CONTROLLED DOCUMENT

ADULT GUIDELINES FOR ANTIMICROBIAL PRESCRIBING

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CLASSIFICATION:	Clinical
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Distribution: • **Essential Reading for:** • **Information for:**	Clinicians, all non-medical Prescribers, Pharmacists and nurses Wards Managers, Senior Nurses, ADNs, Divisional Directors

University Hospitals Birmingham NHS
NHS Foundation Trust

Antimicrobial Prescribing Guidelines

Version 7.0

Date: July 2027

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- Colistin

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Part G. Appendices

General Information

Please Read Before First Use

Renal function

- Please note that unless otherwise mentioned all doses advised assume normal renal function.
- Where patients have renal impairment please click on the drug names and you will be given doses adjustments in renal impairment

Penicillin allergy

- Remember that those with genuine severe allergy to "penicillin" may also be allergic to related penicillins (e.g. piperacillin-tazobactam) and other beta-lactams. If in doubt discuss with Pharmacy and/or Infection specialist
- See Allergies - penicillin, cephalosporins and carbapenems for more information

Previously cultured MRSA and other resistant organisms

- Remember to check PICS / Concerto for previous microbiology results as they can affect the appropriate treatment the patient needs
- If a patient has previously cultured MRSA see the appropriate guideline option for MRSA.
- If a patient has previously cultured resistant Gram-negative organisms contact infection specialist to discuss treatment - Making referrals to Infection specialist

Drug interactions and contraindications

- The guidelines provided here are empirical and suitable for the majority of patients.
- It is the prescribers responsibility to check for drug interactions, indicated dose changes and contraindications (e.g. pregnancy) that may necessitate alternative treatment.
- If in doubt call Pharmacy

Comments / Guideline changes

- Any comments please contact:
    - shahzad.razaq@uhb.nhs.uk
    - jawaad.ellahi@uhb.nhs.uk
    - abigail.jenkins@uhb.nhs.uk
    - nirlep.agravedi@uhb.nhs.uk

Introduction & General Considerations

- These guidelines have been produced in collaboration with infection specialists on the Queen Elizabeth, Heartlands, Good Hope and Solihull sites and the University Hospital Birmingham's Antimicrobial Stewardship Group (AMSG), Medicine Management Advisory Group (MMAG) and relevant specialist clinical teams.
- They are designed to help in the management of infections in adult (over16 year-old) 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 infection specialists 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 hospital intranet and 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 or infection specialist if required.
- These guidelines take into account national and international guidelines as well as the local the local epidemiology of infection and antimicrobial resistance.

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 (http://uhbhome/Microsites/Policies_Procedures/assets/BloodCultureCollectionProcedure.pdf (last accessed 16/07/2020)
- 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.

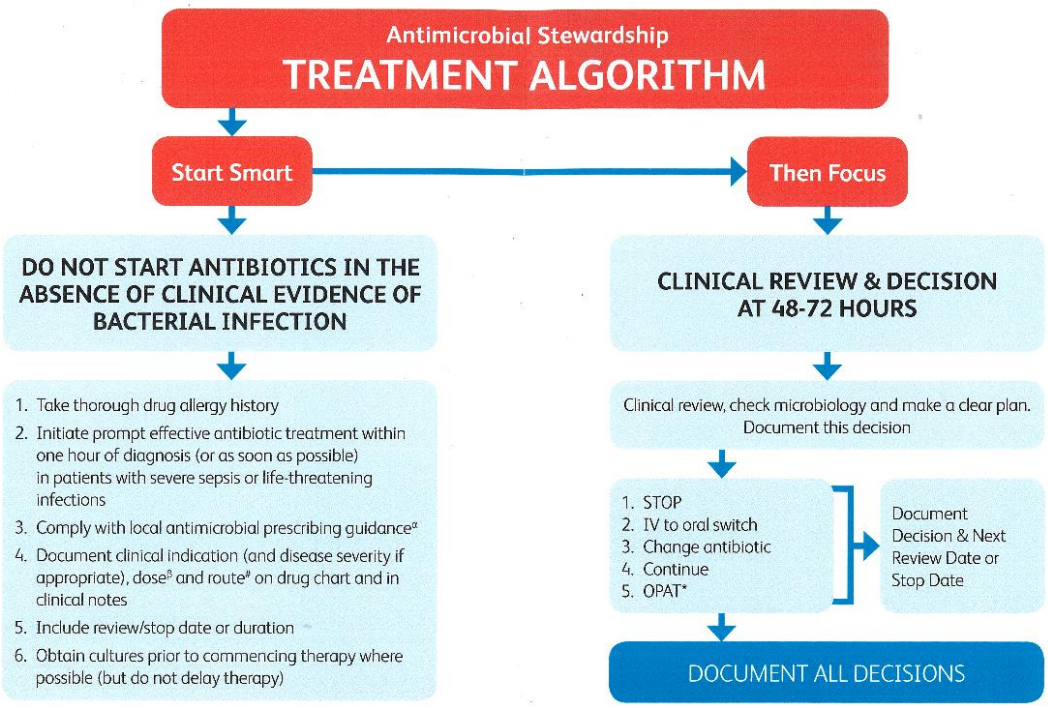
- Previously known resistant organisms

    - Check microbiology system and/or PICS for Bee Aware logo  (This may indicate that the patient has a previously known antibiotic-resistant organism).
    - 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 infection in someone who has had a previous infection with an ESBL positive E.coli or Klebsiella species, should include an agent known to be active against these organisms.

Principles of Good Antimicrobial Prescribing (Start Smart Then Focus)

- 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., *Clostridioides 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 in patients with severe 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 of therapy in the medical notes and on PICS / JAC
- Obtain cultures prior to commencing antimicrobial therapy where possible

THEN FOCUS – this means:

- All antimicrobial therapy should be reviewed at 24-72 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:
    - Clinical improvement
    - Reducing inflammatory markers e.g. WCC, CRP
    - 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 (at QEHB) or JAC (at HGS).
    - 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) for detailed information on each medicine. See link to BNF under help tab on PICS and / or contact your ward Pharmacist for further advice.
    - Renal function – dosage adjustments may be necessary in renal impairment. Contact your ward Pharmacist or infection specialist for further advice.
    - Pregnancy and 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)
    - Weight
    - Renal/hepatic function

4. Prescribe correct duration of therapy
    - When prescribing antimicrobials on PICS or JAC / Paper drug charts ensure you review the duration before authorising the prescription / prescribing
    - Note the default duration on the electronic prescribing system may not always be appropriate and should be adjusted accordingly.
    - Most intravenous antibiotics are only required for up to 72hours 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 wherever possible 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 – 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 Infection service for further advice if required.

7. Support and advice
   - Expert advice should be sought from an infection specialist for complicated infections, interpretation of culture and sensitivity results if their 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 (See contacts details above regarding site specific support)

Empirical IV to Oral Switch Options

Intravenous (IV)	**ORAL**
Amoxicillin 500mg to 1g tds	Amoxicillin 500mg to 1g tds
Benzylpenicillin 1.2g to 2.4g qds	Amