Dose (Weight ≥70 kg): 800 mg - intravenous infusion over 30mins</td>
</tr>
<tr>
<td>If procedure lasts more that 8h, a second dose should be given</td>
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</tbody>
</table>

PLUS

<table>
<thead>
<tr>
<th>Metronidazole</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dose: 500mg - intravenous injection – one dose within 30 minutes before incision.</td>
</tr>
<tr>
<td>If procedure lasts more that 8h, a second dose should be given</td>
</tr>
</tbody>
</table>

PLUS

<table>
<thead>
<tr>
<th>Gentamicin</th>
</tr>
</thead>
<tbody>
<tr>
<td>(note this is prophylaxis dose)</td>
</tr>
<tr>
<td>Dose: 1.5mg/kg (Ideal Body Weight) - intravenous injection - one dose within 30 minutes before</td>
</tr>
</tbody>
</table>
incision. If procedure lasts more that 8h, a second dose should be given

Comment: If ESBL positive Gram negative organisms have been previously isolated in a patient, the antibiotic prophylaxis should include adequate cover, eg, such as Meropenem. Recommendations based on SIGN Guideline 104, 2008 and BNF 65, March 2013.

3. Surgery with established infection:

APPENDICITIS WITH PERFORATION / CLOSURE OF PERFORATED DUODENAL ULCER / HARTMANN’S PROCEDURE FOR DIVERTICULAR DISEASE / COLONIC PERFORATION

- Screen patient for MRSA prior to surgery according to the UHB MRSA policy
- Review previous Microbiology results and PICS alerts for other multi-drug resistant organisms
- For best efficacy antibiotics should be given within 30 minutes before incision (SIGN Guideline 104, 2008); for practical reasons, doses are usually given at induction.
- In the event of major intra-operative blood loss in adults (>1,500 ml) additional dosage of prophylactic antibiotic should be considered after fluid replacement
- All aspects of antibiotic prophylaxis, for example, where prophylaxis is not given when recommended, should be clearly recorded in the case records.

First choice:

Co-amoxiclav
Dose: 1.2g - intravenous injection – one dose within 30 minutes before incision.
May need to be continued with three times a day dosing for up to 5 days

In addition for septic patients:
Gentamicin
Dose: See intravenous gentamicin – ONCE daily dosing guideline for prescribing and monitoring.
May need to be continued with once a day dosing for up to 5 days.

Continued below - Second choice (penicillin allergic or MRSA positive)………

Second choice (penicillin allergic or MRSA positive):

Ciprofloxacin
Dose: 400mg - intravenous injection – one dose within 30 minutes before incision.
May need to be continued with twice a day dosing for up to 5 days, but consider switch to oral ciprofloxacin during this period.

PLUS
Metronidazole
Dose: 500mg - intravenous injection – one dose within 30 minutes before incision.
If procedure lasts more that 8h, a second dose should be given
May need to be continued with three times a day dosing for up to 5 days, but consider switch to oral metronidazole during this period.

PLUS
Gentamicin (note this is treatment dose for established infection)
Dose: 5mg/kg (ideal body weight) – intravenous infusion over 60min - one dose commenced before induction
May need to be continued with once a day dosing for up to 5 days. See intravenous gentamicin – ONCE daily dosing guideline for prescribing and monitoring

PLUS (if MRSA positive):
Teicoplanin
Dose (Weight <70 kg): 600 mg - intravenous injection over 3 to 5 minutes
Dose (Weight ≥70 kg): 800 mg - intravenous infusion over 30mins

If procedure lasts more than 8h, as second dose should be given

Comment:

If ESBL positive Gram negative organisms have been previously isolated in a patient, the antibiotic prophylaxis should include adequate cover, eg, such as Meropenem.
Recommendations based on SIGN Guideline 104, 2008 and BNF 65, March 2013

4. Surgical prophylaxis in peritonitis

Continue antibiotics for treatment of Peritonitis – see guideline
iv. HAND SURGERY – PROPHYLAXIS/TREATMENT

- Screen patient for MRSA prior to surgery according to the UHB MRSA policy
- Review previous Microbiology results and PICS alerts for other multi-drug resistant organisms
- For best efficacy antibiotics should be given within 30 minutes before incision (SIGN Guideline 104, 2008); and before tourniquet application for practical reasons, doses are usually given at induction.
- For long procedures (over 6 hours) consider giving a second dose of antibiotic at the appropriate timing
- If microbiological sampling is needed in the case of suspected infection, prophylaxis should be delayed until the sampling has been done.
- All aspects of antibiotic prophylaxis, for example, where prophylaxis is not given when recommended, should be clearly recorded in the case records.
- If samples are taken when there is a significant infection, in particular pus or tissue, then arrange for the specimens to be taken to the laboratory for processing rapidly. The on call biomedical scientist should be contacted (via switchboard) out of hours so that samples are not left overnight in theatres or in a fridge for processing in the morning.

EMERGENCY HAND PATIENTS

OPEN WOUNDS NOT REQUIRING IMMEDIATE ADMISSION

**First line:**
Flucloxacillin  
Dose: 500mg – oral - **6 hourly until surgery**  
PLUS at induction of surgery (within 30 minutes before incision):  
Flucloxacillin  
Dose: 1g - intravenous injection – one dose.

No further antibiotic unless clinically indicated (e.g. signs of infection at start of operation, or adequate surgical debridement impossible and there are major concerns of infection)

**Second line (penicillin allergy):**
Clindamycin  
Dose: 450mg – oral - **6 hourly until surgery**  
PLUS at induction of surgery (within 30 minutes before incision):  
Clindamycin  
Dose: 600mg – intravenous infusion – one dose.

No further antibiotic unless clinically indicated (e.g. signs of infection at start of operation, or adequate surgical debridement impossible and there are major concerns of infection)

**Second line (known MRSA):**
Check PICS for last sensitivities - 85% of MRSA are sensitive to doxycycline (oral)

*If the last known MRSA was doxycycline (tetracycline) sensitive:*
Doxycycline  
Dose 200mg orally stat, then 100mg **twice a day** until surgery

PLUS at induction (within 30 minutes before incision):
<table>
<thead>
<tr>
<th>Teicoplanin</th>
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<tr>
<td>Dose (Weight &lt;70 kg): 600 mg - intravenous injection over 3 to 5 minutes</td>
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<td>Dose (Weight ≥70 kg): 800 mg - intravenous infusion over 30mins</td>
</tr>
<tr>
<td>No further antibiotic unless clinically indicated (e.g. signs of infection at start of operation, or adequate surgical debridement impossible and there are major concerns of infection)</td>
</tr>
</tbody>
</table>

OR

<table>
<thead>
<tr>
<th>If the last known MRSA was clindamycin (erythromycin) sensitive:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clindamycin</td>
</tr>
<tr>
<td>Dose: 450mg - oral – four times a day</td>
</tr>
</tbody>
</table>

PLUS at induction (within 30 minutes before incision):

<table>
<thead>
<tr>
<th>Clindamycin</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dose: 600mg – intravenous infusion – one dose.</td>
</tr>
</tbody>
</table>

No further antibiotic unless clinically indicated (e.g., signs of infection at start of operation, or adequate surgical debridement impossible and there are major concerns of infection)

OR

<table>
<thead>
<tr>
<th>If the last known MRSA was neither tetracycline nor clindamycin sensitive:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Linezolid</td>
</tr>
<tr>
<td>Dose: 600mg two times a day - oral</td>
</tr>
</tbody>
</table>

PLUS at induction (within 30 minutes before incision):

<table>
<thead>
<tr>
<th>Teicoplanin</th>
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</thead>
<tbody>
<tr>
<td>Dose (Weight &lt;70 kg): 600 mg - intravenous injection over 3 to 5 minutes</td>
</tr>
<tr>
<td>Dose (Weight ≥70 kg): 800 mg - intravenous infusion over 30mins</td>
</tr>
</tbody>
</table>

No further antibiotic unless clinically indicated (e.g., signs of infection at start of operation, or adequate surgical debridement impossible and there are major concerns of infection)
OPEN WOUNDS REQUIRING IMMEDIATE ADMISSION

a. Animal bites (including human bites, eg fight bites)

Antibiotic administration is recommended. In human bites assess the risk of blood-borne virus and consider the need for hepatitis B vaccination/HIV post-exposure prophylaxis. If bite occurred overseas or a bat bite is suspected consult the Medical Virologist to assess risk of rabies, and therefore need for post-exposure vaccination.

Organisms: *Staphylococcus aureus*, Group A streptococci, *Pasteurella multocida*, anaerobes

For immediately presenting, clinically uninfected wounds, use antibiotics described above in section ‘Animal bites; A) Minor infections and/or patients presenting within the first 24hrs after the bite’.

For clinically infected and/or delayed presenting wounds, use antibiotics described above in section ‘Animal bites; B) Severe infections and/or patients presenting 24hrs or more after the bite’.

Due to good bioavailability, ciprofloxacin and metronidazole can be given orally as soon as the patient is able to tolerate oral medication.

b. Heavily contaminated wounds (or those from contaminated environment)

Immunisation


Treatment

First line:

Co-amoxiclav – total 5 days (IV or IV/oral)
Dose: 1.2g - intravenous injection - three times a day after theatre if no signs of cellulitis, change to:
Dose: 625mg - oral three times a day

PLUS at induction (within 30 minutes before incision):
Gentamicin
Dose: 1.5mg/kg (Ideal Body Weight) - intravenous injection – one dose

Review results of any operative microbiological samples to check which antibiotics are appropriate.

Second line (penicillin allergic):

Clindamycin
Dose: 300mg to 600mg (depending on severity) - intravenous injection - four times a day
Change to 300mg to 450mg – orally – four times a day, after theatre

PLUS at induction (within 30 minutes before incision):
Gentamicin
Dose: 1.5mg/kg (Ideal Body Weight) - intravenous injection – one dose
Review results of any operative microbiological samples to check which antibiotics are appropriate.

c. Open fractures

There are no current national guidelines. Therefore, except for the open distal phalanx tuft fractures (which do not require admission), use orthopaedic prophylaxis guidelines for open fractures.

d. Soft tissue infection/Cellulitis

Treat as per cellulitis/wound infection guideline, starting with high dose intravenous treatment until response.

e. Closed fracture fixation

See orthopaedic prophylaxis guidelines for fixation of closed fractures.
ELECTIVE HAND SURGERY

SOFT TISSUE SURGERY

Antibiotics are not generally needed

PROCEDURES INVOLVING INSERTION OR REMOVAL OF IMPLANTS OR GRAFTS (SOFT TISSUE)

First choice:

At induction (within 30 minutes before incision):
Flucloxacillin
Dose: 1g - intravenous injection - one dose.

In operations lasting more than 6 hrs:
Flucloxacillin 1g - intravenous injection - 6 hourly during the operation

Second choice: (penicillin allergic or MRSA positive patient):

Teicoplanin
Dose: 600 mg (for patients <70 kg) OR 800 mg (for patients ≥70kg) - intravenous injection over 3 to 5 minutes or as a 30-minute infusion - one dose within 30 minutes before incision.

In operations lasting more than 8hrs or more:
Further doses of Teicoplanin 400mg - intravenous injection over 3 to 5 minutes or as a 30-minute infusion – 8 hourly up to a maximum of three doses in total, including that given at induction

PROCEDURES INVOLVING BONE OR JOINT

a. Arthroplasty including bone grafting
   Use [orthopaedic prophylaxis guideline for arthroplasty/implant insertion](#)

b. Amputation
   Use [orthopaedic prophylaxis guideline for amputation](#)
v. HEPATOLOGY & HEPATO-BILIARY SURGICAL PROPHYLAXIS

LAPAROSCOPIC CHOLECYSTECTOMY & OPEN CHOLECYSTECTOMY

- Screen patient for MRSA prior to surgery according to the UHB MRSA policy
- Review previous Microbiology results and PICS alerts for other multi-drug resistant organisms
- For best efficacy antibiotics should be given within 30 minutes before incision (SIGN Guideline 104, 2008); for practical reasons, doses are usually given at induction.
- In the event of major intra-operative blood loss in adults (>1,500 ml) additional dosage of prophylactic antibiotic should be considered after fluid replacement
- All aspects of antibiotic prophylaxis, for example, where prophylaxis is not given when recommended, should be clearly recorded in the case records.
- RCTs and meta-analysis indicate that in the absence of established infection one dose of antibiotics is sufficient prophylaxis for all types of surgery (DTB 2003:41:83)
- Organisms: Coliforms and anaerobes
- Antibiotics are required in laparoscopic cholecystectomy only if patients are: diabetic / morbidly obese / has acute cholecystitis/ empyema / if there is bile spill intra-operatively

First choice:
Co-amoxiclav
Dose: 1.2g - intravenous injection – single dose within 30 minutes before incision.
If procedure lasts more that 4h, a second dose should be given

Second choice (penicillin allergic):
Ciprofloxacin
Dose: 400 mg - intravenous injection – single dose within 30 minutes before incision

PLUS
Metronidazole
Dose: 500mg - intravenous injection single dose within 30 minutes before incision

Additional circumstances:

If patient MRSA positive:
Add to above:
Vancomycin
Dose: 1g intravenous infusion single dose only (start infusion 60mins before start of incision)

If ESBL positive Gram negative organisms have been previously isolated in a patient, the antibiotic prophylaxis should include adequate cover. Check sensitivities prior to theatre
PERCUTANEOUS or TRANSJUGULAR LIVER BIOPSY

The current data on the use of prophylactic antibiotics are inconclusive and The routine use of prophylactic antibiotics is not recommended

References:

LIVER RESECTION PROPHYLAXIS

- Screen patient for MRSA prior to surgery according to the UHB MRSA policy
- Review previous Microbiology results and PICS alerts for other multi-drug resistant organisms

- For best efficacy antibiotics should be given within 30 minutes before incision (SIGN Guideline 104, 2008); for practical reasons, doses are usually given at induction.
- In the event of major intra-operative blood loss in adults (>1,500 ml) additional dosage of prophylactic antibiotic should be considered after fluid replacement
- All aspects of antibiotic prophylaxis, for example, where prophylaxis is not given when recommended, should be clearly recorded in the case records.
- RCTs and meta-analysis indicate that in the absence of established infection one dose of antibiotics is sufficient prophylaxis for all types of surgery (DTB 2003:41;83)
- Organisms: Coliforms and anaerobes

### First choice:
Co-amoxiclav  
Dose: 1.2g - intravenous injection – three times a day, for 24 hours (i.e. 3 doses)

### Second choice (penicillin allergy):
Ciprofloxacin 400mg BD for 24hrs (i.e. 2 doses)  
PLUS  
Metronidazole 500mg TDS for 24hrs (i.e. 3 doses)

### Comments:
- Patients with a pre-operative biliary stent receive a dose of Fluconazole 100mg
PANCREATIC RESECTION PROPHYLAXIS

- Screen patient for MRSA prior to surgery according to the UHB MRSA policy
- Review previous Microbiology results and PICS alerts for other multi-drug resistant organisms
- For best efficacy antibiotics should be given within 30 minutes before incision (SIGN Guideline 104, 2008); for practical reasons, doses are usually given at induction.
- In the event of major intra-operative blood loss in adults (>1,500 ml) additional dosage of prophylactic antibiotic should be considered after fluid replacement.
- All aspects of antibiotic prophylaxis, for example, where prophylaxis is not given when recommended, should be clearly recorded in the case records.
- RCTs and meta-analysis indicate that in the absence of established infection one dose of antibiotics is sufficient prophylaxis for all types of surgery (DTB 2003:41;83)
- Organisms: Coliforms and anaerobes

First choice:

Piperacillin-tazobactam
Dose: 4.5g - intravenous injection – three times a day, for 24 hours (i.e. 3 doses)

Second choice (penicillin allergic):

Ciprofloxacin
Dose: 400 mg - intravenous injection – twice a day, for 24 hours (i.e. 2 doses)

PLUS
Metronidazole
Dose: 500mg - intravenous injection – three times a day, for 24 hours (i.e. 3 doses)

Additional circumstances:

If patient MRSA positive:
Add to above:
Vancomycin
Dose: see intravenous vancomycin – intermittent infusion guideline for dosing and monitoring. For 2 doses

If patient stented
Add to above:
Fluconazole
Dose: 100mg – intravenous injection – one dose

If ESBL positive Gram negative organisms have been previously isolated in a patient, the antibiotic prophylaxis should include adequate cover. Check sensitivities prior to theatre

Comments:
- If bile clinically infected the antibiotics should continue for five days and modified according to bile culture results.
- Antibiotic doses above are given for patients with normal renal function; they need to be modified in renal impairment accordingly.
LIVER TRANSPLANT PROPHYLAXIS

- Screen patient for MRSA prior to surgery according to the UHB MRSA policy
- Review previous Microbiology results and PICS alerts for other multi-drug resistant organisms
- For best efficacy antibiotics should be given within 30 minutes before incision (SIGN Guideline 104, 2008); for practical reasons, doses are usually given at induction.
- In the event of major intra-operative blood loss in adults (>1,500 ml) additional dosage of prophylactic antibiotic should be considered after fluid replacement
- All aspects of antibiotic prophylaxis, for example, where prophylaxis is not given when recommended, should be clearly recorded in the case records.
- RCTs and meta-analysis indicate that in the absence of established infection one dose of antibiotics is sufficient prophylaxis for all types of surgery (DTB 2003:41;83)
- Organisms: Coliforms and anaerobes

<table>
<thead>
<tr>
<th>First choice:</th>
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<tbody>
<tr>
<td>Piperacillin/tazobactam 4.5 g STAT 30mins prior to incision and then continue TDS for 24hrs</td>
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<table>
<thead>
<tr>
<th>Second choice (penicillin allergy):</th>
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<tbody>
<tr>
<td>Ciprofloxacin 400mg BD for 24hrs</td>
</tr>
<tr>
<td>PLUS Metronidazole 500mg TDS for 24hrs</td>
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<table>
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<tr>
<th>Antifungal prophylaxis:</th>
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<tbody>
<tr>
<td>Low risk:</td>
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<tr>
<td>Fluconazole IV 100mg od for 5 days (or until leaving ITU if earlier)</td>
</tr>
<tr>
<td>High risk (fulminant liver failure, re-transplantation):</td>
</tr>
<tr>
<td>Ambisome IV 50mg od</td>
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</table>

Comments:
- For further information, including PCP and CMV prophylaxis, refer to http://uhbpolicies/assets/MicrobiologyConsiderationsLiverTransplant.pdf
<table>
<thead>
<tr>
<th><strong>Transjugular intrahepatic portosystemic shunt (TIPS) procedures</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Percutaneous cholangiogram (including stents/dilation)</strong></td>
</tr>
<tr>
<td><strong>T-Tube removal in transplant patients</strong></td>
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<table>
<thead>
<tr>
<th><strong>Ciprofloxacin</strong></th>
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<tbody>
<tr>
<td><strong>Dose:</strong> 750 mg - oral - one dose, one hour before procedure</td>
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</table>

If patient MRSA positive:

**PLUS**

<table>
<thead>
<tr>
<th><strong>Teicoplanin</strong></th>
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<tbody>
<tr>
<td><strong>Dose (Weight &lt;70 kg):</strong> 600 mg - intravenous injection over 3 to 5 minutes</td>
</tr>
<tr>
<td><strong>Dose (Weight ≥70 kg):</strong> 800 mg - intravenous infusion over 30mins</td>
</tr>
</tbody>
</table>
vi. NEUROSURGERY – PROPHYLAXIS

- Screen patient for MRSA prior to surgery according to the UHB MRSA policy
- Review previous Microbiology results and PICS alerts for other multi-drug resistant organisms

- For best efficacy antibiotics should be given within 30 minutes before incision (SIGN Guideline 104, 2008); for practical reasons, doses are usually given at induction.
- In the event of major intra-operative blood loss in adults (>1,500 ml) additional dosage of prophylactic antibiotic should be considered after fluid replacement
- Where a procedure extends beyond 4 hours, with an open wound, additional doses of antibiotic may need to be administered, and repeated at regular intervals, until the wound is closed.
- All aspects of antibiotic prophylaxis, for example, where prophylaxis is not given when recommended, should be clearly recorded in the case records.

CLEAN NON-IMPLANT OPERATIONS
(Craniotomy and spinal operations – NO implants)

**First choice:**

Cefuroxime  
Dose: 1.5g - intravenous injection - one dose within 30 minutes before incision.

**In operations lasting more than 4 hours:**

Further doses of Cefuroxime 750mg - intravenous injection - should be given **4 hourly during the operation**

**Second choice (in cephalosporin or severe penicillin allergic patients, or in patients colonised with MRSA):**

Teicoplanin  
Dose (Weight <70 kg): 600 mg - intravenous injection over 3 to 5 minutes  
Dose (Weight ≥70 kg): 800 mg - intravenous infusion over 30mins

PLUS  
Gentamicin  
Dose: 1.5mg/kg (Ideal Body Weight) - intravenous injection - one dose within 30 minutes before incision.

**In operations lasting more than 8 hours:**

Further doses of Teicoplanin 400 mg - intravenous injection over 3 to 5 minutes or as a 30-minute infusion, **8 hourly during the operation**

PLUS  
Gentamicin 1.5mg/kg - intravenous injection should be given **8 hourly during the operation**
Teicoplanin is added to the routine prophylaxis with cefuroxime in order to prevent prosthetic material-associated infection due to coagulase-negative staphylococci.

**First choice:**

Cefuroxime  
Dose: 1.5g - intravenous injection - one dose within 30 minutes before incision.  

**PLUS**  
Teicoplanin  
Dose (Weight <70 kg): 600 mg - intravenous injection over 3 to 5 minutes  
Dose (Weight ≥70 kg): 800 mg - intravenous infusion over 30mins

**In operations lasting more than 4 hrs:**

Further dose of Cefuroxime 750mg - intravenous injection - should be given **4hourly during the operation**

**PLUS**  
Teicoplanin 400mg - intravenous injection over 3 to 5 minutes or as a 30-minute infusion - should be given **8 hourly during the operation**.

**Second choice (in patients with severe/immediate penicillin allergy or cephalosporin allergy or in those colonised with MRSA):**

Teicoplanin  
Dose (Weight <70 kg): 600 mg - intravenous injection over 3 to 5 minutes  
Dose (Weight ≥70 kg): 800 mg - intravenous infusion over 30mins

**PLUS**  
Gentamicin  
Dose: 1.5mg/kg (Ideal Body Weight) - intravenous injection - one dose within 30 minutes before incision.

**In operations lasting more than 8 hrs:**

Further doses of Teicoplanin 400mg - intravenous injection over 3 to 5 minutes or as a 30-minute infusion, **8 hourly during the operation**  

**PLUS**  
Gentamicin 1.5mg/kg - intravenous injection should be given **8 hourly during the operation**.
**CLEAN-CONTAMINATED OPERATIONS**

One or more cranial air sinuses crossed or access via nasopharynx or oropharynx - e.g. base of skull surgery if sinuses are opened or likely to be opened

<table>
<thead>
<tr>
<th><strong>First choice:</strong></th>
</tr>
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<tbody>
<tr>
<td>Cefuroxime</td>
</tr>
<tr>
<td>Dose: 1.5g - intravenous injection - one dose within 30 minutes before incision.</td>
</tr>
<tr>
<td><strong>PLUS</strong></td>
</tr>
<tr>
<td>Metronidazole</td>
</tr>
<tr>
<td>Dose: 500mg - intravenous injection - one dose within 30 minutes before incision.</td>
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</table>

**In prolonged operative procedures (>4 hours):**

Further doses of Cefuroxime 750mg - intravenous injection should be given **4 hourly during the operation**

**PLUS**

Metronidazole 500mg - intravenous injection should be given **8 hourly during the operation**

<table>
<thead>
<tr>
<th><strong>Second choice (in cephalosporin - or severe penicillin allergic patients or in patients colonised with MRSA):</strong></th>
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<tbody>
<tr>
<td>Teicoplanin</td>
</tr>
<tr>
<td>Dose (Weight &lt;70 kg): 600 mg - intravenous injection over 3 to 5 minutes</td>
</tr>
<tr>
<td>Dose (Weight ≥70 kg): 800 mg - intravenous infusion over 30mins</td>
</tr>
<tr>
<td><strong>PLUS</strong></td>
</tr>
<tr>
<td>Gentamicin</td>
</tr>
<tr>
<td>Dose: 1.5mg/kg ([Ideal Body Weight; reduce dose in renal impairment] - intravenous injection - one dose within 30 minutes before incision.</td>
</tr>
</tbody>
</table>

**PLUS**

Metronidazole
Dose: 500mg – intravenous injection - one dose within 30 minutes before incision.

**In operations lasting more than 8 hrs:**

Further doses of Teicoplanin 400mg - intravenous injection over 3 to 5 minutes or as a 30-minute infusion, **8 hourly during the operation**

**PLUS**

Gentamicin 1.5mg/kg intravenous injection **8 hourly during the operation**

**PLUS**

Metronidazole 500mg - intravenous injection should be given **8 hourly during the operation.**
COMPOUND SKULL FRACTURES

- If contamination is light and surgical debridement undertaken within 6 hours, antibiotic prophylaxis same as for clean-contaminated operations.

- If heavy contamination or surgical debridement delayed beyond 6 hours, antibiotic prophylaxis same as for clean-contaminated operations, but usually extended for a duration of 5 days, according to response.

PENETRATING CRANIAL INJURIES

- Debridement of devitalised tissue is essential. Review the tetanus status of the patient.

- Though there are no controlled or comparative studies, pre-emptive antibiotic therapy following the initial injury may prevent deep-seated infection (e.g. brain abscess, osteomyelitis and meningitis) and should be used at the discretion of the surgeon in charge.

<table>
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<tr>
<th>First choice:</th>
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<tbody>
<tr>
<td>Ceftriaxone</td>
</tr>
<tr>
<td>Dose: 2g - intravenous injection - twice a day - one dose within 30 minutes before incision and continued for up to 5 days postoperatively.</td>
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PLUS

<table>
<thead>
<tr>
<th>Metronidazole</th>
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</thead>
<tbody>
<tr>
<td>Dose: 500mg - intravenous injection - three times a day - one dose within 30 minutes before incision and continued for up to 5 days postoperatively.</td>
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<table>
<thead>
<tr>
<th>Second choice (in case of severe/immediate penicillin allergy or cephalosporin allergy):</th>
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<tbody>
<tr>
<td>Vancomycin</td>
</tr>
<tr>
<td>Dose: 1g - intravenous infusion over 100 minutes - every 12 hours - one dose within 30 minutes before incision and continued for up to 5 days postoperatively.</td>
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<tr>
<td>(adjust dose in renal impairment)</td>
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PLUS

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<tr>
<th>Ciprofloxacin</th>
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<tbody>
<tr>
<td>Dose: 400mg - intravenous infusion over 60 minutes - every 12 hours - one dose within 30 minutes before incision and continued for up to 5 days postoperatively.</td>
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PLUS

<table>
<thead>
<tr>
<th>Metronidazole</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dose: 500mg - intravenous injection - every 8 hours - one dose within 30 minutes before incision and continued for up to 5 days postoperatively.</td>
</tr>
</tbody>
</table>

Note: Antibiotic regimen may differ if there is a risk of an unusual environmental source, in particular with battlefield injuries. Please discuss with Medical Microbiologist in these situations.
EARLY RE-OPERATION/ RE-OPENING OF SURGICAL WOUNDS

Teicoplanin
Dose (Weight <70 kg): 600 mg - intravenous injection over 3 to 5 minutes one dose at induction.
Dose (Weight ≥70 kg): 800 mg - intravenous infusion over 30 mins one dose at induction.

PLUS
Gentamicin
Dose: 1.5mg/kg - intravenous injection - one dose at induction

PLUS
Metronidazole
Dose: 500mg - intravenous injection - one dose within 30 minutes before incision.

In operations lasting more than 8 hrs, further doses of:

Teicoplanin 400mg - intravenous injection over 3 to 5 minutes or as a 30-minute infusion, 8 hourly during the operation

PLUS
Gentamicin 1.5mg/kg - intravenous injection 8 hourly during the operation

PLUS
Metronidazole 500mg - intravenous injection should be given 8 hourly during the operation.

CSF SHUNT OPERATIONS

First choice:
Cefuroxime
Dose: 1.5g - intravenous injection - one dose within 30 minutes before incision.

Second choice (in patients with severe/immediate penicillin allergy or cephalosporin allergy or in those colonised with MRSA):

Teicoplanin
Dose: 600 mg (for patients <70 kg) OR 800 mg (for patients ≥70kg) - intravenous injection over 3 to 5 minutes or as a 30-minute infusion - one dose within 30 minutes before incision.

Comments:
- Use antibiotic-impregnated catheters if possible. Antibiotic prophylaxis is not recommended for insertion of external ventricular drains.

- As an alternative, intraventricular Vancomycin 10mg (see dosing of intraventricular antibiotics and method of preparation) and preservative-free Gentamicin 3 to 4mg can be administered intraventricularly through catheter to be retained in ventricle for at least 15 minutes.

- If there is a history of recent meningitis or ventriculitis prior to CSF shunt insertion, please contact Medical Microbiologist to discuss.
CSF LEAKS

1. **Traumatic CSF leak after skull fracture (usually basal)**

Pneumococcal polysaccharide vaccine (PPV23) should be given

The Infection in Neurosurgery Working Party of the BSAC concluded that the available evidence does **not** support the use of prophylactic antibiotics in patients with a skull fracture and CSF fistulae.

However, patients should be closely monitored for signs and symptoms of meningitis. Meningitis in a patient with skull fractures and CSF leak should be treated as below.

**TREATMENT of meningitis associated with CSF leak – NOT to be used as prophylaxis**

**First choice**

Ceftriaxone  
Dose: 2g - intravenous injection - twice a day  
(Review doses at 48 hrs depending on renal function.)

**PLUS**

Metronidazole  
Dose: 500mg - intravenous injection - three times a day

Duration to be discussed with medical Microbiologist

**TREATMENT of meningitis associated with CSF leak – NOT to be used as prophylaxis**

**Second choice - severe penicillin allergy:**

Chloramphenicol  
Dose: 25mg/kg - intravenous injection - every 6 hours

**PLUS**

Metronidazole  
Dose: 500mg - intravenous injection - three times a day

Duration to be discussed with medical Microbiologist

2. **Spontaneous CSF leak**

Pneumococcal polysaccharide vaccine (PPV23) should be given and the cause for CSF leak should be investigated.

3. **Post-operative CSF leak (transphenoidal or through wound)**

CSF fistula should be managed surgically (eg. using a lumbar drain or wound suture). CSF should be sampled. Prophylaxis antibiotics should not be given. In case of meningitis, refer to the [postoperative meningitis regime](#) (Neurosurgery).

Pneumococcal polysaccharide vaccine (PPV23) should be given if the leak and/or surgical procedure traverses sinuses.
DENTAL PROPHYLAXIS IN PATIENTS WITH CSF SHUNTS

Dental prophylaxis has been recommended by certain authors in patients with ventriculooatrial shunts. However, this was recently refuted by a literature review and certainly no antibiotic prophylaxis is recommended routinely in patients with ventriculoperitoneal or lumboperitoneal shunts. 10

There are no clear recommendations for dental antibiotic prophylaxis for patients with intracranial aneurysm coils but, on balance, there are probably more risks than benefits associated with it, so this would not be routinely recommended.

Rationale:

• There have been no randomised controlled trials evaluating the use of antibiotic prophylaxis to prevent secondary infection from a distant source, including the mouth, in patients with VP or VA shunts.
• The risk of CSF shunt infection following dental procedures appears to be almost negligible. There are no reported cases of CSF shunt infection following a dental procedure.
• There are risks associated with the use of antibiotic prophylaxis.

Key References of Neurosurgical prophylaxis section

4. NICE Clinical diagnosis and management of tuberculosis, and measures for its prevention and control 2006
ORTHOPAEDIC SURGERY – PROPHYLAXIS

ARTHROPLASTY/IMPLANT INSERTION

- Screen patient for MRSA prior to surgery according to the UHB MRSA policy
- Review previous Microbiology results and PICS alerts for other multi-drug resistant organisms
- For best efficacy antibiotics should be given within 30 minutes before incision (SIGN Guideline 104, 2008); for practical reasons, doses are usually given at induction.
- In the event of major intra-operative blood loss in adults (>1,500 ml) additional dosage of prophylactic antibiotic should be considered after fluid replacement
- All aspects of antibiotic prophylaxis, for example, where prophylaxis is not given when recommended, should be clearly recorded in the case records.
- **Organisms:** Staphylococci including MRSA, streptococci.

**First choice:**
Flucloxacillin  
Dose: 1g - intravenous injection - one dose within 30 minutes before incision.

**PLUS**  
Gentamicin  
Dose: 1.5mg/kg (Ideal Body Weight) - intravenous injection - one dose before induction.

<table>
<thead>
<tr>
<th>In operations lasting more than 6 hrs:</th>
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<tbody>
<tr>
<td>Flucloxacillin 1g - intravenous injection <strong>6 hourly</strong> during the operation</td>
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<table>
<thead>
<tr>
<th>In operations lasting more than 8 hrs:</th>
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<tbody>
<tr>
<td>Gentamicin 1.5mg/kg - intravenous injection <strong>8 hourly</strong> during the operation</td>
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</table>

**Second choice: (penicillin allergic or MRSA positive patient):**
Teicoplanin  
Dose (Weight <70 kg): 600 mg - intravenous injection over 3 to 5 minutes  
Dose (Weight ≥70 kg): 800 mg - intravenous infusion over 30mins

**PLUS**  
Gentamicin  
Dose: 1.5mg/kg (Ideal Body Weight) - intravenous injection - one dose within 30 minutes before incision.

<table>
<thead>
<tr>
<th>In operations lasting more than 8 hrs:</th>
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<tbody>
<tr>
<td>Further doses of Teicoplanin 400mg - intravenous injection over 3 to 5 minutes or as a 30-minute infusion, <strong>8 hourly</strong> during the operation</td>
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</table>

**PLUS**  
Gentamicin 1.5mg/kg - intravenous injection **8 hourly** during the operation

**Comment:** Further post-op antibiotics may be given at surgeon’s discretion. However, gentamicin must be dosed according to renal function and levels done. These recommendations are based on the evidence-based guidelines “Antibiotic prophylaxis in surgery” produced by the Scottish Intercollegiate Guideline Network, July 2008 and updated 2014 and the BNF 65, March 2013.
**FIXATION OF CLOSED FRACTURES**

- Screen patient for MRSA prior to surgery according to the UHB MRSA policy
- Review previous Microbiology results and PICS alerts for other multi-drug resistant organisms
- For best efficacy antibiotics should be given within 30 minutes before incision (SIGN Guideline 104, 2008); for practical reasons, doses are usually given at induction.
- In the event of major intra-operative blood loss in adults (>1,500 ml) additional dosage of prophylactic antibiotic should be considered after fluid replacement
- All aspects of antibiotic prophylaxis, for example, where prophylaxis is not given when recommended, should be clearly recorded in the case records.
- **Organisms:** Staphylococci including MRSA, streptococci.

### First choice:

Flucloxacillin  
Dose: 1g - intravenous injection - one dose within 30 minutes before incision.

**In operations lasting more than 6 hrs or more, or ‘high-risk’ procedures:**

Further doses of Flucloxacillin 1g - intravenous injection - 6 hourly up to a maximum of four doses in total, including that at induction

### Second choice: (penicillin allergic or MRSA positive patient):

Teicoplanin  
Dose (Weight <70 kg): 600 mg - intravenous injection over 3 to 5 minutes  
Dose (Weight ≥70 kg): 800 mg - intravenous infusion over 30mins

**In operations lasting more than 8hrs or more, or ‘high-risk’ procedures:**

Further doses of Teicoplanin 400mg - intravenous injection over 3 to 5 minutes or as a 30-minute infusion – 8 hourly up to a maximum of three doses in total, including that at induction
OPEN FRATURES

- Intravenous antibiotics should be administered as soon as possible after the injury, and certainly within three hours.
- Review tetanus status and need for vaccination and immunoglobulin.
- Screen patient for MRSA according to the UHB MRSA policy.
- For best efficacy for operative prophylaxis, antibiotics should be given within 30 minutes before incision (SIGN Guideline 104, 2008) and before tourniquet application; for practical reasons, doses are usually given at induction.
- All aspects of antibiotic prophylaxis, for example, where prophylaxis is not given when recommended, should be clearly recorded in the case records.

**First choice:**

Co-amoxiclav

Dose: 1.2g - intravenous injection – every eight hours.

To be continued until soft tissue closure or for a maximum of 72 hours, whichever is sooner.

**Second choice (penicillin allergy):**

Clindamycin

Dose: 600mg - intravenous injection – every six hours.

To be continued until soft tissue closure or for a maximum of 72 hours, whichever is sooner.

**If known or high risk of MRSA:**

PLUS

Vancomycin

Dose: see [intravenous vancomycin – intermittent infusion](#) guideline for dosing and monitoring.

To be continued until soft tissue closure or for a maximum of 72 hours (whichever is sooner).

**IN ADDITION:**

1. **At time of first debridement:**

Co-amoxiclav or clindamycin (+/- vancomycin) – to continue as above

PLUS

Gentamicin

Dose: 1.5mg/kg (Ideal Body Weight) - intravenous injection - one dose within 30 minutes before incision.

2. **At the time of skeletal stabilisation and definitive soft tissue closure:**

Teicoplanin (unless has had vancomycin within last 8 hours)

Dose: 600 mg (for patients <70 kg) OR 800 mg (for patients ≥70kg) - intravenous injection over 3 to 5 minutes or as a 30-minute infusion - one dose within 30 minutes before incision.

Not to be continued

PLUS

Gentamicin

Dose: 1.5mg/kg (Ideal Body Weight) - intravenous injection - one dose within 30 minutes before incision. Not to be continued

**Comment:**

- Based on *Standards for the management of open fractures of the lower limb, BOA & BAPRAS, 2009*
HIGH LOWER-LIMB AMPUTATION
(for other limb amputation, see below)

- Screen patient for MRSA prior to surgery according to the UHB MRSA policy
- Review previous Microbiology results and PICS alerts for other multi-drug resistant organisms
- For best efficacy antibiotics should be given within 30 minutes before incision (SIGN Guideline 104, 2008); for practical reasons, doses are usually given at induction.
- In the event of major intra-operative blood loss in adults (>1,500 ml) additional dosage of prophylactic antibiotic should be considered after fluid replacement
- All aspects of antibiotic prophylaxis, for example, where prophylaxis is not given when recommended, should be clearly recorded in the case records.
- **Organisms:** Staphylococci including MRSA, streptococci, coliforms and anaerobes including clostridia

### First choice:

Co-amoxiclav  
Dose: 1.2g - intravenous injection – one dose within 30 minutes before incision, continue three times a day for 48 hours and then wound review

### Second choice (penicillin allergic or MRSA positive patient):

- **Teicoplanin**  
  Dose (Weight <70 kg): 600 mg - intravenous injection over 3 to 5 minutes  
  Dose (Weight ≥70 kg): 800 mg - intravenous infusion over 30mins

Followed by two more 400mg doses (regardless of patient weight) at 12 hrs and 24 hrs and then wound review

**PLUS**  
- **Gentamicin**  
  Dose: 1.5mg/kg (Ideal Body Weight) - intravenous injection - one dose within 30 minutes before incision.

**PLUS**  
- **Metronidazole**  
  Dose: 500mg - intravenous injection – one dose within 30 minutes before incision, three times a day for 48 hours and then wound review

**Patients with active ongoing sepsis need to continue with their current therapeutic antibiotic treatment.**

**Comment:**  
- These recommendations are based on the evidence-based guidelines “Antibiotic prophylaxis in surgery” produced by the Scottish Intercollegiate Guideline Network, July 2008
LIMB AMPUTATION
(such as BKA, TMA, toe amputation; for high lower-limb amputation see above)

- Screen patient for MRSA prior to surgery according to the UHB MRSA policy
- Review previous Microbiology results and PICS alerts for MRSA status
- For best efficacy antibiotics should be given within 30 minutes before incision (SIGN Guideline 104, 2008) and before tourniquet application; for practical reasons, doses are usually given at induction.
- All aspects of antibiotic prophylaxis, for example, where prophylaxis is not given when recommended, should be clearly recorded in the case records.

### First choice
Co-amoxiclav
Dose: 1.2g - intravenous injection – one dose within 30 minutes before incision, then three times a day for 48 hours and then wound review.

### Second choice, if penicillin allergic or previous MRSA
Teicoplanin
Dose (Weight <70 kg): 600 mg - intravenous injection over 3 to 5 minutes
Dose (Weight ≥70 kg): 800 mg - intravenous infusion over 30mins

Followed by two more 400mg doses (regardless of patient weight) at 12 hrs and 24 hrs and then wound review

Patients with active ongoing sepsis need to continue with their current therapeutic antibiotic treatment.

**Comment:** These recommendations are based on the evidence-based guidelines “Antibiotic prophylaxis in surgery” produced by the Scottish Intercollegiate Guideline Network, July 2008 and the BNF 65, March 2013.
vii. PROPHYLACTIC ANTIBIOTICS FOR UROLOGICAL PROCEDURES

This guideline applies to patients who do NOT have systemic symptoms or signs of infection (e.g. fever > 38°C, rigors, chills, unexplained new confusion etc) or symptoms of urinary tract infection. Wherever possible, symptomatic urinary tract infections should be treated according to UTI guidelines and elective procedures delayed until treatment is complete.

If patients are known to be colonised or infected (either currently or previously) with resistant organisms such as MRSA, Extended Spectrum Beta-Lactamase (ESBL)-producing Gram-negative organisms or vancomycin-resistant enterococci (VRE), therapy should be adjusted to cover these organisms if they are likely to play a role in the presenting infection, in addition to their recent urine culture.

Gentamicin dose at 2mg/kg is higher than that in BNF for surgical prophylaxis (1.5mg/kg), as higher dose is consensus dose from a number of Urological Centres. For VRE, use linezolid or teicoplanin (if not already doing so for MRSA), dependent on susceptibilities.

**TRANSURETHRAL ULTRASOUND AND BIOPSY OF PROSTATE**

<table>
<thead>
<tr>
<th>First choice:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Ciprofloxacin</td>
<td></td>
</tr>
<tr>
<td>Dose: 750mg - PO – 30-60min prior to procedure and two further doses at 12h and 24h after this dose.</td>
<td></td>
</tr>
<tr>
<td><strong>PLUS</strong></td>
<td></td>
</tr>
<tr>
<td>Gentamicin</td>
<td></td>
</tr>
<tr>
<td>Dose: 2mg/kg (Ideal Body Weight) - intravenous injection - one dose ≤ 1 hour prior to procedure.</td>
<td></td>
</tr>
</tbody>
</table>

If ciprofloxacin resistance detected the antibiotic choice should be directed by the results of susceptibility testing.

<table>
<thead>
<tr>
<th>Second choice (MRSA positive):</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Teicoplanin</td>
<td></td>
</tr>
<tr>
<td>Dose (Weight &lt;70 kg): 600 mg - intravenous injection over 3 to 5 minutes</td>
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</tr>
<tr>
<td>Dose (Weight ≥70 kg): 800 mg - intravenous infusion over 30mins</td>
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<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Second choice (ESBL positive):</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Meropenem</td>
<td></td>
</tr>
<tr>
<td>Dose: 1g - intravenous injection - one dose ≤ 1 hour prior to procedure and two further doses at 8h and 16h after this dose.</td>
<td></td>
</tr>
</tbody>
</table>
**TRANSPERINEAL BIOPSY OF PROSTATE AND BRACHYTHERAPY**

<table>
<thead>
<tr>
<th>First choice:</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Ciprofloxacin</strong></td>
</tr>
<tr>
<td><strong>Dose:</strong> 750mg - PO – single dose 30-60min prior to procedure</td>
</tr>
</tbody>
</table>

**PLUS**

<table>
<thead>
<tr>
<th>Gentamicin</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Dose:</strong> 2mg/kg (Ideal Body Weight) - intravenous injection - one dose ≤ 1 hour prior to procedure.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Second choice (MRSA positive):</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Teicoplanin</strong></td>
</tr>
<tr>
<td><strong>Dose (Weight &lt;70 kg):</strong> 600 mg - intravenous injection over 3 to 5 minutes</td>
</tr>
<tr>
<td><strong>Dose (Weight ≥70 kg):</strong> 800 mg - intravenous infusion over 30mins</td>
</tr>
</tbody>
</table>

**PLUS**

| **Ciprofloxacin**             |
| **Dose:** 750mg – PO – single dose 30-60min prior to procedure |

<table>
<thead>
<tr>
<th>Second choice (ESBL positive):</th>
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<td><strong>Meropenem</strong></td>
</tr>
<tr>
<td><strong>Dose:</strong> 1g - intravenous injection - one dose ≤ 1 hour prior to procedure</td>
</tr>
</tbody>
</table>
**CYSTOSCOPY**

**Prophylaxis not routinely recommended.** It should only be used if there is asymptomatic bacteriuria. Symptomatic urinary tract infections should be treated according to UTI guidelines (Chapter 5) and elective procedures delayed until treatment is complete.

<table>
<thead>
<tr>
<th>Asymptomatic bacteriuria</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single dose of prophylaxis according to organism susceptibility</td>
</tr>
<tr>
<td><strong>OR</strong></td>
</tr>
<tr>
<td>Gentamicin</td>
</tr>
<tr>
<td>Dose: 2mg/kg (Ideal Body Weight) - intravenous injection - one dose ≤ 1 hour prior to procedure.</td>
</tr>
<tr>
<td><strong>PLUS</strong></td>
</tr>
<tr>
<td>Amoxicillin 1g - intravenous injection - single dose ≤ 1 hour prior to procedure</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Second choice (if asymptomatic bacteriuria and MRSA positive; or penicillin allergy):</th>
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</thead>
<tbody>
<tr>
<td>Teicoplanin</td>
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<tr>
<td>Dose (Weight &lt;70 kg): 600 mg - intravenous injection over 3 to 5 minutes</td>
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<table>
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<tr>
<th>Second choice (if asymptomatic bacteriuria and ESBL positive):</th>
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</thead>
<tbody>
<tr>
<td>Meropenem</td>
</tr>
<tr>
<td>Dose: 1g - intravenous injection - one dose ≤ 1 hour prior to procedure</td>
</tr>
</tbody>
</table>
**ENDO-UROLOGICAL PROCEDURES**

**a. Extracorporeal shock wave lithotripsy**

Prophylaxis not routinely required unless asymptomatic bacteriuria or immunocompromised.

**b. Ureterorenoscopy (diagnostic, therapeutic, stent change/removal)**

Patients with suspected asymptomatic bacteriuria (e.g. dipstick positive for leucocytes and nitrites) but culture results unknown should receive Gentamicin.

Patients with suspected asymptomatic bacteriuria (as above) or active infection and endocarditis risk factors – treat as for MRSA risk.

### EXTRACORPOREAL SHOCK WAVE LITHOTRIPSY / URETERORENOSCOPY / TRANSURETHRAL RESECTION OF PROSTATE OR BLADDER TUMOUR

<table>
<thead>
<tr>
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<tbody>
<tr>
<td>Gentamicin</td>
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<tr>
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</tr>
</tbody>
</table>

PLUS

| Amoxicillin 1g - intravenous injection - single dose ≤ 1 hour prior to procedure |

<table>
<thead>
<tr>
<th>Second choice (MRSA positive; or penicillin allergy):</th>
</tr>
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<tbody>
<tr>
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<tr>
<td>Dose (Weight &lt;70 kg): 600 mg - intravenous injection over 3 to 5 minutes</td>
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</table>

PLUS

| Gentamicin                                           |
| Dose: 2mg/kg (Ideal Body Weight) - intravenous injection - one dose ≤ 1 hour prior to procedure. |

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<td>Dose: 1g - intravenous injection - one dose ≤ 1 hour prior to procedure</td>
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</tbody>
</table>
a. Percutaneous nephrolithotomy

Always give prophylaxis below.

b. Percutaneous nephrostomy

If kidney infection suspected treat according to UTI guidelines.

Give prophylaxis (below) only if stones present, surgical reconstruction of urinary tract, stent or catheter in situ, diabetes

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<tr>
<td>Dose: 1g - intravenous injection - one dose ≤ 1 hour prior to procedure</td>
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</tbody>
</table>
OPEN/LAPAROSCOPIC PROCEDURES

a. Clean procedures (e.g. scrotal surgery, groin surgery and circumcision)

Antibiotic prophylaxis not routinely recommended, however if adequate skin preparation difficult then:

First choice:
Co-amoxiclav
Dose: 1.2g – intravenous injection – single dose ≤ 1 hour prior to procedure

Second choice (MRSA positive; or penicillin allergy):
Teicoplanin
Dose (Weight <70 kg): 600 mg - intravenous injection over 3 to 5 minutes
Dose (Weight ≥70 kg): 800 mg - intravenous infusion over 30mins
PLUS
Gentamicin
Dose: 2mg/kg (Ideal Body Weight) - intravenous injection - one dose ≤ 1 hour prior to procedure.

Second choice (ESBL positive):
Meropenem
Dose: 1g - intravenous injection - one dose ≤ 1 hour prior to procedure

b. Clean-contaminated (opening of intestine)

First choice (also first choice if MRSA positive):
Teicoplanin
Dose (Weight <70 kg): 600 mg - intravenous injection over 3 to 5 minutes
Dose (Weight ≥70 kg): 800 mg - intravenous infusion over 30mins
PLUS
Gentamicin
Dose: 2mg/kg (Ideal Body Weight) - intravenous injection - one dose ≤ 1 hour prior to procedure.
PLUS
Metronidazole
Dose: 500mg - intravenous injection - single dose ≤ 1 hour prior to procedure.

Second choice (ESBL positive):
Meropenem
Dose: 1g - intravenous injection - one dose ≤ 1 hour prior to procedure
c. Clean-contaminated (opening of urinary tract e.g. nephrectomy, prostatectomy, cystectomy)

<table>
<thead>
<tr>
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<tbody>
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**PLUS**

Amoxicillin 1g - intravenous injection - single dose ≤ 1 hour prior to procedure.

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**PLUS**

Gentamicin
Dose: 2mg/kg (Ideal Body Weight) - intravenous injection - one dose ≤ 1 hour prior to procedure.

<table>
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<td>Dose: 1g - intravenous injection - one dose ≤ 1 hour prior to procedure</td>
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</table>

**Implantation of Prosthetic Penile Devices**
**First choice (also first choice if MRSA positive):**

Teicoplanin  
*Dose (Weight <70 kg): 600 mg - intravenous injection over 3 to 5 minutes*  
*Dose (Weight ≥70 kg): 800 mg - intravenous infusion over 30 mins*

**PLUS**  
Gentamicin  
*Dose: 2mg/kg (Ideal Body Weight) - intravenous injection - one dose ≤ 1 hour prior to procedure.*

**Comment:**

viii. PROPHYLACTIC ANTIBIOTICS IN VASCULAR SURGERY

- Screen patient for MRSA prior to surgery according to the UHB MRSA policy
- Review previous Microbiology results and PICS alerts for other multi-drug resistant organisms
- For best efficacy antibiotics should be given within 30 minutes before incision (SIGN Guideline 104, 2008); for practical reasons, doses are usually given at induction.
- In the event of major intra-operative blood loss in adults (>1,500 ml) additional dosage of prophylactic antibiotic should be considered after fluid replacement.
- All aspects of antibiotic prophylaxis, for example, where prophylaxis is not given when recommended, should be clearly recorded in the case records.
- RCTs and meta-analysis indicate that in the absence of established infection one dose of antibiotics is sufficient prophylaxis for all types of surgery (DTB 2003:41:83)

VARICOSE VEINS

No antibiotics are needed

CAROTID ENDARTERECTOMY WITH PROSTHETIC PATCH

First choice:
Co-amoxiclav
Dose: 1.2 g - intravenous injection – one dose within 30 minutes before incision.

Second choice, if penicillin allergic or previous MRSA
Teicoplanin
Dose (Weight <70 kg): 600 mg - intravenous injection over 3 to 5 minutes
Dose (Weight ≥70 kg): 800 mg - intravenous infusion over 30mins

PLUS
Gentamicin
Dose: 1.5mg/kg (Ideal Body Weight) - intravenous injection - one dose within 30 minutes before incision.

In operations lasting more than 8 hrs, further doses of:
Teicoplanin 400mg - intravenous injection over 3 to 5 minutes or as a 30-minute infusion, 8 hourly during the operation

PLUS
Gentamicin 1.5mg/kg - intravenous injection 8 hourly during the operation

If patch not to be employed during carotid endarterectomy, then no antibiotic prophylaxis required.
Lower Limb Bypass
(such as femoro-popliteal bypass, femoro-distal bypass)
or revision and In-flow bypass (such as aorto-bifemoral, axillo-bifemoral, femoro-femoral crossover)
or revision, for both vein grafts or prosthetic graft

First choice:

Co-amoxiclav
Dose: 1.2 g - intravenous injection - one dose within 30 minutes before incision and subsequent doses at 8 and 16hrs post-op

PLUS
Gentamicin
Dose: 1.5mg/kg (Ideal Body Weight) - intravenous injection - one dose within 30 minutes before incision.

In operations lasting more than 8 hrs:

Gentamicin 1.5mg/kg - intravenous injection 8 hourly during the operation

If open wound then antibiotics based on recent swabs.

Second choice, if penicillin allergic or previous MRSA

Teicoplanin
Dose (Weight <70 kg): 600 mg - intravenous injection over 3 to 5 minutes
Dose (Weight ≥70 kg): 800 mg - intravenous infusion over 30mins

PLUS
Gentamicin
Dose: 1.5mg/kg (Ideal Body Weight) - intravenous injection - one dose within 30 minutes before incision.

In operations lasting more than 8 hrs, further doses of:

Teicoplanin 400mg - intravenous injection over 3 to 5 minutes or as a 30-minute infusion, 8 hourly during the operation

PLUS
Gentamicin 1.5mg/kg - intravenous injection 8 hourly during the operation

If open wound then antibiotics based on recent swabs.
HIGH LOWER-LIMB AMPUTATION

Organisms: Staphylococci including MRSA, streptococci, coliforms and anaerobes including clostridia.

**First choice:**
Co-amoxiclav  
Dose: 1.2g - intravenous injection – one dose within 30 minutes before incision., three times a day for 48 hours and then wound review

**Second choice:** (penicillin allergic or MRSA positive patient):
Teicoplanin  
Dose (Weight <70 kg): 600 mg - intravenous injection over 3 to 5 minutes  
Dose (Weight ≥70 kg): 800 mg - intravenous infusion over 30mins  
Followed in by two more 400mg doses (regardless of patient weight) at 12 hrs and 24 hrs and then wound review

**PLUS**  
Gentamicin  
Dose: 1.5mg/kg (Ideal Body Weight) - intravenous injection - one dose within 30 minutes before incision.

**PLUS**  
Metronidazole  
Dose: 500mg - intravenous injection – one dose within 30 minutes before incision then three times a day for 48 hours and then wound review

Patients with active ongoing infection need to continue with their current therapeutic antibiotic treatment.
MAJOR LIMB AMPUTATION (BKA, TMA, TOE AMPUTATION)

- For high lower-limb amputation – [see above](#)

<table>
<thead>
<tr>
<th><strong>First choice</strong></th>
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<tbody>
<tr>
<td>Co-amoxiclav</td>
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<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Second choice, if penicillin allergic or previous MRSA</strong></th>
<th></th>
</tr>
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<tbody>
<tr>
<td>Teicoplanin</td>
<td></td>
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<tr>
<td>Dose (Weight &lt;70 kg): 600 mg - intravenous injection over 3 to 5 minutes</td>
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<td>Dose (Weight ≥70 kg): 800 mg - intravenous infusion over 30mins</td>
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</tr>
<tr>
<td>Followed by two more 400mg doses at 12 hrs and 24 hrs and then wound review</td>
<td></td>
</tr>
</tbody>
</table>

**Patients with active ongoing infection need to continue with their current therapeutic antibiotic treatment.**
### OPEN AAA REPAIR (ABDOMINAL AORTIC ANEURYSM) / EVAR REPAIR (ENDOVASCULAR ABDOMINAL AORTIC ANEURYSM)

<table>
<thead>
<tr>
<th>First choice</th>
</tr>
</thead>
<tbody>
<tr>
<td>Co-amoxiclav</td>
</tr>
<tr>
<td>Dose: 1.2 g - intravenous injection - one dose within 30 minutes before incision and subsequent doses at 8 and 16hrs post-op.</td>
</tr>
</tbody>
</table>

**PLUS**

<table>
<thead>
<tr>
<th>Gentamicin</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dose: 1.5mg/kg (Ideal Body Weight) - intravenous injection - one dose within 30 minutes before incision.</td>
</tr>
</tbody>
</table>

**In operations lasting more than 8 hrs:**

| Gentamicin 1.5mg/kg - intravenous injection 8 hourly during the operation |

<table>
<thead>
<tr>
<th>Second choice, if penicillin allergic or previous MRSA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teicoplanin</td>
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<table>
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<tr>
<td>Dose: 1.5mg/kg (Ideal Body Weight) - intravenous injection - one dose within 30 minutes before incision.</td>
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</tbody>
</table>

**In operations lasting more than 8 hrs, further doses of:**

| Teicoplanin 400mg - intravenous injection over 3 to 5 minutes or as a 30-minute infusion, 8 hourly during the operation |

**PLUS**

| Gentamicin 1.5mg/kg - intravenous injection 8 hourly during the operation |
ANGIOGRAPHIC PUNCTURE OF SYNTHETIC VASCULAR GRAFTS (PTFE OR DACRON)
FOR ANGIOPLASTY/STENTING, OR RADIOLOGICAL INTERVENTION POST EVAR

First choice

Co-amoxiclav
Dose: 1.2g - intravenous injection - single dose at induction

PLUS

Gentamicin
Dose: 120mg - intravenous injection - one dose within 30 minutes before incision

Second choice, if penicillin allergic or previous MRSA

Teicoplanin
Dose (Weight <70 kg): 600 mg - intravenous injection over 3 to 5 minutes
Dose (Weight ≥70 kg): 800 mg - intravenous infusion over 30mins

PLUS

Gentamicin
Dose: 120mg - intravenous injection - one dose within 30 minutes before incision

GASTROINTESTINAL ENDOSCOPY


PERCUTANEOUS ENDOSCOPIC GASTROSTOMY (PEG) PROPHYLAXIS
(Including radiographically inserted gastrostomy (RIG))

<table>
<thead>
<tr>
<th>First choice:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Co-amoxiclav</td>
</tr>
<tr>
<td>Dose: 1.2g - intravenous injection - one dose within 30 minutes before incision.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Second choice (non-severe penicillin allergy):</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cefuroxime</td>
</tr>
<tr>
<td>Dose: 750 mg - intravenous injection - one dose within 30 minutes before incision.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>If severe penicillin allergic (such as anaphylaxis or angioedema):</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teicoplanin</td>
</tr>
<tr>
<td>Dose (Weight &lt;70 kg): 600 mg - intravenous injection over 3 to 5 minutes</td>
</tr>
<tr>
<td>Dose (Weight ≥70 kg): 800 mg - intravenous infusion over 30mins</td>
</tr>
</tbody>
</table>
BILIARY ENDOSCOPIC PROCEDURES PROPHYLAXIS

Summary of prophylactic antibiotic regimens on ERCP for the following patient groups (adapted from Allison *et al.* Antibiotic prophylaxis in gastrointestinal endoscopy, Gut 2009)

Comment: If ESBL positive Gram negative organisms have been previously isolated in a patient, the antibiotic prophylaxis should include adequate cover, such as intravenous meropenem.

A) Ongoing cholangitis or sepsis elsewhere

Rationale: Prevention of procedure-related bacteraemia

Be guided by recent culture results. Patients should already have been established on antibiotics. May need advice from Medical Microbiologist

B) Biliary obstruction and/or common bile duct stones and/or straightforward stent change

Rationale: Prevention of cholangitis

Not indicated unless biliary decompression not achieved.

A full course of antibiotics becomes indicated if adequate biliary decompression is not achieved during the procedure

C) ERCP when complete biliary drainage unlikely to be achieved (e.g. sclerosing cholangitis and/or hilar cholangiocarcinoma)

Special considerations may apply in cover for a repeat ERCP

Rationale: Prevention of cholangitis

Ciprofloxacin

Dose: 750 mg - oral - one dose 60 to 90 min before procedure

OR

Gentamicin

Dose: 1.5mg/kg (Ideal Body Weight) - intravenous injection - one dose before induction.

Comment: If ESBL positive Gram negative organisms have been previously isolated in a patient, the antibiotic prophylaxis should include adequate cover, eg, such as meropenem injection.

D) Communicating pancreatic cyst or pseudocyst

Rationale: Reducing risk of introducing infection into cavity

Recommendation:
Ciprofloxacin
Dose: 750 mg - oral - one dose 60 to 90 min before procedure

OR

Gentamicin
Dose: 1.5mg/kg - intravenous injection - one dose before induction.

Comment: If ESBL positive Gram negative organisms have been previously isolated in a patient, the antibiotic prophylaxis should include adequate cover, e.g., such as meropenem injection.

E) Biliary complications following liver transplant

Little evidence that prophylaxis is helpful in routine ERCP post-transplant and the decision is best taken by the endoscopist who will know whether drainage has been successful
ENDOSCOPIC ULTRASOUND INTERVENTION PROPHYLAXIS

Summary of prophylactic antibiotic regimens for the following patient groups:

A) Fine needle aspiration solid lesions
Rationale: Prevention of local infection
Recommendation: Not indicated

B) Fine needle aspiration of cystic lesions in or near pancreas, or drainage of cystic cavity
Rationale: Prevention of cyst infection
Recommendation:

<table>
<thead>
<tr>
<th>First line:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Co-amoxiclav</td>
</tr>
<tr>
<td>Dose: 1.2 g - intravenous injection - one dose before procedure</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Second line (penicillin allergy):</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ciprofloxacin</td>
</tr>
<tr>
<td>Dose: 750 mg - oral - one dose - 60 to 90 minutes before procedure</td>
</tr>
</tbody>
</table>
VARICEAL BLEEDING PROPHYLAXIS

**Rationale:** Prevention of infections such as bacterial peritonitis

<table>
<thead>
<tr>
<th><strong>First line:</strong></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Ceftriaxone</td>
<td></td>
</tr>
<tr>
<td>Dose: 1g – intravenous infusion – od (once daily) for 7 days</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Second line (severe penicillin allergy):</strong></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Ciprofloxacin</td>
<td></td>
</tr>
<tr>
<td>Dose: 400mg – intravenous infusion - bd (twice a day) for 7 days</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Oral switch (Consider once patient can tolerate tablets):</strong></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Ciprofloxacin</td>
<td></td>
</tr>
<tr>
<td>Dose: 500mg – oral - bd (twice a day) for total 7 days including IV therapy</td>
<td></td>
</tr>
</tbody>
</table>

**References:**
- AASLD Guidelines
HIGH RISK PATIENTS UNDERGOING PROCEDURE PROPHYLAXIS

For patients who are immunocompromised (e.g. neutropenia <0.5x10^9/l or advanced haematological malignancy)

Rationale: Prevention of procedure-related bacteraemia

Recommendation:

Only indicated in procedures with high risk of bacteraemia (e.g., sclerotherapy, dilatation, ERCP with obstructed system)

Discuss with Haematologist
SPLENECTOMY PROPHYLAXIS

Rationale: Protection against infection by *Streptococcus pneumoniae*, *Neisseria meningitidis*, *Haemophilus influenzae* type b, influenza virus by immunisation and antibiotic prophylaxis.

Notify patient and patient’s GP of:
- splenectomy and vulnerability to parasitic infections (malaria and babesiosis)
- immunisations given and need for further immunisations after one month (see below)
- advisability of on-going antibiotic prophylaxis
- advisability annual influenza vaccination
- advisability of pneumococcal vaccine booster (23-valent pneumococcal polysaccharide vaccine) at 5 years

Immunisations (regardless of previous immunisation history)

- For **elective** splenectomy, ideally immunise 4-6 weeks (at least 2 weeks) **before surgery** with the first 4 vaccines (1-4).
- If given the 4 vaccines pre-op, the second set of vaccines (5 & 6) should be given after a month, and at least 2 weeks post-op if already operated on.
- For **emergency** splenectomy, immunise **at least 2 weeks after surgery**, or when sufficiently well, with below four vaccines (1-4):

**Initial vaccines:**
1. Pneumococcal polysaccharide vaccine (PPV23) – one dose
   **PLUS**
2. Menitorix® (Hib plus meningococcal group C vaccine) – one dose
   **PLUS**
3. Bexsero® (meningococcal group B vaccine) – one dose
   **PLUS**
4. current season’s influenza (flu) vaccine – one dose

**One month after the administration of initial vaccines:**
5. Bexsero® (meningococcal group B vaccine) booster – one dose
   **AND**
6. Meningococcal group A, C, W135, Y conjugate vaccine – one dose
   (e.g., Menveo®, Nimenrix®, ACWY Vax®)

Antibiotic prophylaxis

**First choice:**
Penicillin V
Dose: 250mg - oral – bd (twice a day) – for at least the first two years post-splenectomy, possibly for life.

**Second choice (penicillin allergy):**
Erythromycin
Dose: 500mg - oral - twice a day - for at least the first two years post-splenectomy, possibly for life.

PATIENTS WITH BADLY SOILED WOUNDS TO PREVENT TETANUS OR GAS GANGRENE

NB. Wound toilet and tetanus immunization are more important than antibiotics.

Organisms: Clostridium tetani, Clostridium perfringens

**Immunisation**


**Treatment**

**First choice:**

Penicillin V  
Dose: 500mg - oral – qds (four times a day) for 5 days.

**Second choice (penicillin allergy):**

Metronidazole  
Dose: 400mg - oral – tds (three times a day) for 5 days.
PROPHYLAXIS OF CONTACTS OF INFECTIOUS DISEASE

CLOSE CONTACTS OF CASES OF MENINGOCOCCAL DISEASE

Prophylaxis to be administered on advice from the CCDC (Consultant in Communicable Disease Control), Public Health England.

**First line:**

<table>
<thead>
<tr>
<th>Medication</th>
<th>Dose</th>
<th>Route</th>
<th>Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ciprofloxacin</td>
<td>500mg</td>
<td>oral</td>
<td>single dose</td>
</tr>
<tr>
<td>Rifampicin</td>
<td>600mg</td>
<td>oral</td>
<td>twice daily – for 2 days</td>
</tr>
<tr>
<td>Ceftriaxone (unlicensed indication, but advised in BNF; suitable for pregnant women)</td>
<td>250mg</td>
<td>intramuscular injection</td>
<td>one dose</td>
</tr>
</tbody>
</table>

**CLOSE CONTACTS OF CASES OF DIPHTHERIA**

- Prophylaxis to be administered on advice from the CCDC (Consultant in Communicable Disease Control), Public Health England

<table>
<thead>
<tr>
<th>Medication</th>
<th>Dose</th>
<th>Route</th>
<th>Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Erythromycin</td>
<td>500mg</td>
<td>oral</td>
<td>qds (four times a day) for 7 days</td>
</tr>
</tbody>
</table>

**CLOSE CONTACTS OF CASES OF PERTUSSIS**

- Prophylaxis to be administered on advice from the CCDC (Consultant in Communicable Disease Control), Public Health England


<table>
<thead>
<tr>
<th>Medication</th>
<th>Dose</th>
<th>Route</th>
<th>Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Erythromycin</td>
<td>500mg</td>
<td>oral</td>
<td>four times a day - 7 days</td>
</tr>
</tbody>
</table>
Part D. Antimicrobial drug dosing and monitoring

I. Antibiotic Assays

- The concentration of gentamicin, tobramycin, amikacin and vancomycin must be monitored to avoid toxicity.
- Serum for assays **must be collected at the appropriate time** as the time of sampling in relation to the dose is vital to ensure accurate interpretation.
- Please record the current regimen, time of dose, time of assay and a contact number clearly on the request form.
- Please ensure that monitoring occurs during the working week as there may be limited availability of assays at weekends.

### INTRAVENOUS GENTAMICIN / TOBRAMYCIN – ONCE DAILY

**Practice points:**
- This guideline covers the use of intravenous (IV) gentamicin and tobramycin in adults (16yrs and over) for the treatment of infection only.
- Exclusion to once daily dosing regimen:

<table>
<thead>
<tr>
<th>Ascites</th>
<th>Severe burns</th>
</tr>
</thead>
<tbody>
<tr>
<td>Infective endocarditis</td>
<td>Pregnancy</td>
</tr>
</tbody>
</table>

- If patient has any of the above see ‘[Intravenous Gentamicin / Tobramycin - multiple daily dosing guideline](#)’
- See surgical prophylaxis guidelines for dosing prior to surgery.
- **Once daily dosing:** Efficacy of gentamicin / tobramycin is concentration-dependent. Once daily administration achieves high initial peak concentrations and has been demonstrated to have less toxicity and supersede multiple daily dose regimens in many cases.
- **Therapeutic Drug Monitoring**
  - Concentrations must be monitored to avoid toxicity.
  - Serum assays must be collected at the appropriate time, as the time of sampling in relation to the dose is vital to ensure accurate interpretation.

#### Steps for dosing of ONCE daily dosing

1. **STEP 1**
   - Calculate the patient’s **weight**

2. **STEP 2**
   - Calculate the patient’s **renal function**

3. **STEP 3**
   - Prescribe dose using **dose banding table**

4. **STEP 4**
   - Monitor levels
**STEP 1** Calculate patient’s weight
- If the patient’s BMI is ≥30 (this can be found under ‘height/weight’ in observations on PICS) calculate the patient’s IBW below.
  - Note: Aminoglycosides distribute poorly into adipose tissue, therefore in obese patients do NOT use actual body weight as this will result in an overdose.
  - **Ideal Body Weight (IBW) formula**

<table>
<thead>
<tr>
<th>Males</th>
<th>IBW = 50.0 + 0.91 x (Height [cm] - 152.4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Females</td>
<td>IBW = 45.5 + 0.91 x (Height [cm] - 152.4)</td>
</tr>
</tbody>
</table>

**STEP 2** Calculate patient’s renal function (GFR)
- Use of estimated glomerular filtration rate (eGFR) on PICS is not recommended
- Calculate patients GFR using equation below:

**Cockcroft Gault equation**

\[
\text{GFR (mL/min)} = \text{constant} \times [140 – \text{Age (years)}] \times \text{weight (kg)}
\]

\[
\text{Serum creatinine (micromol/L)}
\]

\[
\text{Constant} = 1.23 \text{ (male)} \text{ OR } 1.04 \text{ (female)}
\]

Use IBW (kg) if patient is obese (BMI ≥30)

**Note:**
- Use actual body weight when calculating GFR. However, ‘Cockcroft Gault’ is of limited benefit in patients who are obese (BMI ≥30) therefore use IBW for these patients. See PICS for actual body weight and BMI
- In patients with low creatinine (i.e. less than 60 micromol/L), use 60 micromol/L in the above equation.

**STEP 3** Prescribe dose and frequency
- Using the patients weight (or calculated IBW if BMI ≥30) and GFR (Step 1&2), select the correct dose from the banding table below:

<table>
<thead>
<tr>
<th>Normal Dosing (GFR &gt;30mL/min)</th>
<th>GFR 10-30mL/min</th>
<th>GFR 5-10mL/min</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Patients Weight</strong></td>
<td><strong>Dose</strong></td>
<td><strong>Dose</strong></td>
</tr>
<tr>
<td>40 – 55kg</td>
<td>240mg every 24 hours</td>
<td>40 – 59kg</td>
</tr>
<tr>
<td>56 – 69g</td>
<td>320mg every 24 hours</td>
<td>60 – 79kg</td>
</tr>
<tr>
<td>70 – 89kg</td>
<td>400mg every 24 hours</td>
<td>&gt;80kg</td>
</tr>
<tr>
<td>&gt;90kg</td>
<td>480mg every 24 hours</td>
<td></td>
</tr>
</tbody>
</table>

- If patient is on renal replacement therapy dose as follows:
  - CVVHD – Dose as per GFR 10-13ml/min in table above as per patients ABW or IBW if obese.
  - HDF – Dose as per GFR 5-10ml/min in table above as per patients ABW or IBW if obese.
  - Subsequent levels need to be taken every 24-48hrs to assess rate of clearance.
The maximum daily dose allowed is **480mg**

For further information and support discuss with ward pharmacist or microbiology.

### STEP 4 Monitor levels

If creatinine clearance (GFR) is **above 21ml/min**

- Take blood sample between 6-14 hours after the start of the first infusion.
- **Concentrations are meaningless unless the dose and sample times are recorded on the request form.**
  - On the request form please clearly record:
    - The current dose and frequency
    - Time of last dose
    - Time level taken
    - A contact number of person requesting
- Plot the concentration measured on the graph below to check dosing frequency.
- If the level is too high adjust the dosing frequency as per the graph and give.

If creatinine clearance (GFR) is **below 21ml/min**

- Take the first level 24 hours after the start of the first infusion (trough level)
- **Concentrations are meaningless unless the dose and sample times are recorded on the request form.**
  - On the request form please clearly record:
    - The current dose and frequency
    - Time of last dose
    - Time level taken
    - A contact number of person requesting
- Aim for pre-dose level ≤1mg/L
### Result interpretation

<table>
<thead>
<tr>
<th>Pre-Dose Level (trough – level taken less than 2 hours prior to drug administration)</th>
<th>Recommendation</th>
</tr>
</thead>
<tbody>
<tr>
<td>≤1mg/L</td>
<td>Continue and give same dose every 24 hours at same time</td>
</tr>
</tbody>
</table>
| >1mg/L                                                                            | 1. Ensure that the level was taken correctly:  
   a. Was level taken more than 20 hours after the last dose was given (i.e. trough level)  
   b. If level was not taken at correct time. Take another level and review  
   2. If level correctly taken and level is above 1.0mg/L:  
   a. Increase the **dosing interval** by **12 hours**  
   b. **Repeat the level** before the next dose is due  
   c. **Await the result** before giving the next dose |

### Subsequent Levels
- **Take further blood samples a minimum of twice weekly** using the same method as above depending on the patient's renal function
- **If the concentration in the blood sample is unexpectedly high, or if renal function is altered, daily sampling may be necessary**
- **Always ensure to enter the date and time the blood sample was collected on the blood request form.**
- **To minimise the risk of toxicity, duration of treatment should normally be limited to 72 hours.**
  - All gentamicin and tobramycin prescriptions that continue beyond 72 hours must be discussed with microbiology.

### Toxicity
- Please ensure a review for the need for gentamicin and tobramycin is undertaken daily.
- Box 1 and 2 below describe signs and symptoms to monitor to reduce likelihood of side effects.

#### Box 1: Renal Toxicity
- Monitor creatinine daily. Seek advice if renal function is unstable (e.g. a change in creatinine of >15-20%).
- If the patient’s creatinine has risen by 20% or more consider stopping the aminoglycoside. If the aminoglycoside is continued, creatinine and gentamicin/tobramycin levels should be measured daily and the case discussed with pharmacy/microbiology.
- Excretion of aminoglycosides is principally via the kidney and the half-life increases exponentially as the GFR decreases; therefore accumulation arises in CKD/AKI, resulting in toxicity.
Box 2: Ototoxicity

- Ototoxicity secondary to aminoglycosides is independent of drug concentration. It is suggested by any of the following:
  - New tinnitus
  - Dizziness
  - Poor balance
  - Hearing loss
  - Oscillating vision

- Toxicity is associated with prolonged aminoglycoside use (usually >10 days but may occur with >72 hours) and is secondary to drug accumulation within the inner ear.
- Stop treatment if ototoxicity is suspected and refer to microbiology for advice.
- For patients requiring more than 10 days gentamicin therapy, patients must have baseline audiology testing. This should be repeated every 2 weeks during therapy to assess potential side-effects and the need to withhold / change therapy.

References

- British national formulary (BNF) – Accessed 11/04/2017
- Scottish aminoglycoside guidelines – Accessed 11/04/2017
- Dosing nomogram; Scottish aminoglycoside guidelines – Accessed 11/04/2017
INTRAVENOUS GENTAMICIN / TOBRAMYCIN – MULTIPLE DAILY DOSING

Practice points:
- To be used only where once daily dosing is excluded e.g. Ascites, Severe burns, infective endocarditis

Steps for dosing of multiple daily dosing

1. Calculate the patient’s ideal body weight if obese
2. Calculate the patients renal function
3. Prescribe dose of gentamicin / tobramycin
4. Monitor levels

**STEP 1** Calculate patient’s weight
- If the patient’s BMI is <30, use actual body weight
- If the patient’s BMI is ≥30 (this can be found under ‘height/weight’ in observations on PICS) calculate the patient’s IBW below.
  - Note: Gentamicin distributes poorly into adipose tissue, therefore in obese patients do NOT use actual body weight as this will result in an overdose.
  - Use Ideal Body Weight (IBW) formula

<table>
<thead>
<tr>
<th>Gender</th>
<th>Formula</th>
</tr>
</thead>
<tbody>
<tr>
<td>Males</td>
<td>IBW = 50.0 + 0.91 x (Height [cm] - 152.4)</td>
</tr>
<tr>
<td>Females</td>
<td>IBW = 45.5 + 0.91 x (Height [cm] - 152.4)</td>
</tr>
</tbody>
</table>

**STEP 2** Calculate patient’s renal function (GFR)
- Use of estimated glomerular filtration rate (eGFR) on PICS is not recommended
- Calculate patients GFR using equation below:

**Cockcroft Gault equation**

\[
GFR \text{ (mL/min) = constant x [140 – Age (years)] x weight (kg) x Serum creatinine (micromol/L)}
\]

Constant = 1.23 (male) OR 1.04 (female)
Use IBW (kg) if patient is obese (BMI ≥30)

Note:
- Use actual body weight when calculating GFR. However, ‘Cockcroft Gault’ is of limited benefit in patients who are obese (BMI ≥30) therefore use IBW for these patients. See PICS for actual body weight and BMI
- In patients with low creatinine (i.e. less than 60micromol/L), use 60 micromol/L in the above equation.
Prescribe dose of Gentamicin / tobramycin

- Dose prescribed depends on indication of therapy:

<table>
<thead>
<tr>
<th>Indication</th>
<th>Dose (round dose to nearest 40mg to aid administration)</th>
</tr>
</thead>
<tbody>
<tr>
<td>All conditions excluding endocarditis</td>
<td>1mg/kg (up to 80mg) - intravenous injection – tds (three times daily)</td>
</tr>
<tr>
<td>Infective endocarditis (IE)</td>
<td>1mg/kg (up to 80mg) - intravenous injection – bd (twice daily)</td>
</tr>
</tbody>
</table>

- Give intravenous slowly over 3-5 minutes,
- Adjusted in renal failure. If GFR < 30ml/min
  - Reduce tds (three times daily) dose to bd (twice daily). Adjust dose according to levels.
  - Reduce bd (twice daily) doses to od (once daily). Adjust dose according to levels.

Monitor levels

- Measure pre-dose (trough) and 1 hour post-dose (peak) levels. Take first levels after 24 hours of therapy (no earlier than 24 hours or 3 doses)
- Target levels depends on indication of therapy:

<table>
<thead>
<tr>
<th>Indication</th>
<th>Timely of level</th>
<th>Target level</th>
</tr>
</thead>
<tbody>
<tr>
<td>All conditions (excluding endocarditis)</td>
<td>Pre-dose (trough level taken immediately prior to drug administration)</td>
<td>&lt;2mg/L</td>
</tr>
<tr>
<td></td>
<td>Post-dose (peak level taken one hour after drug administration)</td>
<td>5 - 10 mg/L</td>
</tr>
<tr>
<td>Infective endocarditis (IE)</td>
<td>Pre-dose (trough level taken immediately prior to drug administration)</td>
<td>&lt;1mg/L</td>
</tr>
<tr>
<td></td>
<td>Post-dose (peak level taken one hour after drug administration)</td>
<td>3 to 5 mg/L</td>
</tr>
</tbody>
</table>

- Repeat levels at 2 to 3 day intervals, depending on length of therapy, dosage, renal function and condition of patient.
- If the concentration in the blood sample is unexpectedly high, or if renal function is altered, daily sampling may be necessary
- Always ensure to enter the date and time the blood sample was collected on the blood request form.

Toxicity

- Please ensure a review for the need for therapy is undertaken daily.
- Box 1 and 2 below describe signs and symptoms to monitor to reduce likelihood of side effects.

Box 1: Renal Toxicity

- Monitor creatinine daily. Seek advice if renal function is unstable (e.g. a change in creatinine of >15-20%).
- If the patient’s creatinine has risen by 20% or more consider stopping. If gentamicin / tobramycin is continued, creatinine and drug levels should be measured daily and the case discussed with pharmacy / microbiology.
- Excretion is principally via the kidney and the half-life increases exponentially as the GFR decreases; therefore accumulation arises in CKD/AKI, resulting in toxicity
Box 2: Ototoxicity

- Ototoxicity secondary to gentamicin is independent of drug concentration. It is suggested by any of the following:
  - New tinnitus
  - Dizziness
  - Poor balance
  - Hearing loss
  - Oscillating vision
- Toxicity is associated with prolonged aminoglycoside use (usually >10 days but may occur with >72 hours) and is secondary to drug accumulation within the inner ear.
- Stop treatment if ototoxicity is suspected and refer to microbiology for advice.
- For patients requiring more than 10 days gentamicin therapy, patients must have baseline audiology testing. This should be repeated every 2 weeks during therapy to assess potential side-effects and the need to withhold / change therapy.
INTRAVENOUS AMIKACIN – ONCE DAILY

Practice points:
- This guideline covers the use of intravenous (IV) Amikacin in adults (16yrs and over) for the treatment of infection only.
- Exclusion to once daily dosing regimen:

<table>
<thead>
<tr>
<th>Ascites</th>
<th>Severe burns</th>
</tr>
</thead>
<tbody>
<tr>
<td>Infective endocarditis</td>
<td>Pregnancy</td>
</tr>
</tbody>
</table>

- If patient has any of the above discuss with microbiology
- **Therapeutic Drug Monitoring**
  - Concentrations of Amikacin must be monitored to avoid toxicity.
  - Serum assays must be collected at the appropriate time, as the time of sampling in relation to the dose is vital to ensure accurate interpretation.
  - Treatment should preferably not continue for longer than 7 to 10 days, and the total dose given to adults should not exceed 15 g.

**Steps for dosing of ONCE daily Amikacin**

1. **Calculate the patient’s weight**
2. **Calculate the patient’s renal function**
3. **Prescribe dose of Amikacin using dose banding table**
4. **Monitor levels**

**STEP 1** Calculate patient’s weight
- If the patient’s **BMI is ≥30** (this can be found under ‘height/weight’ in observations on PICS) calculate the patient’s **IBW** below.
  - Note: Amikacin distributes poorly into adipose tissue, therefore in obese patients **do NOT** use actual body weight as this will result in an overdose.
  - **Use Ideal Body Weight (IBW) formula**

<table>
<thead>
<tr>
<th></th>
<th>Males</th>
<th>Females</th>
</tr>
</thead>
<tbody>
<tr>
<td>IBW</td>
<td>IBW = 50.0 + 0.91 x (Height [cm] - 152.4)</td>
<td>IBW = 45.5 + 0.91 x (Height [cm] - 152.4)</td>
</tr>
</tbody>
</table>

**STEP 2** Calculate patient’s renal function (GFR)
- Use of estimated glomerular filtration rate (eGFR) on PICS is not recommended
- Calculate patients GFR using equation below:

**Cockcroft Gault equation**

\[
GFR \ (\text{mL/min}) = \text{constant} \times \left[ \frac{140 - \text{Age (years)}}{\text{Serum creatinine (micromol/L)}} \right] \times \text{weight (kg)}
\]

Constant = 1.23 (male) OR 1.04 (female)
Use IBW (kg) if patient is obese (BMI ≥30)
Note:
- Use actual body weight when calculating GFR. However, ‘Cockcroft Gault’ is of limited benefit in patients who are obese (BMI ≥30) therefore use IBW for these patients. See PICS for actual body weight and BMI.
- In patients with low creatinine (i.e. less than 60 micromol/L), use 60 micromol/L in the above equation.

**STEP 3** Prescribe Amikacin dose and frequency

- Using the patients weight (or calculated IBW if BMI ≥30) and GFR (Step 1&2), select the correct dose from the banding table below.
- **Maximum daily dose:** 1.5g / day
- **MAXIMUM CUMULATIVE DOSE = 15g – STOP TREATMENT ONCE AMOUNT REACHED AND DISCUSS TREATMENT WITH MICROBIOLOGY**

<table>
<thead>
<tr>
<th>Renal function</th>
<th>GFR &gt; 50ml/min</th>
<th>GFR 20-50ml/min</th>
<th>GFR 10-20ml/min</th>
<th>GFR &lt;10ml/min</th>
</tr>
</thead>
<tbody>
<tr>
<td>40 – 55kg</td>
<td>750mg every 24 hours</td>
<td>250mg every 12 hours</td>
<td>150mg every 24 hours</td>
<td>100mg every 48 hours</td>
</tr>
<tr>
<td>56 – 69g</td>
<td>1000mg every 24 hours</td>
<td>300mg every 12 hours</td>
<td>200mg every 24 hours</td>
<td>150mg every 48 hours</td>
</tr>
<tr>
<td>70 – 89kg</td>
<td>1250mg every 24 hours</td>
<td>400mg every 12 hours</td>
<td>250mg every 24 hours</td>
<td></td>
</tr>
<tr>
<td>&gt;90kg</td>
<td>1500mg every 24 hours</td>
<td>500mg every 12 hours</td>
<td>300mg every 24 hours</td>
<td>200mg every 48 hours</td>
</tr>
</tbody>
</table>

- If patient is on renal replacement therapy / CKD = 5, give one dose only as per GFR <10ml/min. Subsequent levels need to be taken every 48hrs to assess rate of clearance.
- For further information and support discuss with ward pharmacist or microbiology.

**STEP 4** Monitor levels

**If creatinine clearance (GFR) is above 21ml/min**
- Take blood sample between 6-14 hours after the start of the first Amikacin infusion.
- **Concentrations are meaningless unless the dose and sample times are recorded on the request form.**
- **On the request form please clearly record:**
  - The current dose and frequency
  - Time of last dose
  - Time level taken
  - A contact number of person requesting
- **Plot the concentration measured on the graph below to check dosing frequency.**
- If the level is too high adjust the dosing frequency as per the graph and give.

If creatinine clearance (GFR) is below 21ml/min
- Take the first level 24 hours after the start of the first Amikacin infusion (trough level)
- Concentrations are meaningless unless the dose and sample times are recorded on the request form.
  On the request form please clearly record:
  o The current dose and frequency
  o Time of last dose
  o Time level taken
  o A contact number of person requesting
- Aim for level less than 5mg/L
- Result interpretation

<table>
<thead>
<tr>
<th>Pre-Dose Level (trough – level taken less than 2 hours prior to drug administration)</th>
<th>Recommendation</th>
</tr>
</thead>
<tbody>
<tr>
<td>≤5mg/L</td>
<td>Continue and give same dose every 24 hours at same time</td>
</tr>
</tbody>
</table>
| >5mg/L                                                                            | 3. Ensure that the level was taken correctly
  a. Was level taken more than 20 hours after the last dose was given (i.e. trough level)
  b. If level was not taken at correct time. Take another level and review
  4. If level correctly taken and level is above 5.0mg/L:
    a. Increase the dosing interval by 12 hours
    b. Repeat the level before the next dose is due
    c. Await the result before giving the next dose |
Subsequent Levels

- Take further blood samples a **minimum of twice weekly** using the same method as above depending on the patients renal function
- If the Amikacin concentration in the blood sample is unexpectedly high, or if renal function is altered, daily sampling may be necessary
- **Always ensure to enter the date and time the blood sample was collected on the blood request form.**
- To minimise the risk of toxicity, duration of treatment should normally be limited to 72 hours. All gentamicin prescriptions that continue beyond 72 hours must be discussed with microbiology.

Toxicity

- Please ensure a review for the need for Amikacin is undertaken daily.
- Box 1 and 2 below describe signs and symptoms to monitor to reduce likelihood of side effects.

<table>
<thead>
<tr>
<th>Box 1: Renal Toxicity</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Monitor creatinine daily. Seek advice if renal function is unstable (e.g. a change in creatinine of &gt;15-20%).</td>
</tr>
<tr>
<td>- If the patient’s creatinine has risen by 20% or more consider stopping Amikacin.</td>
</tr>
<tr>
<td>- If Amikacin is continued, creatinine and levels should be measured daily and the case discussed with pharmacy / microbiology.</td>
</tr>
<tr>
<td>- Excretion of gentamicin is principally via the kidney and the half-life increases exponentially as the GFR decreases; therefore accumulation arises in CKD/AKI, resulting in toxicity.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Box 2: Ototoxicity</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Ototoxicity secondary to Amikacin is independent of drug concentration. It is suggested by any of the following:</td>
</tr>
<tr>
<td>- New tinnitus</td>
</tr>
<tr>
<td>- Dizziness</td>
</tr>
<tr>
<td>- Poor balance</td>
</tr>
<tr>
<td>- Hearing loss</td>
</tr>
<tr>
<td>- Oscillating vision</td>
</tr>
<tr>
<td>- Toxicity is associated with prolonged aminoglycoside use (usually &gt;10 days but may occur with &gt;72 hours) and is secondary to drug accumulation within the inner ear.</td>
</tr>
<tr>
<td>- Stop treatment if ototoxicity is suspected and refer to microbiology for advice.</td>
</tr>
<tr>
<td>- For patients requiring more than 10 days amikacin therapy, patients must have baseline audiology testing. This should be repeated every 2 weeks during therapy to assess potential side-effects and the need to withhold / change therapy.</td>
</tr>
</tbody>
</table>

References:

- **British national formulary (BNF)** – Accessed 11/04/2017
**PRactice points:**
- This guideline covers the use of intravenous (IV) vancomycin in adults (16yrs and over) for the treatment of infection only. See specific guideline for continuous infusion administration on critical care.
- This guideline is not intended for patients on dialysis. See vancomycin in renal protocol for dosing advice and monitoring.

**a) Contra-indications**
- Hypersensitivity to glycopeptides and its excipients.

**b) Therapeutic Drug Monitoring**
- Concentrations of Vancomycin must be monitored to avoid sub-therapeutic treatment and toxicity.
- Serum assays must be collected at the appropriate time, as the time of sampling in relation to the dose is vital to ensure accurate interpretation.

**c) Steps for dosing of Vancomycin**

<table>
<thead>
<tr>
<th>STEP 1</th>
<th>Consider need for loading dose</th>
</tr>
</thead>
<tbody>
<tr>
<td>STEP 2</td>
<td>Calculate the patient’s <strong>renal function</strong></td>
</tr>
<tr>
<td>STEP 3</td>
<td>Prescribe maintenance dosing schedule using dose banding table</td>
</tr>
<tr>
<td>STEP 4</td>
<td><strong>Monitor levels</strong> and dose alteration</td>
</tr>
</tbody>
</table>

**STEP 1** Consider need for loading dose

- **If UNDER 65 YEARS OF AGE** – Prescribe loading dose immediately as per table 1 below.
  - Use the patients actual body weight
- **If OVER 65 YEARS OF AGE** – Do not routinely prescribe loading dose. Consider the following
  - Patients over 65yrs, who are otherwise fit and well with no co-morbidities may receive the loading dose, at the prescriber’s clinical discretion. Document the intention clearly in the medical notes and monitor patient closely.
  - Patients with poor renal function, poor renal output, or multiple co-morbidities are at greater risk of toxicity and should not receive the loading dose.

**Table 1: Vancomycin loading dose**

<table>
<thead>
<tr>
<th>Actual body weight</th>
<th>Dose</th>
<th>Volume of sodium Chloride 0.9% or Glucose 5% to dilute in</th>
<th>Duration of infusion</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 40 kg</td>
<td>750 mg</td>
<td>250 mL</td>
<td>90 minutes</td>
</tr>
<tr>
<td>40 – 59 kg</td>
<td>1000 mg</td>
<td>250 mL</td>
<td>2 hours</td>
</tr>
<tr>
<td>60 – 90 kg</td>
<td>1500 mg</td>
<td>500 mL</td>
<td>3 hours</td>
</tr>
<tr>
<td>&gt; 90 kg</td>
<td>2000 mg</td>
<td>500 mL</td>
<td>4 hours</td>
</tr>
</tbody>
</table>
**STEP 2**

Calculate patient's renal function (GFR)

- Use of estimated glomerular filtration rate (eGFR) on PICS is not recommended
- Calculate patients GFR using equation below:

**Cockcroft Gault equation**

\[
\text{GFR (mL/min) = constant x [140 – Age (years)] x weight (kg)}
\]

\[
\text{Serum creatinine (micromol/L)}
\]

Constant = 1.23 (male) OR 1.04 (female)

Use IBW (kg) if patient is obese (BMI ≥30)

Note:
- In patients with low creatinine (i.e. less than 60micromol/L), use 60 micromol/L in the above equation.

**STEP 3**

Prescribe vancomycin maintenance dose schedule

- Using the calculated renal function (GFR) select the correct dose from the banding table below.
- Patients who HAVE NOT received a loading dose should start the maintenance dose immediately
- Patients who HAVE received a loading dose should receive their second dose in accordance with the dosing interval. Refer to Table 2.

<table>
<thead>
<tr>
<th>GFR (ml/minute)</th>
<th>Dose</th>
<th>Volume of Sodium chloride 0.9% or Glucose 5% PLUS infusion time</th>
<th>Dose interval</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 20</td>
<td>500 mg</td>
<td>250ml over 1 hour</td>
<td>48 hourly</td>
</tr>
<tr>
<td>20 – 29</td>
<td>500 mg</td>
<td>250ml over 1 hour</td>
<td>24 hourly</td>
</tr>
<tr>
<td>30 – 39</td>
<td>750 mg</td>
<td>250ml over 1.5 hours</td>
<td>24 hourly</td>
</tr>
<tr>
<td>40 – 54</td>
<td>500 mg</td>
<td>250ml over 1 hour</td>
<td>12 hourly</td>
</tr>
<tr>
<td>55 - 74</td>
<td>750 mg</td>
<td>250ml over 1.5 hours</td>
<td>12 hourly</td>
</tr>
<tr>
<td>75 - 89</td>
<td>1000 mg</td>
<td>250ml over 2 hours</td>
<td>12 hourly</td>
</tr>
<tr>
<td>90 - 110</td>
<td>1250 mg</td>
<td>250ml over 2.5 hours</td>
<td>12 hourly</td>
</tr>
<tr>
<td>&gt; 110</td>
<td>1500 mg</td>
<td>500ml over 3 hours</td>
<td>12 hourly</td>
</tr>
</tbody>
</table>

**STEP 4**

Monitor levels

**Renal Function**
- Monitor urea and electrolytes daily to prevent toxicity
- Re-dose vancomycin if renal function changes in accordance with dose and dose interval suggested in Table 2
- Seek advice if renal function is unstable (i.e. a change in creatinine of > 15-20%)

**Vancomycin Levels**
- Due to wide variability in the handling of vancomycin, Take a trough sample (pre-dose) 48 hours after starting therapy
- Levels are meaningless unless the dose and sample times are recorded accurately. Record the exact time of all samples on PICS and on the sample request form.
• Levels may be required more frequently if the patient has unstable renal function, seek pharmacy & microbiological advice.
• If renal function is stable, give the next dose before the trough result is available.

Target Vancomycin level
• Target trough concentration range: 10 – 15 mg/L (See table 3a for advice on adjusting dosing)
• Some patients require a higher target Vancomycin range of 15 – 20 mg/L (See table 3b for advice on adjusting dosing). Example indications include:
  o MRSA bacteraemia
  o Deep seated infection such as endocarditis, meningitis and osteomyelitis
  These patients should be discussed with microbiology
• If the patient is failing to respond after 48hrs, seek advice from microbiology or an infection specialist.

Adjustment of vancomycin doses
• Always check that the dosage history and sampling time are appropriate before interpreting the result.
• Seek advice from pharmacy or microbiology if you need help to interpret the result.
• If the measured concentration is unexpectedly HIGH or LOW, consider the following:
  o Was the dose and sample times recorded accurately? If no re-check level
  o Was the correct dose administered? If no re-check level
  o Was the sample taken from the line used to administer the drug? If yes consider re-checking from another line / peripherally
  o Has renal function declined or improved? If yes. Re-check level
  o Does the patient have new oedema or ascites? If yes. Re-check level

*If in doubt, take another sample before modifying the dosage regimen and / or contact pharmacy or microbiology for advice

<table>
<thead>
<tr>
<th>Vancomycin level</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;10 mg/L*</td>
<td>Increase the dose to next dose line in table 2 and recheck pre-dose levels after 48 hours. If unsure discuss with pharmacy or microbiology</td>
</tr>
<tr>
<td>10 - 15 mg/L</td>
<td>Maintain present dosage regimen and monitor patient response to therapy</td>
</tr>
<tr>
<td>16 - 20 mg/L</td>
<td>Reduce dose to the line below current dose in table 2. Recheck pre-dose level after 48hrs</td>
</tr>
<tr>
<td>&gt; 21 mg/L*</td>
<td>Pause and repeat levels daily until pre-dose level below 16mg/L. Then seek advice on re-starting treatment</td>
</tr>
</tbody>
</table>

*If in doubt, take another sample before modifying the dosage regimen and / or contact pharmacy or microbiology for advice

<table>
<thead>
<tr>
<th>Vancomycin level</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;15 mg/L*</td>
<td>Increase the dose to next dose line in table 2 and recheck pre-dose levels after 48 hours. If unsure discuss with pharmacy or microbiology</td>
</tr>
<tr>
<td>15 - 20 mg/L</td>
<td>Maintain present dosage regimen and monitor patient response to therapy</td>
</tr>
<tr>
<td>21 - 25 mg/L</td>
<td>Reduce dose to the line below current dose in table 2. Recheck pre-dose level after 48hrs</td>
</tr>
<tr>
<td>&gt; 25 mg/L*</td>
<td>Pause and repeat levels daily until pre-dose level below 21mg/L. Then seek advice on re-starting treatment</td>
</tr>
</tbody>
</table>

General points
• Document any action taken in the medical notes / PICS.
• Undertake pre-prescribing checks below to assess the risk of toxicity
• Review the need for vancomycin daily

### Risk of toxicity

- Monitor creatinine daily. Seek advice if renal function is unstable (e.g. a change in creatinine of > 15-20%)
- Signs of renal toxicity include increase in creatinine or decrease in urine output / oliguria
- Consider an alternative agent if creatinine is rising or the patient becomes oliguric.
- Vancomycin may increase the risk of aminoglycoside-induced nephron – and ototoxicity

---

d) References

- [British national formulary (BNF)](Accessed 17/08/2017)
- [Scottish Vancomycin pulsed infusion guideline](Accessed 17/08/2017)
**DAPTOMYCIN**

**Practice points:**
- Daptomycin is a redistricted antibiotic and requires approval by consultant microbiologist prior to supply and starting therapy
- Monitor renal function carefully as can enhance nephrotoxicity of other drugs and concurrent conditions
- Monitor creatinine kinase levels regularly as per monitoring advice below

**Dosing**
- Choose correct dose band below based on indication. If unsure discuss with microbiology first.
- **Skin and soft tissue infections (SSTI) without *Staphylococcus aureus* bacteraemia**
  - 4mg/kg ONCE daily (Round dose to nearest 50mg)
  - Max dose = 600mg
- **Skin and soft tissue infections (SSTI) with *Staphylococcus aureus* bacteraemia or Right-sided infective endocarditis (RIE) due to *Staphylococcus aureus***
  - 6mg/kg ONCE daily (Round dose to nearest 50mg)
  - Max dose = 900mg

**Dosing in renal impairment**

<table>
<thead>
<tr>
<th>Renal function (GFR)</th>
<th>GFR ≥50ml/min</th>
<th>GFR 30-50ml/min</th>
<th>GFR 10 – 29ml/min</th>
<th>GFR &lt;10ml/min</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dose</td>
<td>Dose as in normal renal function</td>
<td>4-6mg/kg (use dose tables above) and give <strong>dose every 48 hours</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Dialysis patients**
- **CAPD**: Not dialysed. Dose as in GFR<30 mL/min
- **HD**: Not dialysed. Dose as in GFR<30 mL/min
- **HDF/High flux**: Dialysed. Dose as in GFR<30 mL/min
- **CAV/VVHD**: Slightly dialysed. Dose as in GFR<30 mL/min

**Monitoring**
- Baseline plasma creatinine kinase levels must be taken prior to therapy and then repeated and monitored on a weekly basis. This must be done in all patients
- CK should be measured more frequently (every 2-3 days at least during first two weeks of treatment) in patients with higher risk of myopathy (renal impairment, haemodialysis, CAPD, and medication (e.g. statins, fibrates and ciclosporin)
- Patients with baseline CK greater than 5 times normal may be increased risk of myopathy
- Patients that develop unexplained muscle pain, tenderness, muscle weakness or cramps should have CK levels monitored every 2 days. Daptomycin should be discontinued in the presence of such symptoms if the CK reaches greater than 5 times the upper limit of normal.

**Levels**
- Levels should only be taken and sent in patients with:
  - Raised creatinine kinase levels compared to baseline,
  - High dose therapy (6mg/kg)
  - Patients with renal impairment
  - Patients requiring more than 14 days therapy.
- Pre-dose levels should be taken immediately prior to the dose being given.
- Take first level 6-8 days after starting therapy. Take further levels 6-8 days after dose changes
• Samples are sent to Bristol antibiotic reference lab to be processed. Results usually take approx. 48 hours to be reported. Continue therapy at same dosing schedule and ensure no doses are missed

• **Target pre-dose levels between 5-20 mg/L**
  • If pre-dose levels are found to be below or above the target range ensure doses were given and that the level was taken at the correct time. If yes then discuss with pharmacy for advice dosing

**References**

• Antimicrobial Reference Laboratory North Bristol NHS Trust – Guideline ranges for TDM 2017
• Renal drug database (Daptomycin) – Accessed 22/08/2017
• British National Formulary (BNF) – Accessed 22/08/2017
COLISTIMETHATE SODIUM (COLISTIN)
(Intravenous administration)

Practice points:
- Colistin can cause renal impairment and other side effects. Ensure renal function is measured at baseline (calculate GFR using Cockcroft and Gault equation) and monitored regularly.
- Dose patient according to table(s) below based on renal function.
- Loading doses are generally given to:
  - Patients who are critically ill
  - Have evidence of deep seated infection
  - Have a known resistant organism and recommended by microbiology.

Loading dose

<table>
<thead>
<tr>
<th>Loading dose (in critically ill patients)</th>
<th>9 – 12* million units as slow IV infusion (mix in 250ml NaCl 0.9% or Glucose 5% and give over 120mins)</th>
</tr>
</thead>
</table>

*12 million units should only be on the recommendation of a microbiologist.

Maintenance dose
- First maintenance dose to be given 8 hours after loading dose completed.

Dosing in renal impairment

<table>
<thead>
<tr>
<th>Renal function (GFR)</th>
<th>GFR ≥ 50ml/min</th>
<th>GFR 30-50ml/min</th>
<th>GFR 10 – 29ml/min</th>
<th>GFR &lt;10ml/min</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maintenance dose</td>
<td>3 million units TDS</td>
<td>3.75 million units BD</td>
<td>2.5 million units BD</td>
<td>1.75 million units BD</td>
</tr>
<tr>
<td></td>
<td>(5.5 – 7.5 million units per day in 2 divided doses)</td>
<td>(4.5 – 5.5 million units per day in 2 divided doses)</td>
<td>(3.5 million units per day in 2 divided doses)</td>
<td></td>
</tr>
</tbody>
</table>

Dialysis patients

<table>
<thead>
<tr>
<th>CAPD</th>
<th>Dialysed 2.25 million units/day in 2 divided doses.</th>
</tr>
</thead>
<tbody>
<tr>
<td>HD</td>
<td>Dialysed Non-HD days: 2.25 million units/day in 2 divided doses; HD days: 3 million units/day after dialysis.</td>
</tr>
<tr>
<td>HDF/High flux</td>
<td>Dialysed Non-HDF days: 2.25 million units/day in 2 divided doses; HDF days: 3 million units/day after dialysis.</td>
</tr>
<tr>
<td>CAV/VVHD</td>
<td>Dialysed Dose as in normal renal function in 3 divided doses. (Also in CVVHDF.)</td>
</tr>
</tbody>
</table>

Levels
- Take first pre-dose level ONE week after starting.
- The samples are referred to North Bristol antibiotic reference laboratory to be processed. Result usually takes approx. 48 hours to be reported. Continue therapy at same dosing schedule and ensure no doses are missed.
- **Target pre-dose level between 2 - 4mg/L**
- Ensure doses have been given and level taken at the correct time. Contact pharmacy or microbiology for dosing advice.
- Levels can be repeated every 14-28 days if within therapeutic range. If a dose alteration is made, repeat level after 7 days.
Interactions
- Note. colistin will interact with neuromuscular blockers (e.g. suxamethonium) and may cause respiratory muscle paralysis. Calcium gluconate was found to reverse the blockade.

Reference
- Antimicrobial Reference Laboratory North Bristol NHS Trust– Guideline ranges for TDM 2017
- Renal drug database (Colistimethate sodium (Colistin) – Accessed 21/08/2017
FLUCYTOSINE

Practice points:
- Ensure renal function is measured first (calculate GFR using Cockcroft and Gault equation)
- Dose patient according to table(s) below based on renal function

Dosing

<table>
<thead>
<tr>
<th>Renal function (GFR)</th>
<th>GFR ≥ 40ml/min</th>
<th>GFR 20-40ml/min</th>
<th>GFR 10 – 19ml/min</th>
<th>GFR &lt;10ml/min</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dose</td>
<td>100-200 mg/kg per day in FOUR divided doses</td>
<td>50 mg/kg every 12 hours</td>
<td>50 mg/kg every 24 hours</td>
<td>50 mg/kg STAT then dose according to levels (Dose of 0.5–1 g daily is usually adequate)</td>
</tr>
</tbody>
</table>

Dialysis patients

| CAPD | Dialysed | Give 50 mg/Kg daily in 4 divided doses. Monitor levels |
| HD | Dialysed | Dose as in GFR<10 mL/min, given post dialysis. Monitor trough level pre dialysis, and reduce post-dialysis dose accordingly |
| HDF/High flux | Dialysed | Dose as in GFR<10 mL/min, given post dialysis. Monitor trough level pre dialysis, and reduce post-dialysis dose accordingly |
| CAV/VVHD | Dialysed | Dialysed. Give dose as in GFR=10–19 mL/min and monitor blood levels, pre dose. |

Monitoring
- Take pre- and post-dose levels:
  - Within 72h of starting treatment
  - Within 72h of any dose adjustment
  - Within 72h of any medication which interacts with flucytosine starting or stopping (e.g. Ambisome)
  - Changes in renal function
  - In stable patients take levels ONCE weekly
- Samples are sent to Bristol Antimicrobial reference Laboratory to be processed. Results usually take approx. 48hours to be reported (the assay service is not available at the weekend). Continue therapy at same dosing schedule and ensure no doses are missed
- **Target pre-dose level**
  - (trough – level taken immediately prior to drug administration): **20-40 mg/L**
  - Pre-dose levels less than 20mg/L have been associated with treatment failure and emergence of resistance.
  - If pre-dose levels are found to be less than 20mg/L, increase dose by 50%
- **Target post-dose level**
  - (peak - level taken 30 min after intravenous dose or 2 hours after oral dose): **50-100 mg/L**
  - Post dose levels over 100 mg/L are associated with toxicity.
- If post-dose levels are found to be over 100mg/L reduce dose by 50%
- Monitor full blood count at least weekly to detect myelosuppression

Reference
- Antimicrobial Reference Laboratory – Guideline ranges for TDM 2017
- Renal drug database (Flucytosine) – Accessed 21/08/2017
**POSACONAZOLE**

**Practice points:**
- Ensure renal function is measured first (calculate GFR using Cockcroft and Gault equation)
- Absorption and metabolism of posaconazole varies from patient to patient. Most patients receiving posaconazole should have therapeutic drug monitoring done.
- Steady-state levels may not be achieved for up to a week.
- **There is a huge difference between the bioavailability of the suspension and tablets.** DO NOT USE SUSPENSION as therapeutic levels are unlikely to be achieved with this preparation. If patient has swallowing difficulties discuss with pharmacy or microbiology and use intravenous route in the meantime.
- In patients with moderate or severe renal impairment (creatinine clearance <50 mL/min), accumulation of the intravenous vehicle, Betadex Sulfobutyl Ether Sodium (SBEC), is expected to occur. Avoid unless benefit outweighs the risk.

**Dosing**
- Dose patient according to table(s) below based on renal function

<table>
<thead>
<tr>
<th>Renal function (GFR)</th>
<th>GFR ≥ 50ml/min</th>
<th>GFR 20-50ml/min</th>
<th>GFR 10 – 19ml/min</th>
<th>GFR &lt;10ml/min</th>
</tr>
</thead>
<tbody>
<tr>
<td>Therapeutic and prophylactic dose (Tablets, IV)</td>
<td>300mg BD on day 1, then 300mg once daily thereafter</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Dialysis patients**

<table>
<thead>
<tr>
<th>Type</th>
<th>Dose</th>
</tr>
</thead>
<tbody>
<tr>
<td>CAPD</td>
<td>Not dialysed. Dose as in GFR&lt;10 mL/min</td>
</tr>
<tr>
<td>HD</td>
<td></td>
</tr>
<tr>
<td>HDF/High flux</td>
<td></td>
</tr>
<tr>
<td>CAV/VVHD</td>
<td></td>
</tr>
</tbody>
</table>

**Levels**
- Take first pre-dose level within 3-8 days of starting therapy
- Samples are sent to Bristol antibiotic reference lab to be processed. Results usually take approx. 48 hours to be reported. Continue therapy at same dosing schedule and ensure no doses are missed
  - **Therapeutic** dose target pre-dose (trough) level (level taken immediately prior to drug administration): 1.0 - 3.75 mg/L
  - **Prophylactic** dose target pre-dose (trough) level (level taken immediately prior to drug administration): 0.7 - 1.5 mg/L
- If pre-dose levels are found to be less than 0.7 mg/L increase dose by 100mg BD and recheck level after 4-8 days
- If levels are above the therapeutic range then ensure levels taken at the correct time and discuss with pharmacy on advice on changing the dose

**Additional information**
- Note Posaconazole interacts with a large number of drugs including anti-bacterials, anti-coagulants, anti-depressants, anti-epileptics, ciclosporin, tacrolimus, etc. Please see BNF for full list of medication and discuss with pharmacy how these should be managed.

**Reference**
- Antimicrobial Reference Laboratory – Guideline ranges for TDM 2017
- Renal drug database (Posaconazole) – Accessed 21/08/2017
- British National Formulary (BNF) – Accessed 21/08/2017
TEICOPLANIN (Skin and soft tissue infections – LOW DOSE)

**Practice points:**
- Teicoplanin is mainly used in the Trust for surgical prophylaxis. Measuring levels is not required when used in this circumstance.
- Treatment using Teicoplanin is restricted. Prior approval by microbiology is required prior to supplying.
- Guidelines below are tailored for patients with skin and soft tissue infections caused by *S. aureus* requiring Teicoplanin.
- **Treatment duration:** 7 - 14 days. Switch to oral to complete course as soon as appropriate.

**Loading dose**
- Doses based on approximately 6mg/kg body weight.
- No adjustment to loading dose required in renal impairment.

<table>
<thead>
<tr>
<th>Actual body weight (kg)</th>
<th>Dose</th>
</tr>
</thead>
<tbody>
<tr>
<td>≤ 85kg</td>
<td>400mg every 12 hours for 3 doses (0, 12, 24hrs)</td>
</tr>
<tr>
<td>&gt; 85kg</td>
<td>600mg every 12 hours for 3 doses (0, 12, 24hrs)</td>
</tr>
</tbody>
</table>

**Maintenance dose**
- Estimated renal function (eGFR) on PICS can be used to select appropriate dose below.

<table>
<thead>
<tr>
<th>Actual body weight (kg)</th>
<th>Normal eGFR &gt; 80ml/min</th>
<th>Mild – moderate renal impairment eGFR 30-80ml/min</th>
<th>Severe renal impairment eGFR &lt;30ml/min</th>
</tr>
</thead>
<tbody>
<tr>
<td>≤ 85kg</td>
<td>400mg ONCE daily</td>
<td>Then reduce to 200mg ONCE daily (or 400mg alt days)</td>
<td>400mg daily till day 4 Then reduce to 400mg every 72hours (or 130mg daily)</td>
</tr>
<tr>
<td>&gt; 85kg</td>
<td>600mg ONCE daily</td>
<td>600mg daily till day 4 Then reduce to 300mg ONCE daily (or 600mg alt days)</td>
<td>600mg daily till day 4 Then reduce to 600mg every 72hours (or 300mg daily)</td>
</tr>
</tbody>
</table>

**Monitoring**
- Renal function must be monitored on a regular basis.
- Teicoplanin levels should be initially taken 4 - 5 days after starting treatment and then on a weekly basis.
- Take as a pre-dose (i.e. immediately before the dose is due).
- Samples are sent to Bristol Antibiotic Reference Lab to be processed. Results usually take approx. 48hours to be reported (the assay service is not available at the weekend).
- Continue therapy at same dosing schedule and ensure no doses are missed.
- **Aim pre-dose (trough) levels between 15-30mg/L**
- Max level is 60mg/L. If pre-dose level above this withhold therapy and take daily levels until level less than 30mg/L and discuss with pharmacy for dosing.

<table>
<thead>
<tr>
<th>Level (mg/L)</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;15 mg/L</td>
<td>Contact antimicrobial pharmacist / pharmacy for dosing advice</td>
</tr>
<tr>
<td>Level</td>
<td>Action</td>
</tr>
<tr>
<td>-------------</td>
<td>-------------------------------------------</td>
</tr>
<tr>
<td>15 – 30 mg/L</td>
<td>Continue at present dosing regimen. Continue to monitor regularly</td>
</tr>
<tr>
<td>31 – 60 mg/L</td>
<td>Ensure doses have been given and not missed and level taken at the correct time. Contact antimicrobial pharmacist / pharmacy for dosing advice on reducing dose.</td>
</tr>
<tr>
<td>&gt;60 mg/L</td>
<td>Stop treatment immediately and retest level. Contact antimicrobial pharmacist / pharmacy for dosing advice</td>
</tr>
</tbody>
</table>

**Reference**
- Antimicrobial Reference Laboratory – Guideline ranges for TDM 2017
- Renal drug database (Teicoplanin) – Accessed 22/08/2017
TEICOPLANIN (bone and joint infections / Deep seated infections – HIGH DOSE)

Practice points:
• Teicoplanin is mainly used in the Trust for surgical prophylaxis. Measuring levels is not required when used in this circumstance.
• Treatment using Teicoplanin is restricted. Prior approval by microbiology is required prior to supplying
• The guidelines below are tailored for patients with bone and joint infections or deep seated infections such as Endocarditis or severe Staph. aureus infection requiring Teicoplanin
• Treatment duration: variable, depending on indication (discuss with microbiology). Switch to oral to complete course as soon as appropriate.

Loading dose
• Doses based on approximately 12mg/kg body weight
• No adjustment to loading dose required in renal impairment
• Doses ≥ 800mg require to be diluted in 100ml NaCl 0.9% and infused over 30-60mins

<table>
<thead>
<tr>
<th>Actual body weight (kg)</th>
<th>Dose</th>
</tr>
</thead>
<tbody>
<tr>
<td>≤ 85kg</td>
<td>800mg every 12 hours for 3 doses (0, 12, 24hrs)</td>
</tr>
<tr>
<td>&gt; 85kg</td>
<td>1000mg every 12 hours for 3 doses (0, 12, 24hrs)</td>
</tr>
</tbody>
</table>

Maintenance dose
• Estimated renal function (eGFR) on PICS can be used to select appropriate dose below

<table>
<thead>
<tr>
<th>Actual body weight (kg)</th>
<th>Renal function</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Normal eGFR &gt; 80ml/min</td>
</tr>
<tr>
<td>≥ 85kg</td>
<td>Mild – moderate renal impairment eGFR 30-80ml/min</td>
</tr>
<tr>
<td>≤ 85kg</td>
<td>Severe renal impairment eGFR &lt;30ml/min</td>
</tr>
<tr>
<td>≥ 85kg</td>
<td>800mg ONCE daily</td>
</tr>
<tr>
<td>≥ 85kg</td>
<td>1000mg ONCE daily</td>
</tr>
<tr>
<td>&gt; 85kg</td>
<td>800mg daily till day 4 then reduce to 400mg ONCE daily (or 800mg alt days)</td>
</tr>
<tr>
<td>&gt; 85kg</td>
<td>1000mg daily till day 4 then reduce to 500mg ONCE daily (or 1000mg alt days)</td>
</tr>
<tr>
<td>&gt; 85kg</td>
<td>800mg daily till day 4 then reduce to 800mg every 72hours (or 260mg daily)</td>
</tr>
<tr>
<td>&gt; 85kg</td>
<td>1000mg daily till day 4 then reduce to 1000mg every 72hours (or 330mg daily)</td>
</tr>
</tbody>
</table>

Monitoring
• Renal function must be monitored on a regular basis
• Teicoplanin levels should be initially taken 4 - 5 days after starting treatment and then on a weekly basis.
• Take as a pre-dose (i.e. immediately before the dose administration is due)
• Samples are sent to Bristol Antimicrobial Reference Laboratory to be processed. Results usually take approx. 48hours to be reported. Continue therapy at same dosing schedule and ensure no doses are missed until result available.
• Aim levels as per table(s) below depending on indication of treatment
• Max level is 60mg/L. If pre-dose level above this withhold therapy and take daily levels until level less than 30mg/L and discuss with pharmacy for dosing
### TEICOPLANIN DOSE ADJUSTMENT TABLE – Bone and joint infections / Severe *Staph. aureus* infections (other than endocarditis)

<table>
<thead>
<tr>
<th>Level (mg/L)</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;20 mg/L</td>
<td>Contact antimicrobial pharmacist / pharmacy for dosing advice on increasing the dose</td>
</tr>
<tr>
<td><strong>20 – 40 mg/L</strong></td>
<td>Continue at present dosing regimen. Continue to monitor regularly</td>
</tr>
<tr>
<td>41 – 60 mg/L</td>
<td>Ensure doses have been given and not missed and level taken at the correct time. Contact antimicrobial pharmacist / pharmacy for dosing advice on reducing dose.</td>
</tr>
<tr>
<td>&gt;60 mg/L</td>
<td>Stop treatment immediately and retest level Contact antimicrobial pharmacist / pharmacy for dosing advice</td>
</tr>
</tbody>
</table>

### TEICOPLANIN DOSE ADJUSTMENT TABLE – Endocarditis

<table>
<thead>
<tr>
<th>Level (mg/L)</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;30 mg/L</td>
<td>Contact antimicrobial pharmacist / pharmacy for dosing advice</td>
</tr>
<tr>
<td><strong>30 – 40 mg/L</strong></td>
<td>Continue at present dosing regimen. Continue to monitor regularly</td>
</tr>
<tr>
<td>41 – 60 mg/L</td>
<td>Ensure doses have been given and not missed and level taken at the correct time. Contact antimicrobial pharmacist / pharmacy for dosing advice on reducing dose.</td>
</tr>
<tr>
<td>&gt;60 mg/L</td>
<td>Stop treatment immediately and retest level Contact antimicrobial pharmacist / pharmacy for dosing advice</td>
</tr>
</tbody>
</table>

**Reference**
- Antimicrobial Reference Laboratory – Guideline ranges for TDM 2017
- Renal drug database (Teicoplanin) – Accessed 22/08/2017
- Medusa injectable medicines guide (Teicoplanin) – Accessed 22/08/2017
VORICONAZOLE

Practice points:

- Oral bioavailability is 96%. Take oral dose 1 hour before or an hour after meals.
- *Only use IV in renal patients if patient is unable to tolerate oral, as intravenous vehicle (SBECD) accumulates in renal failure.

Dosing

- Intravenous (IV): 6 mg/kg 12 hourly for 24 hours, then 3–4 mg/kg 12 hourly
- Oral:
  - <40 kg, 200 mg 12 hourly for 24 hours, then 100–150 mg twice daily
  - >40 kg, 400 mg 12 hourly for 24 hours, then 200–300 mg twice daily

<table>
<thead>
<tr>
<th>Renal function (GFR)</th>
<th>Dose</th>
</tr>
</thead>
<tbody>
<tr>
<td>GFR ≥50ml/min</td>
<td>Dose as in normal renal function*.</td>
</tr>
<tr>
<td>GFR 20-50ml/min</td>
<td>Dose as in normal renal function*.</td>
</tr>
<tr>
<td>GFR 10–19ml/min</td>
<td>Dose as in normal renal function*.</td>
</tr>
<tr>
<td>GFR &lt;10ml/min</td>
<td>Dose as in normal renal function*.</td>
</tr>
</tbody>
</table>

Dialysis patients*

<table>
<thead>
<tr>
<th>Dialysis</th>
<th>Dose</th>
</tr>
</thead>
<tbody>
<tr>
<td>CAPD</td>
<td>Probably dialysed. Dose as in normal renal function.</td>
</tr>
<tr>
<td>HD</td>
<td>Not dialysed. Dose as in normal renal function.</td>
</tr>
<tr>
<td>HDF/High flux</td>
<td>Not dialysed. Dose as in normal renal function.</td>
</tr>
<tr>
<td>CAV/VVHD</td>
<td>Not dialysed. Dose as in normal renal function.</td>
</tr>
</tbody>
</table>

Levels

- The absorption and metabolism of voriconazole will vary from patient to patient.
- Most patients receiving voriconazole should have therapeutic drug monitoring done.
- Take first pre-dose level at 5-7 days of starting therapy or if there is a change in dosing or an interacting drug has been started or stopped.
- Samples are sent to Manchester Mycology Reference Laboratory to be processed. Results usually take approx. 48-72hours to be reported (the assay service is not available at the weekend). Continue therapy at same dosing schedule and ensure no doses are missed.
- **Therapeutic & prophylactic dose target pre-dose level**
  - (trough – level taken immediately prior to drug administration): **1.3 - 5.7 mg/L**
  - In disseminated or 'bulky infections' a pre-dose level more than 2mg/L is preferable
- If pre-dose levels are found to be below or above the target range ensure doses were given and that the level was taken at the correct time. If yes then discuss with pharmacy for advice dosing.
- Monitor liver function before starting treatment, then at least weekly for 1 month, and then monthly during treatment.
- Patients should be advised to avoid intense or prolonged exposure to direct sunlight. In sunlight, patients should cover sun-exposed areas of skin and use a sunscreen with a high sun protection factor.

Additional information

- Note. Voriconazole interacts with a large number of drugs including analgetics, antibacterials, anti-coagulants, anti-depressants, anti-epileptics, ciclosporin, tacrolimus, etc.
- Please see BNF for full list of medication and discuss with pharmacy how these should be managed.

Reference

- Renal drug database (Voriconazole) – Accessed 22/08/2017
- British National Formulary (BNF) – Accessed 22/08/2017
INTRAVENOUS FOSFOMYCIN

Practice points:
- Adults and adolescents ≥ 12 years of age (> 40 kg)
- Fosfomycin is primarily excreted renally unchanged

The general dosage guidelines for adults with estimated creatinine clearance > 80 ml/min:

<table>
<thead>
<tr>
<th>Indication</th>
<th>Daily dose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acute osteomyelitis</td>
<td>12-24 g(^a) in 2-3 divided doses</td>
</tr>
<tr>
<td>Complicated urinary tract infection</td>
<td>12-16 g(^b) in 2-3 divided doses (consider using 3g orally 72 hourly for 9 days)</td>
</tr>
<tr>
<td>Nosocomial lower respiratory tract infection</td>
<td>12-24 g(^a) in 2-3 divided doses</td>
</tr>
<tr>
<td>Bacterial meningitis</td>
<td>16-24 g(^a) in 3-4 divided doses</td>
</tr>
</tbody>
</table>

Individual doses must not exceed 8 g.
\(^a\) The high-dose regimen in 3 divided doses should be used in severe infections expected or known to be caused by less susceptible bacteria.
\(^b\) There are limited safety data in particular for doses in excess of 16 g/day. Special caution is advised when such doses are prescribed.

Dosage of fosfomycin in renal insufficiency

The dose recommendations for patients with renal impairment are based on pharmacokinetic modelling and limited clinical data; safety and efficacy have not yet been evaluated in clinical trials. It is unclear if dose reductions are necessary for patients with an estimated creatinine clearance between 40-80 ml/min. Great caution should be exercised in these cases, particularly if doses at the higher end of the recommended range are considered.

Dosage table for patients with impaired renal function:

<table>
<thead>
<tr>
<th>GFR ml/min</th>
<th>Daily dosage recommended (^a)</th>
</tr>
</thead>
<tbody>
<tr>
<td>40 - 80</td>
<td>70% (in 2-3 divided doses)</td>
</tr>
<tr>
<td>30 - 39</td>
<td>60% (in 2-3 divided doses)</td>
</tr>
<tr>
<td>20 - 29</td>
<td>40% (in 2-3 divided doses)</td>
</tr>
<tr>
<td>10 - 19</td>
<td>20% (in 1-2 divided doses)</td>
</tr>
</tbody>
</table>

\(^a\) The dose is expressed as a proportion of the dose that would have been considered appropriate if the patient's renal function were normal. The first (loading) dose should be increased by 100%.

Patients undergoing renal replacement therapy

Patients undergoing chronic intermittent dialysis (every 48 hours) should receive 2 g of fosfomycin at the end of each dialysis session.

During continuous veno-venous hemofiltration (post-dilution CVVHF), fosfomycin is effectively eliminated. Patients undergoing post-dilution CVVHF will not require any dose adjustment.

No clinical data exist for intravenous fosfomycin in patients undergoing pre-dilution CVVHF or other forms of renal replacement therapy.
II. ADMINISTRATION OF VANCOMYCIN BY CONTINUOUS INFUSION IN CRITICAL CARE

Background
Antibiotic efficacy of Vancomycin is dependent on the time for which local concentration exceeds MIC for the microorganism. Tissue penetration depends on the area under the serum concentration – time curve (AUC). Evidence suggests that giving antibiotics by infusion gives a better AUC (1), is cost-effective (2) and may be beneficial to the patient (3). Continuous infusion of vancomycin is simpler to monitor and reduces the risk of toxic antibiotic peaks. It is already established practice in many ICUs.

Prescribing
- All patients should receive a weight-related loading dose prescribed on the ‘One Off’ section of PICS:

<table>
<thead>
<tr>
<th>Vancomycin Continuous Infusion</th>
<th>LOADING DOSE REGIMEN</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;70 Kg:</td>
<td>1g in 250ml of 0.9% Saline intravenous infusion over 1 hour</td>
</tr>
<tr>
<td>≥ 70 Kg:</td>
<td>1.25g in 250ml of 0.9% Saline intravenous infusion over 1 hour</td>
</tr>
</tbody>
</table>

- A continuous infusion should be started immediately after the loading dose by prescribing 1000 mg in 250ml of 0.9% Saline, the rate of infusion based on the patient’s renal function:

<table>
<thead>
<tr>
<th>Vancomycin Continuous Infusion</th>
<th>MAINTAINENCE DOSE STARTING REGIMEN (Day 1)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Serum Creatinine</td>
</tr>
<tr>
<td>Normal Renal Function &lt;120</td>
<td>1500 mg</td>
</tr>
<tr>
<td>Impaired Renal Function &gt;120</td>
<td>1000 mg</td>
</tr>
<tr>
<td>CVVH</td>
<td>1000 mg</td>
</tr>
</tbody>
</table>

- DAILY LEVELS MUST BE TAKEN AT 6:00 am – a level may only be omitted if the infusion has been running for less than 6 hours
• The level should be checked by medical staff daily and the prescription modified accordingly. If the level is greater than 25 mg/L, then the total dose that the patient receives during the day should be reduced by 500 mg by adjusting the rate of the infusion. Similarly, patients with levels less than 15 mg/L should have the infusion rate increased so that they receive 500 mg per day more (see Infusion Adjustment Table).

• Patients with levels greater than 30 mg/L should have the infusion stopped for 6 hours and the infusion started at a reduced dose (to be agreed on the ward round)

• Patients with levels persistently below 10 mg/L despite continuous infusion >24 hours, should be re-loaded as above and placed at the next infusion level.

Exclusions to the Protocol

The following groups of patients should not be entered into the protocol:

• Those with a known drug reaction to vancomycin
• Those with known vancomycin-resistant or vancomycin-intermediate sensitive organisms
• Those also receiving gentamicin

The infusion should be terminated at the end of treatment or if a causative pathogen not treatable by vancomycin is found. There is no need for blood levels to be taken once the infusion has stopped.
Infusion Adjustment according to Daily Level

<table>
<thead>
<tr>
<th>Vancomycin Level</th>
<th>Dosage Change Required</th>
<th>Infusion Rate Adjustment</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 15 mg/L</td>
<td>Increase daily dose by 500 mg by adjusting rate</td>
<td>Increase infusion rate to next level on table</td>
</tr>
<tr>
<td>15 – 25 mg/L</td>
<td>No change</td>
<td>-</td>
</tr>
<tr>
<td>&gt; 25 mg/L</td>
<td>Decrease daily dose by 500 mg* by adjusting rate</td>
<td>Decrease infusion rate to next level on table</td>
</tr>
<tr>
<td>&gt; 30 mg/L</td>
<td>STOP infusion for 6 hours</td>
<td>Restart at reduce dose (as agreed on ward round)</td>
</tr>
</tbody>
</table>

* If the patient is receiving 500 mg/day, the dose should be reduced to 250 mg/day

Infusion Table
The Total Daily Dose should be used when converting patients to a BD/OD regimen

<table>
<thead>
<tr>
<th>Total Daily Dose</th>
<th>Infusion Rate (ml/hr)</th>
<th>Equivalent Hourly Dose (mg/hr)</th>
</tr>
</thead>
<tbody>
<tr>
<td>250 mg</td>
<td>3</td>
<td>10</td>
</tr>
<tr>
<td>500 mg</td>
<td>5</td>
<td>21</td>
</tr>
<tr>
<td>1000 mg</td>
<td>10</td>
<td>42</td>
</tr>
<tr>
<td>1500 mg</td>
<td>16</td>
<td>63</td>
</tr>
<tr>
<td>2000 mg</td>
<td>21</td>
<td>83</td>
</tr>
<tr>
<td>2500 mg</td>
<td>26</td>
<td>104</td>
</tr>
<tr>
<td>3000 mg</td>
<td>31</td>
<td>125</td>
</tr>
</tbody>
</table>

† Starting Dose (Impaired Renal Function)
* Starting Dose (Normal Renal Function)
References


III. Antimicrobial doses for adults with renal impairment

An estimate of renal function should be obtained prior to dosing any drugs for a patient with suspected renal impairment. It is worth noting that the elderly may have a degree of renal impairment, even though they have normal levels of serum creatinine.

There are two methods of estimating renal function, the MDRD equation (often reported as eGFR by biochemistry) or the Cockcroft-Gault equation, which needs to be calculated from the following equation:

Cockcroft-Gault equation

\[
\text{Creatinine Clearance (ml/min)} = F \times \frac{[140 - \text{age (in years)}]}{\text{serum creatinine (micromol/L)}} \times \text{weight (kg)}
\]

Where F is a factor of 1.23 (for male) and 1.04 (for female)

Do not use eGFR to calculate dosing for aminoglycosides (i.e. Gentamicin, Tobra mycin and Amikacin) or for vancomycin dosing.

Both estimates are largely the same for clearances <30ml/min. It is important to use the same method of renal function estimation throughout the patient’s stay. The MDRD (eGFR) is likely to provide an overestimation of renal function in the elderly and small females, and an underestimation in young, muscular males.

Please note, reported eGFR values need to be multiplied by a factor of 1.21 in Afro-Carribean patients.
Classification of renal disease

<table>
<thead>
<tr>
<th>Level of renal impairment</th>
<th>CrCl or eGFR (ml/min)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mild</td>
<td>20-50</td>
</tr>
<tr>
<td>Moderate</td>
<td>10-20</td>
</tr>
<tr>
<td>Severe</td>
<td>&lt; 10</td>
</tr>
</tbody>
</table>

For patients with acute renal impairment and progressive decline in renal function, it would be inaccurate to adjust drug dosage based on a single renal function result. Renal function should be monitored on a daily basis and drug dosage adjusted according to the nearest estimate of renal function. Please seek advice if in doubt.

Limitations of Renal Function Estimation

If patient is anuric, morbidly obese or in acute renal failure (ARF), these equations will NOT give a true reflection of creatinine clearance.

For those who are morbidly obese, amputees, oedematous or pregnant, Ideal Body Weight (IBW) must be calculated as below, and the Cockroft-Gault equation must be used:

- Where height is > 60 inches or 5 feet, use the following formula

\[
\text{IBW for male} = 50 + [2.3 \times \{(\text{Feet} \times 12) + \text{inches} - 60\}]
\]

\[
\text{IBW for female} = 45 + [2.3 \times \{(\text{Feet} \times 12) + \text{inches} - 60\}]
\]

- However if height is < 60 inches (or 5 feet) then use the following,

\[
\text{IBW for male} = 50\text{kg}
\]

\[
\text{IBW for female} = 45\text{kg}
\]

- Anuric and oliguric (< 500ml/day) patients can be assumed to have an eGFR < 10ml/min (severe renal impairment)

- MDRD (eGFR) does not apply to those with rapidly changing creatinine values, cachexia, amputees, pregnant women or patients aged under 18 years

1 foot = 12 inches
1 inch = 0.025m
RENAL DOSING MONOGRAPHS

- The Antimicrobial doses recommended in this guideline are derived from the renal drug database, specific product characteristics (SPC), and represent those commonly used in the University Hospitals of Birmingham (UHB).
- The doses quoted are from published literature and clinical experience and may not be in accordance with the licensed doses for the drugs included.
- For licensed doses please refer to British National Formulary (BNF)
- If 50% dose reduction is quoted, give half the dose but retain the normal frequency.
- For dosing advice in **peritonitis associated with peritoneal dialysis or in high-flux dialysis**, please contact the lead pharmacist for renal services at the Queen Elizabeth Hospital (bleep 1836, ext 3147).
- For dosing in renal impairment for treatment of **viral encephalitis, meningitis and endocarditis**, please contact the Microbiology Department.
- Glossary:
  - ND = Not dialysed
  - D = Dialysed
  - GFR = Glomerular filtration rate
<table>
<thead>
<tr>
<th>Antimicrobial</th>
<th>GFR (ml/min)</th>
<th>GFR (ml/min)</th>
<th>GFR (ml/min)</th>
<th>CAPD</th>
<th>Haemodialysis</th>
<th>Continuous veno-venous filtration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aciclovir IV</td>
<td>GFR 25-50</td>
<td>GFR 10-25</td>
<td>Severe (&lt; 10)</td>
<td>ND</td>
<td>D, dose as severe</td>
<td>D, dose as in moderate</td>
</tr>
<tr>
<td></td>
<td>5 - 10mg/kg</td>
<td>5 to 10mg/kg</td>
<td>2.5 to 5mg/kg</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>every 12 hours</td>
<td>every 24 hours</td>
<td>every 24 hours</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aciclovir Oral</td>
<td>GFR 25-50</td>
<td>GFR 10-25</td>
<td>Severe (&lt; 10)</td>
<td>ND</td>
<td>D, dose as severe</td>
<td>D, dose as in moderate</td>
</tr>
<tr>
<td></td>
<td>Normal</td>
<td>Simplex: 200mg every 12 hours</td>
<td>Simplex: 200mg every 12 hours</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Normal</td>
<td>Zoster: 800mg every 8-12 hours</td>
<td>Zoster: 400 to 800mg every 12 hours</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Amikacin</td>
<td>GFR 20-50</td>
<td>GFR 10-20</td>
<td>Severe (&lt; 10)</td>
<td>ND</td>
<td>D, dose as severe</td>
<td>D, give 7.5mg/kg every 24 hours</td>
</tr>
<tr>
<td>Measure levels (Adjustments to be discussed with a pharmacy / Microbiologist)</td>
<td>5 - 6mg/kg every 12 hours</td>
<td>3 - 4 mg/kg every 24 hours</td>
<td>2mg/kg every 24 - 48 hours</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Amoxicillin IV</td>
<td>GFR 20-50</td>
<td>GFR 10-20</td>
<td>Severe (&lt; 10)</td>
<td>ND</td>
<td>D, dose as severe</td>
<td>D, normal dose</td>
</tr>
<tr>
<td></td>
<td>Normal</td>
<td>Normal</td>
<td>250mg to 1g every 8 hours (maximum 6g per day in endocarditis)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ceftolozane and tazobactam sodium (Zerbaxa®)</td>
<td>GFR 30-50</td>
<td>GFR 15-29</td>
<td>GFR &lt; 10</td>
<td>ND</td>
<td>D, dose as GFR &lt;10</td>
<td>D, 375mg every 8 hours</td>
</tr>
<tr>
<td></td>
<td>750mg every 8 hours</td>
<td>375mg every 8 hours</td>
<td>Loading dose: 375mg, then 150mg every 8 hours</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Antimicrobial</td>
<td>GFR (ml/min)</td>
<td>GFR &gt;55ml/min</td>
<td>GFR &lt;55ml/min</td>
<td>CAPD</td>
<td>Haemodialysis</td>
<td>Continuous veno-venous filtration</td>
</tr>
<tr>
<td>------------------------</td>
<td>--------------</td>
<td>---------------</td>
<td>---------------</td>
<td>------</td>
<td>---------------</td>
<td>----------------------------------</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>GFR/kg (ml/min/kg)</td>
<td>Dose (mg/kg)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>1.3-1.8</td>
<td>5</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>1-1.2</td>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>0.8-0.9</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>0.7</td>
<td>2.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>0.5-0.6</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>0.4</td>
<td>1.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>0.2-0.3</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>0.1</td>
<td>0.5</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

For polyoma virus treatment, see RDH.

<table>
<thead>
<tr>
<th>Antimicrobial</th>
<th>GFR (ml/min)</th>
<th>Mild (20-50)</th>
<th>Moderate (10-20)</th>
<th>Severe (&lt; 10)</th>
<th>CAPD</th>
<th>Haemodialysis</th>
<th>Continuous veno-venous filtration</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Normal</td>
<td>50 - 100% of normal dose</td>
<td>50% of normal dose</td>
<td>ND, 200mg every 12 hours</td>
<td>ND, 200mg every 12 hours</td>
<td>D, 200 to 400mg every 12 hours</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Normal</td>
<td>50 to 100% of normal dose</td>
<td>50% of normal dose</td>
<td>ND, 250mg every 12 hours</td>
<td>ND, 250 to 500mg every 12 hours</td>
<td>D, 500 to 750mg every 12 hours</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Normal</td>
<td>Normal</td>
<td>Normal</td>
<td>ND, normal dose</td>
<td>ND, normal dose</td>
<td>ND, normal dose</td>
</tr>
</tbody>
</table>

Clindamycin IV and Oral

Clindamycin IV and Oral

Clindamycin IV and Oral
<table>
<thead>
<tr>
<th>Antimicrobial</th>
<th>GFR (ml/min)</th>
<th>CAPD</th>
<th>Haemodialysis</th>
<th>Continuous veno-venous filtration</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mild (20-50)</td>
<td>Moderate (10-20)</td>
<td>Severe (&lt; 10)</td>
<td></td>
</tr>
<tr>
<td>Co-Amoxiclav (Augmentin®) IV</td>
<td>Normal</td>
<td>1.2g every 12 hours</td>
<td>1.2g STAT followed by 600mg every 8 hours or 1.2g every 12 hours</td>
<td>D, dose as severe</td>
</tr>
<tr>
<td>Co-Amoxiclav (Augmentin®) Oral</td>
<td>Normal</td>
<td>Normal</td>
<td>Normal</td>
<td>D, normal dose</td>
</tr>
<tr>
<td>Co-Trimoxazole (IV and Oral)</td>
<td>GFR &gt;30ml/min</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Normal</td>
<td>PCP: 60mg/kg every 12 hours for 3 days then 30mg/kg every 12 hours thereafter</td>
<td></td>
<td>ND, dose as severe</td>
</tr>
<tr>
<td></td>
<td>GFR 15-30ml/min</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Normal</td>
<td>PCP: 30mg/kg every 12 hours</td>
<td></td>
<td>ND, dose as severe</td>
</tr>
<tr>
<td></td>
<td>GFR &lt;15ml/min</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Normal</td>
<td>Other indications: 50% of normal dose</td>
<td></td>
<td>D, dose as severe</td>
</tr>
<tr>
<td></td>
<td>Other indications: 50% of normal dose</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Daptomycin IV</td>
<td>GFR &gt;50ml/min</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Normal</td>
<td>D, dose as moderate</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Doxycycline Oral</td>
<td>Normal</td>
<td>Normal</td>
<td>Normal</td>
<td>ND, normal dose</td>
</tr>
<tr>
<td>Ertapenem IV</td>
<td>GFR 10-30ml/min</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Normal</td>
<td>500mg - 1g every 24 hours</td>
<td></td>
<td>D, dose as severe</td>
</tr>
<tr>
<td>Erythromycin Oral</td>
<td>Normal</td>
<td>Normal</td>
<td>50 to 75% of normal dose, maximum 2g/day.</td>
<td>ND, dose as severe</td>
</tr>
<tr>
<td>Flucloxacillin IV and Oral</td>
<td>Normal</td>
<td>Normal</td>
<td>Normal</td>
<td>ND, dose as severe</td>
</tr>
<tr>
<td>Fluconazole Oral and IV</td>
<td>Normal</td>
<td>50% of normal dose</td>
<td>D, dose as severe</td>
<td>D, dose normal dose 3 times a week after HD</td>
</tr>
</tbody>
</table>

See [Colistine](#) dosing guideline

See [Daptomycin](#) dosing guideline
<table>
<thead>
<tr>
<th>Antimicrobial</th>
<th>GFR (ml/min)</th>
<th>CAPD</th>
<th>Haemodialysis</th>
<th>Continuous veno-venous filtration</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mild (20-50)</td>
<td>Moderate (10-20)</td>
<td>Severe (&lt; 10)</td>
<td></td>
</tr>
<tr>
<td>Flucytosine IV</td>
<td>See Flucytosine guideline for dosing and monitoring</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Foscarnet IV (Seek Virology advice)</td>
<td>Maintain adequate hydration to prevent renal toxicity</td>
<td>Monitor serum calcium and magnesium</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>28mg/kg every 8 hours</td>
<td>15mg/kg every 8 hours</td>
<td>6mg/kg every 8 hours</td>
<td>D, dose as severe</td>
</tr>
<tr>
<td>Fosomycin oral for UTI</td>
<td>Normal</td>
<td>Normal - but urine levels may not be sufficient to treat</td>
<td>Contraindicated – insufficient urine levels to treat</td>
<td>No data</td>
</tr>
<tr>
<td>Fosfomycin IV</td>
<td>See intravenous Fosfomycin dosing guideline</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fusidic Acid (Sodium Fusidate) IV and Oral</td>
<td>Normal</td>
<td>Normal</td>
<td>Normal</td>
<td>ND, normal dose</td>
</tr>
<tr>
<td>Ganciclovir IV (Monitor full blood count)</td>
<td></td>
<td></td>
<td></td>
<td>D, dose as 1.25mg/kg daily (Give post dialysis on dialysis days)</td>
</tr>
<tr>
<td></td>
<td>GFR (ml/min)</td>
<td>Induction</td>
<td>Maintenance</td>
<td></td>
</tr>
<tr>
<td></td>
<td>&gt;50-69</td>
<td>2.5 mg/kg 12 hourly</td>
<td>2.5 mg/kg/day</td>
<td></td>
</tr>
<tr>
<td></td>
<td>25-49</td>
<td>2.5 mg/kg/day</td>
<td>1.25 mg/kg/day</td>
<td></td>
</tr>
<tr>
<td></td>
<td>10-24</td>
<td>1.25 mg/kg/day</td>
<td>0.625 mg/kg/day</td>
<td></td>
</tr>
<tr>
<td></td>
<td>&lt;10</td>
<td>1.25 mg/kg 3 times a week</td>
<td>0.625 mg/kg three times a week</td>
<td></td>
</tr>
<tr>
<td>Antimicrobial</td>
<td>GFR (ml/min)</td>
<td>CAPD</td>
<td>Haemodialysis</td>
<td>Continuous veno-venous filtration</td>
</tr>
<tr>
<td>--------------</td>
<td>--------------</td>
<td>------</td>
<td>---------------</td>
<td>----------------------------------</td>
</tr>
<tr>
<td></td>
<td>Mild (20-50)</td>
<td>Moderate (10-20)</td>
<td>Severe (&lt; 10)</td>
<td></td>
</tr>
<tr>
<td>Gentamicin</td>
<td>See <a href="#">Gentamicin</a> guideline for dosing and monitoring</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Linezolid</td>
<td>Normal</td>
<td>Normal but monitor platelets closely</td>
<td>D, dose as severe</td>
<td>D, dose as severe</td>
</tr>
<tr>
<td>Meropenem</td>
<td>GFR 26-50</td>
<td>1g every 12 hours</td>
<td>500mg every 12 hours</td>
<td>D, dose as severe</td>
</tr>
<tr>
<td>Metronidazole IV and Oral</td>
<td>GFR 10-25</td>
<td>CNS: 2g every 12 hours</td>
<td>CNS: 1g every 12 hours</td>
<td>D, normal dose</td>
</tr>
<tr>
<td>Moxifloxacin</td>
<td>Normal</td>
<td>Normal</td>
<td>Normal</td>
<td>Normal</td>
</tr>
<tr>
<td>Nitrofurantoin</td>
<td>Do NOT use in renal impairment eGFR&lt;45 (Insufficient urinary concentrations achieved)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Oseltamivir Oral (Treatment dose)**

<table>
<thead>
<tr>
<th>GFR &gt;30</th>
<th>GFR 10-30</th>
<th>GFR &lt;10</th>
</tr>
</thead>
<tbody>
<tr>
<td>75 mg once daily for at least 10 days (up to 6 weeks if epidemic in community)</td>
<td>75mg every 48 hours for 10 days</td>
<td>30 mg once a week (2 doses)</td>
</tr>
<tr>
<td>75mg every 12 hours for 5 days</td>
<td>75mg every 24 hours for 5 days</td>
<td>HDF/high flux: 75mg thrice weekly (post dialysis) for 3 doses</td>
</tr>
</tbody>
</table>

| HDF/high flux: 75mg thrice weekly (post dialysis) for 5 doses (seek advice if anuric or showing adverse effects) | 75mg for 5 days | |

**Oseltamivir Oral (prophylactic dose)**

<table>
<thead>
<tr>
<th>GFR &gt;30</th>
<th>GFR 10-30</th>
<th>GFR &lt;10</th>
</tr>
</thead>
<tbody>
<tr>
<td>75 mg once daily for at least 10 days (up to 6 weeks if epidemic in community)</td>
<td>75mg every 48 hours for 10 days</td>
<td>30 mg once a week (2 doses)</td>
</tr>
<tr>
<td>75mg every 12 hours for 5 days</td>
<td>75mg every 24 hours for 5 days</td>
<td>HDF/high flux: 75mg thrice weekly (post dialysis) for 5 doses</td>
</tr>
</tbody>
</table>

| HDF/high flux: 75mg thrice weekly (post dialysis) for 5 doses (seek advice if anuric or showing adverse effects) | 75mg for 5 days | |

| 75mg for 10 days |

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<table>
<thead>
<tr>
<th>Antimicrobial</th>
<th>GFR (ml/min)</th>
<th>CAPD</th>
<th>Haemodialysis</th>
<th>Continuous veno-venous filtration</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mild (20-50)</td>
<td>Moderate (10-20)</td>
<td>Severe (&lt; 10)</td>
<td></td>
</tr>
<tr>
<td>Penicillin V Oral</td>
<td>Normal</td>
<td>Normal</td>
<td>Normal</td>
<td>ND, normal dose</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>D, normal dose</td>
</tr>
<tr>
<td>Piperacillin/Tazobactam</td>
<td>GFR 40-50</td>
<td>GFR 20-40</td>
<td>GFR &lt;20</td>
<td>D, dose as severe</td>
</tr>
<tr>
<td>(Tazocin)</td>
<td>Normal</td>
<td>4.5g every 8 hours</td>
<td>4.5g every 12 hours</td>
<td>D, CVVH = 4.5g every 12 hours</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>CVVHD = 4.5g every 8 hours</td>
</tr>
<tr>
<td>Posaconazole Oral</td>
<td>Normal</td>
<td>Normal</td>
<td>Normal</td>
<td>ND, normal dose</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>ND, normal dose</td>
</tr>
<tr>
<td>Rifampicin IV and Oral</td>
<td>Normal</td>
<td>Normal</td>
<td>50 to 100% of normal dose</td>
<td>ND, dose as severe</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>ND, dose as severe</td>
</tr>
<tr>
<td>Teicoplanin</td>
<td>See Teicoplanin guideline for dosing and monitoring (Low dose &amp; High dose)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tigecycline</td>
<td>Normal</td>
<td>Normal</td>
<td>Normal</td>
<td>ND, normal</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>ND, normal</td>
</tr>
<tr>
<td>Timentin</td>
<td>GFR 30-60</td>
<td>GFR 10-30</td>
<td>GFR 30-60</td>
<td>ND, dose as severe</td>
</tr>
<tr>
<td></td>
<td>3.2g every 8 hours</td>
<td>1.6g every 8 hours</td>
<td>1.6g every 12 hours</td>
<td>D, dose as severe</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>?, 1.6 to 2.4g every 6 to 8 hours</td>
</tr>
<tr>
<td>Tobramycin</td>
<td>See Tobramycin guideline for dosing and monitoring</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Trimethoprim Oral</td>
<td>GFR &gt;25</td>
<td>GFR 15-25</td>
<td>GFR &lt;15</td>
<td>50-100% of normal dose</td>
</tr>
<tr>
<td>NB: May induce hyperkalaemia</td>
<td>Normal dose</td>
<td>Normal dose</td>
<td>50-100% of normal dose</td>
<td>50-100% of normal dose</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Probably D, normal dose</td>
</tr>
</tbody>
</table>

NB: May induce hyperkalaemia
<table>
<thead>
<tr>
<th>Antimicrobial</th>
<th>GFR (ml/min)</th>
<th>GFR (ml/min)</th>
<th>GFR (ml/min)</th>
<th>GFR (ml/min)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Valaciclovir (For treatment of HSV &amp; Herpes zoster)</td>
<td>GFR 50-75</td>
<td>GFR 30-50</td>
<td>GFR 10-30</td>
<td>GFR &lt; 10</td>
</tr>
<tr>
<td>Normal</td>
<td>HSV = Normal</td>
<td>HSV treatment: 500 mg daily</td>
<td>HSV treatment: 500 mg daily</td>
<td>HSV treatment: 500 mg daily</td>
</tr>
<tr>
<td></td>
<td>Herpes zoster: 1 g every 12 hours.</td>
<td>HSV suppression: 250 mg daily</td>
<td>HSV suppression: 250 mg daily</td>
<td>HSV suppression: 250 mg daily</td>
</tr>
<tr>
<td></td>
<td>Herpes labialis: 1 g stat then 1 g twice daily.</td>
<td>HSV suppression (immunocompromised): 500 mg daily or 250 mg every 12 hours</td>
<td>HSV suppression (immunocompromised): 500 mg daily or 250 mg every 12 hours</td>
<td>HSV suppression (immunocompromised): 500 mg daily or 250 mg every 12 hours</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Herpes zoster: 1 g daily</td>
<td>Herpes zoster: 500 mg daily</td>
<td>Herpes zoster: 500 mg daily</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Herpes labialis: 500 mg stat then 500 mg twice daily</td>
<td>Herpes labialis: 500 mg daily</td>
<td>Herpes labialis: 500 mg daily</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>D, dose as GFR &lt;10, give after dialysis</td>
</tr>
</tbody>
</table>

<p>| Valaciclovir (CMV prophylaxis) | GFR 50-75 | GFR 25-50 | GFR 10-25 | GFR &lt; 10 |
| 1.5 g every 6 hours | 1.5 g every 8 hours | 1.5 g every 12 hours | 1.5 g once daily | D, dose as GFR &lt;10, give after dialysis |
| | | | | D, dose as GFR 10-30 |</p>
<table>
<thead>
<tr>
<th>Antimicrobial</th>
<th>GFR (ml/min)</th>
<th>CAPD</th>
<th>Haemodialysis</th>
<th>Continuous veno-venous filtration</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mild (20-50)</td>
<td>Moderate (10-20)</td>
<td>Severe (&lt; 10)</td>
<td></td>
</tr>
<tr>
<td>Vancomycin IV</td>
<td>See <a href="#">vancomycin</a> guideline for dosing and monitoring</td>
<td>See vancomycin renal protocol</td>
<td>See vancomycin continuous infusion guideline</td>
<td></td>
</tr>
<tr>
<td>Vancomycin Oral</td>
<td>Give normal treatment dose. See <a href="#">Clostridium difficile treatment guideline</a> (Therapeutic drug monitoring is not needed)</td>
<td>A</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Valganciclovir (treatment)</td>
<td>GFR &gt;60</td>
<td>GFR 40-59</td>
<td>GFR 25-39</td>
<td>GFR 10-24</td>
</tr>
<tr>
<td></td>
<td>900mg BD</td>
<td>450mg BD</td>
<td>450mg daily</td>
<td>450mg on alternate days</td>
</tr>
<tr>
<td>Valganciclovir (prophylaxis)</td>
<td>GFR &gt;60</td>
<td>GFR 40-59</td>
<td>GFR 25-39</td>
<td>GFR 10-24</td>
</tr>
<tr>
<td></td>
<td>900mg daily</td>
<td>450mg daily</td>
<td>450mg on alternate days</td>
<td>450mg twice weekly</td>
</tr>
<tr>
<td>Voriconazole (IV and Oral)</td>
<td>GFR &gt;60</td>
<td>GFR 40-59</td>
<td>GFR 25-39</td>
<td>GFR 10-24</td>
</tr>
<tr>
<td></td>
<td>900mg daily</td>
<td>450mg daily</td>
<td>450mg on alternate days</td>
<td>450mg twice weekly</td>
</tr>
<tr>
<td>Zanamivir (inhaled)</td>
<td>Normal</td>
<td>Normal</td>
<td>Normal</td>
<td>? normal dose</td>
</tr>
</tbody>
</table>

See [Voriconazole](#) guideline for dosing and monitoring
Appendix 1

**SEXUAL HEALTH SERVICE DRUG FORMULARY AND PHARMACY PROTOCOL - ANTIMICROBIALS**

The following products to be available in pre-packaged form for dispensing by clinical staff. Drugs marked NMP are available for inclusion in individual formularies of nurses who have been approved as non medical prescribers.

Abbreviations:
- PGD  Patient Group Directives in force
- NMP  Whittall Street Clinic
- Boots GUM  Boots GUM drug cupboard
- Boots FP  Boots Family Planning drug cupboard
- S  Family Planning satellite clinics

<table>
<thead>
<tr>
<th>MEDICATION</th>
<th>INDICATION(S)</th>
<th>COMMENTS</th>
<th>CATEGORY</th>
<th>STOCKED AT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aciclovir 400mg tds for 5 days</td>
<td>First line: primary genital herpes</td>
<td>Follow BASHH and WSC guidelines</td>
<td>PGD NMP</td>
<td>WSC Boots GUM</td>
</tr>
<tr>
<td>Aciclovir 800mg tds for 2 days</td>
<td>HSV recurrence</td>
<td>Follow BASHH AND WSC guidelines</td>
<td>NMP</td>
<td>WSC</td>
</tr>
<tr>
<td>Aciclovir 400mg bd 28 days</td>
<td>First line: HSV suppression</td>
<td>NMP may not initiate treatment. If not prescribed by consultant should have ‘special clinic’ appointment within 3 months.</td>
<td>NMP Consultant advice only</td>
<td>WSC</td>
</tr>
<tr>
<td>Aciclovir 400mg tds 28 days</td>
<td>HSV suppression in third trimester of pregnancy Second line: HSV suppression</td>
<td></td>
<td>Consultant advice only</td>
<td>WSC</td>
</tr>
<tr>
<td>Azithromycin 1g stat 4x 250mg tablets</td>
<td>First line: Genital or pharyngeal chlamydia/NSU / contacts of chlamydia and NSU. Co treatment of Gonorrhoea</td>
<td>Follow BASHH and WSC guidelines</td>
<td>PGD (not in pregnancy) NMP</td>
<td>WSC Boots GUM</td>
</tr>
<tr>
<td>Azithromycin 500mg stat followed by 250mg OD for 4 days</td>
<td>First line: Persistent NSU (use with Metronidazole)</td>
<td>Follow BASHH and WSC* guidelines. Unlicensed use. *limited evidence regarding best course duration. WSC decision to use 7d rather than 5d course</td>
<td>NMP</td>
<td>WSC</td>
</tr>
<tr>
<td>Azithromycin suspension 1.0g 25ml</td>
<td>As for Azithromycin 1g tablets. Used when patient unable to swallow tablets</td>
<td>Follow BASHH and WSC guidelines</td>
<td>PGD (not in pregnancy) NMP</td>
<td>WSC Boots GUM</td>
</tr>
<tr>
<td>Benzathine penicillin 2.4 mu diluted in 2mls 1% lidocaine for injection and 6mls solvent (included in pack)</td>
<td>Syphilis and epidemiological treatment of contacts of syphilis</td>
<td>Follow BASHH guideline. NMP can also prescribe at satellite clinics as epidemiological treatment to contacts if no signs or symptoms of syphilis. Must then have follow up appointment in 1w at WSC for doctor review. Unlicensed product</td>
<td>NMP</td>
<td>WSC</td>
</tr>
<tr>
<td>Co amoxiclav 625mg tds 7 days</td>
<td>Skin infections requiring anaerobic</td>
<td></td>
<td></td>
<td>WSC</td>
</tr>
</tbody>
</table>

222
<table>
<thead>
<tr>
<th>MEDICATION</th>
<th>INDICATION(S)</th>
<th>COMMENTS</th>
<th>CATEGORY</th>
<th>STOCKED AT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cefixime 400mg stat (2x 200mg tablets)</td>
<td>Second line: gonorrhoea</td>
<td>Follow BASHH and WSC guidelines. Co treat with Azithromycin</td>
<td>NMP PGD</td>
<td>WSC Boots GUM</td>
</tr>
<tr>
<td>Ceftriaxone 500mg IM stat</td>
<td>First line: Gonorrhoea PID (with doxycycline and metronidazole)</td>
<td>Follow BASHH and WSC guidelines. Co treat with Azithromycin</td>
<td>NMP PGD</td>
<td>WSC Boots GUM</td>
</tr>
<tr>
<td>Cefalexin 500mg tds 7 days</td>
<td>Pregnant women with UTI. Second line sensitive UTI</td>
<td></td>
<td>Doctor only in pregnancy NMP</td>
<td>WSC Boots GUM</td>
</tr>
<tr>
<td>Ciprofloxacin 500mg stat. Dispensed from pack of 20</td>
<td>Alternative second line: uncomplicated gonorrhoea</td>
<td>Follow BASHH and WSC guidelines</td>
<td>NMP PGD</td>
<td>WSC Boots GUM</td>
</tr>
<tr>
<td>Clindamycin 2% 5g cream PV 7 days</td>
<td>Bacterial vaginosis</td>
<td>Consider special clinic if more than 3 episodes a year and symptoms persisting</td>
<td>NMP</td>
<td>WSC Boots GUM</td>
</tr>
<tr>
<td>Clotrimazole 500mg pessary PV stat</td>
<td>First line vaginal candidiasis</td>
<td>Prescribed with 1% clotrimazole cream if vulvitis present or when prescribed for vaginal candidiasis on PGD. Follow BASHH and WSC guidelines</td>
<td>PGD NMP</td>
<td>WSC Boots GUM</td>
</tr>
<tr>
<td>Clotrimazole: cream 1% 20g</td>
<td>First line: candidiasis, tinea cruris</td>
<td>In women must also prescribe 500mg pessary. Dispensed as separate items</td>
<td>PGD NMP</td>
<td>WSC Boots GUM GUM</td>
</tr>
<tr>
<td>Clotrimatole HC 1% cream 30g</td>
<td>Second Line: Candida, balanitis / vulvitis and genital dermatosis</td>
<td></td>
<td>NMP</td>
<td>WSC Boots GUM GUM</td>
</tr>
<tr>
<td>Doxycycline 100 mg bd 7 days</td>
<td>1st line rectal Chlamydia 2nd line: pharyngeal or genital Chlamydial</td>
<td>Follow WSC guidelines</td>
<td>PGD NMP</td>
<td>WSC Boots GUM</td>
</tr>
<tr>
<td>Doxycycline 100mg bd 14 days</td>
<td>Alternative: Early syphilis 2nd line: epididymo-orchitis</td>
<td>Follow BASSH guidelines</td>
<td></td>
<td>WSC</td>
</tr>
<tr>
<td>Doxycycline 100mg bd 21 days</td>
<td>LGV Failure of treatment of rectal Chlamydia</td>
<td>Follow BASHH and WSC guidelines</td>
<td>NMP</td>
<td>WSC</td>
</tr>
<tr>
<td>Doxycycline 100mg bd 28 days</td>
<td>Second line: Late syphilis</td>
<td>Follow BASHH guideline</td>
<td></td>
<td>WSC</td>
</tr>
<tr>
<td>Doxycycline 200mg bd 28 days</td>
<td>Second line: neurosyphilis</td>
<td>Follow BASHH guideline</td>
<td></td>
<td>WSC</td>
</tr>
<tr>
<td>Erythromycin tablets 500mg BD 14 days</td>
<td>Third line: Uncomplicated Chlamydia 2nd line: Folliculitis Give 7 d only</td>
<td>Follow BASHH and WSC guidelines</td>
<td>PGD (Chlamydia only) NMP</td>
<td>WSC Boots GUM</td>
</tr>
<tr>
<td>MEDICATION</td>
<td>INDICATION(S)</td>
<td>COMMENTS</td>
<td>CATEGORY</td>
<td>STOCKED AT</td>
</tr>
<tr>
<td>------------------------------------</td>
<td>----------------------------------------</td>
<td>--------------------------------------------------------------------------</td>
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</tr>
<tr>
<td>Erythromycin suspension 500mg bd 14 days</td>
<td>As for erythromycin tablets</td>
<td>Used when patient unable to swallow tablets</td>
<td>NMP</td>
<td>WSC Boots GUM</td>
</tr>
<tr>
<td>Flucloxacillin 250mg qds 7 days</td>
<td>First line: folliculitis</td>
<td></td>
<td>NMP</td>
<td>WSC Boots GUM</td>
</tr>
<tr>
<td>Fluconazole 150mg stat</td>
<td>2nd line: genital candidiasis</td>
<td>Follow BASHH and WSC guidelines</td>
<td>NMP</td>
<td>WSC Boots GUM</td>
</tr>
<tr>
<td>Gentamicin 240mg IM</td>
<td>3rd line gonorrhoea</td>
<td>If allergic to cephalosprins or history of penicillin anaphylaxis and spectinomycin not available or contraindicated</td>
<td>On consultant advice only</td>
<td>WSC</td>
</tr>
<tr>
<td>Hepatitis B vaccine</td>
<td>First line: Hepatitis B vaccination</td>
<td>Follow WSC guideline. Stored in fridge</td>
<td>PGD NMP</td>
<td>WSC Boots GUM</td>
</tr>
<tr>
<td>Imiquimod cream 3 times/week (12 sachets)</td>
<td>Alternative 2nd line: anogenital warts</td>
<td>Follow BASHH and WSC guidelines</td>
<td>PGD NMP</td>
<td>WSC Boots GUM</td>
</tr>
<tr>
<td>Lignocaine 2% chlorhexidine gluconate solution 0.25% - 11mL syringe (Instilagel or Optilube Active)</td>
<td>Topical anaesthesia IUD/IUS insertions</td>
<td>Symptomatic relief of HSV</td>
<td>WSC</td>
<td>WSC Boots GUM</td>
</tr>
<tr>
<td>Metronidazole 2g stat</td>
<td>First line: Trichomoniasis (TV)</td>
<td>Follow BASHH and WSC guidelines</td>
<td>PGD NMP</td>
<td>WSC Boots GUM</td>
</tr>
<tr>
<td>Metronidazole gel 0.75% PV nocte 5days</td>
<td>Alternative first line: Bacterial vaginosis</td>
<td></td>
<td>NMP</td>
<td>WSC Boots GUM</td>
</tr>
<tr>
<td>Metronidazole suspension (400mg bd 5 days) 200mg / 5ml</td>
<td>Alternative first line BV (indications as for Metronidazole tablets) Second line: Trichomonas</td>
<td>Follow BASHH and WSC guidelines</td>
<td>NMP</td>
<td>WSC Boots GUM</td>
</tr>
<tr>
<td>Metronidazole 400mg bd 7 days</td>
<td>First line: bacterial vaginosis, Second site: Trichomonas Persistent/recurrent NSU</td>
<td>Follow BASHH and WSC guidelines Use with azithromycin</td>
<td>PGD for BV and TV NMP</td>
<td>WSC Boots GUM</td>
</tr>
<tr>
<td>Metronidazole 400 mg bd 14 days</td>
<td>With ofloxacin or doxycycline and ceftixone for PID</td>
<td>Two 7 day boxes given dispensed</td>
<td>WSC</td>
<td>WSC Boots GUM</td>
</tr>
<tr>
<td>Miconazole HC cream 30g</td>
<td>Second line: Candida, balanitis/vulvitis and genital dermatosis</td>
<td>Kept in fridge</td>
<td>WSC</td>
<td></td>
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<tr>
<td>Moxifloxacin 400mg OD x 14 days</td>
<td>Second line: PID Second line: persistent NSU / Mycoplasma genitalium</td>
<td>Follow BASHH guidelines</td>
<td>WSC</td>
<td></td>
</tr>
<tr>
<td>Nytatin pessaries 100,000 units 1-2 PV x 14 nights</td>
<td>Resistant candidiasis</td>
<td>Follow BASHH guideline Unlicensed product</td>
<td>Consultant advice only</td>
<td>WSC</td>
</tr>
<tr>
<td>MEDICATION</td>
<td>INDICATION(S)</td>
<td>COMMENTS</td>
<td>CATEGORY</td>
<td>STOCKED AT</td>
</tr>
<tr>
<td>-------------------------</td>
<td>------------------------------------------------------------------------------</td>
<td>----------------------------------------------------</td>
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<td>---------------------</td>
</tr>
<tr>
<td>Nitrofurantoin 50mg</td>
<td>qds 7 days First line: uncomplicated cystitis in women</td>
<td>Use in Trimethoprim allergy</td>
<td>NMP</td>
<td>WSC Boots GUM</td>
</tr>
<tr>
<td>Ofloxacin 400mg bd 7</td>
<td>days Severe symptoms of UTI in men Pyelonephritis in men and women</td>
<td></td>
<td></td>
<td>WSC Boots GUM</td>
</tr>
<tr>
<td>Ofloxacin 400mg bd 14</td>
<td>days First line: PID (combined with Metronidazole) First line: epididymo-</td>
<td>Follow BASHH and WSC guidelines</td>
<td></td>
<td>WSC Boots GUM</td>
</tr>
<tr>
<td></td>
<td>orchitis, prostatitis</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Permethrin 5% cream</td>
<td>Scabies Follow BASHH guideline</td>
<td></td>
<td>NMP</td>
<td>WSC Boots GUM</td>
</tr>
<tr>
<td></td>
<td>Pediculosis pubis Follow BASHH and WSC guidelines</td>
<td></td>
<td>NMP</td>
<td></td>
</tr>
<tr>
<td>Podophyllotoxin 0.5%</td>
<td>liquid 3.5ml First line: (alternative to podophyllotoxin cream) penile</td>
<td>Follow BASHH and WSC guidelines</td>
<td>PGD</td>
<td>WSC Boots GUM</td>
</tr>
<tr>
<td></td>
<td>warts</td>
<td></td>
<td>NMP</td>
<td></td>
</tr>
<tr>
<td>Podophyllotoxin cream</td>
<td>0.15% (5g) First line: perianal and vulval warts. Alternative treatment:</td>
<td>Follow BASHH and WSC guidelines</td>
<td>PGD</td>
<td>WSC Boots GUM</td>
</tr>
<tr>
<td></td>
<td>Molluscum Contagiosum</td>
<td></td>
<td>NMP</td>
<td></td>
</tr>
<tr>
<td>Spectinomycin 2g IM sta</td>
<td>Alternative second line: uncomplicated gonorrhoea Follow BASHH guideline</td>
<td>Consultant advice only Unlicensed</td>
<td></td>
<td>WSC</td>
</tr>
<tr>
<td></td>
<td>stat</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Trimethoprim 200mg</td>
<td>bd 3 days First line: uncomplicated UTI (female only)</td>
<td></td>
<td>PGD</td>
<td>WSC Boots GUM</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>NMP</td>
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</table>

**GUM NON STOCK DRUGS – ORDER FROM PHARMACY**

<table>
<thead>
<tr>
<th>MEDICATION</th>
<th>INDICATION(S)</th>
<th>COMMENTS</th>
<th>CATEGORY</th>
<th>STOCKED AT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flucytosine 5g cream</td>
<td>or 1g pessaries with nystatin 100,000 units 14 days Failure of first line</td>
<td>Short expiry date – order as required. Store in</td>
<td>Consultant</td>
<td>Not kept in stock</td>
</tr>
<tr>
<td></td>
<td>treatments of non albicans vaginal yeast infections</td>
<td>fridge Unlicensed indication</td>
<td>advice only</td>
<td></td>
</tr>
<tr>
<td>Probenecid 500mg qds</td>
<td>17 days With procaine penicillin</td>
<td>Follow BASHH syphilis guideline. Unlicensed</td>
<td>Consultant</td>
<td>Not kept in stock</td>
</tr>
<tr>
<td></td>
<td></td>
<td>indication</td>
<td>advice only</td>
<td></td>
</tr>
<tr>
<td>Procaine penicillin 1.8-</td>
<td>2.4MU IM for 17 – 21 days Neurosyphilis. Also prescribe probenecid</td>
<td>Follow BASHH syphilis guideline. Unlicensed product</td>
<td>Consultant</td>
<td>Not kept in stock</td>
</tr>
<tr>
<td></td>
<td>days</td>
<td></td>
<td>advice only</td>
<td></td>
</tr>
<tr>
<td>Tinidazole 2G BD 14</td>
<td>days Failure of first line treatment of trichomonas</td>
<td>Follow BASHH syphilis guideline Unlicensed</td>
<td>Consultant</td>
<td>Not kept in stock</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>advice only</td>
<td></td>
</tr>
</tbody>
</table>

BASHH guidelines from  http://www.bashh.org/guidelines  
Faculty and RSH guidelines  http://www.fsrh.org/pages/Clinical_Guidance.asp  
Local guidelines (access from UHB computers)  https://intranet.whittallstreet.nhs.uk/
Appendix 2.

ANTIBIOTICS FOR STAPHYLOCOCCUS AUREUS BACTERAEMIA

Practice points:
- See Trust guideline for management and treatment of staphylococcus aureus bacteraemia

### Meticillin Sensitive Staphylococcus aureus (MSSA)

<table>
<thead>
<tr>
<th>First line:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Flucloxacillin</td>
<td></td>
</tr>
<tr>
<td>Dose: 2g - intravenous injection – qds (four times a day)</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Second line (penicillin allergy and if vancomycin MIC ≤1mg/L):</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Vancomycin</td>
<td></td>
</tr>
<tr>
<td>Dose: See Vancomycin guideline for dosing and monitoring. Aim pre-dose levels between 15-20mg/L</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Second choice (penicillin allergy), and if vancomycin MIC &gt;1mg/L, and if daptomycin sensitive:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Daptomycin</td>
<td></td>
</tr>
<tr>
<td>Dose: 6mg/kg – intravenous infusion – once a day</td>
<td></td>
</tr>
<tr>
<td>See Daptomycin guideline for dosing and monitoring. Ensure baseline CK level is taken and renal function calculated.</td>
<td></td>
</tr>
</tbody>
</table>

### Meticillin Resistant Staphylococcus aureus (MRSA)

<table>
<thead>
<tr>
<th>First line (if vancomycin MIC ≤1mg/L):</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Vancomycin</td>
<td></td>
</tr>
<tr>
<td>Dose: See Vancomycin guideline for dosing and monitoring. Aim pre-dose levels between 15-20mg/L</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Second line (if vancomycin MIC &gt;1mg/L PLUS daptomycin sensitive):</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Daptomycin</td>
<td></td>
</tr>
<tr>
<td>Dose: 6mg/kg – intravenous infusion – once a day</td>
<td></td>
</tr>
<tr>
<td>See Daptomycin guideline for dosing and monitoring. Ensure baseline CK level is taken and renal function calculated.</td>
<td></td>
</tr>
</tbody>
</table>

Duration of treatment:
- Uncomplicated bacteraemia; 14 days; oral step-down to be discussed with Medical Microbiologist
- Complicated bacteraemia; 4 – 6 weeks
Appendix 3.

CHANGES IN ANTIMICROBIAL PRESCRIBING GUIDELINES

Changes in v4.1

1. Update of Pacemaker Insertion Prophylaxis

2. TB treatment in renal failure.
   There are departmental guidelines (not on intranet) that have been agreed between Resp Med and Renal Med on this topic. The Antimicrobial Prescribing Guidelines have been modified to include the following: Patients with TB and renal impairment should be managed by Respiratory Medicine/Renal Medicine using the Renal Medicine departmental guideline for ‘Treatment of tuberculosis in renal failure’.

3. Clarification over the use of Pneumovax in CSF leaks.
   The Green Book does not differentiate between CSF leaks that involve sinuses or the upper respiratory tract from those, eg, that might involve the spine or cranium away from the risks of upper respiratory tract flora. Including of following statement provides clarification:
   "Pneumococcal vaccine (Pneumovax®II) should be given if the leak and/or surgical procedure traverses sinuses. (Later note Pneumovax®II replaced with Pneumococcal polysaccharide vaccine (PPV23) throughout v4.5 of Guidelines)"

4. Doxycycline duration
   Packs of 100mg tablets of doxycycline contain 8 tablets, ie 7 day’s supply. The duration of doxycycline (where stated) has been modified to clarify a treatment course of 7 days, including the 200mg loading dose.

5. Post-splenectomy immunisation
   This has been updated to include current (May 2014) ‘Green Book’ guidance on use of MenB vaccine.

6. Change in dosing fosfomycin in renal failure
   Old recommendations now replaced with those from the fosfomycin IV SMPC provided by Nordic Pharma.

7. New guidelines for prophylaxis in Hand Surgery

8. Changes in meropenem dosing in renal impairment and RRT
   Dosing modified to bring into line with eGFR bands and doses in BNF. Meropenem dosing increased to 1g 8 hourly from 500mg 8 hourly or 1g 12 hourly for patients on CVVH.

9. Addition of vancomycin cover for patients with history of MRSA to empirical treatment recommendation for catheter associated UTI or complicated UTI/pyelonephritis

Changes in v4.2

1. Antifungal therapeutic drug monitoring.

2. Influenza treatment.

   New section included; based on BCARE Antimicrobial Reference Laboratory's recommendations.


5. Native joint septic arthritis.
   Added introductory paragraph to suggest contacting Medical Microbiologist if septic arthritis is present in patients who are at risk of unusual organisms causing infection. Clarified suggested duration of at least 3 weeks in Comments section.

**Changes in v4.3**

1. Addition of Urology surgical prophylaxis section.

**Changes in v4.4**

1. Changes in posaconazole use to recommend use of newer formulations of posaconazole (IV and delayed-release tablets) rather than oral suspension.

2. Changes in dosing of trimethoprim in renal impairment (GFR ranges below 30ml/min) to make dosing consistent with BNF doses.

3. Changes to suggest oral rather than IV clarithromycin and moxifloxacin to be considered as first choice when either of these drugs are to be used.

4. UTI, biliary tract/intra-abdominal infection guidelines modified to suggest using the Septicaemia/serious sepsis guideline, if the latter is present.

5. Addition of section on Therapeutic Drug Monitoring for teicoplanin.

6. Clarification of the administration of intravenous injection of teicoplanin to include the SmPC statement on administration: 'intravenous injection over 3 to 5 minutes or as a 30-minute infusion'.

7. Addition of the Centor clinical prediction score (as per NICE Clinical Knowledge Summary, July 2015) to guidance for pharyngitis/tonsillitis.

**Changes in v4.5**

1. Addition of guideline for empirical treatment of deep neck space odontogenic infection.

2. Addition of appendix with antibiotics for *Staphylococcus aureus* bacteraemia (extract from full Trust guideline).

   4. ‘Pneumovax®II’ replaced with ‘Pneumococcal polysaccharide vaccine (PPV23)’ to recognise changes in manufacturer’s naming of vaccine and allow generic prescribing consistent with The Green Book (Immunization Against Infectious Diseases).
Changes in v5.0

1. Changes in TDM monitoring for aminoglycosides and glycopeptides
2. Changes in layout and formatting for all sections
3. Changes in contact details for microbiology and pharmacy
4. Addition of infestations sections covering Lice and Scabies
5. Changes in empirical treatment based on local epidemiology and sensitivity data

Acknowledgement

The first version of this form of these Guidelines was based on those written by the late Dr TMA Weller, Consultant Medical Microbiologist, City Hospital, Birmingham. Subsequent versions of these Guidelines have been commented upon, and contributed to, by many clinicians, Pharmacists and Medical Microbiologists, members of the Antimicrobial Steering and sepsis Group and the Medicines Management Advisory Group.
Appendix 4.

ADDITIONAL REFERENCES

- The Health and Social Care Act 2008: Code of Practice for the NHS on the prevention and control of healthcare associated infections and related guidance. DOH.
- Khan & Cheesbrough (2003) Impact of changes in antibiotic policy on *Clostridium difficile*-associated diarrhoea (CDAD) over a five year period in a district general hospital. *J Hosp Infect* 54:104-8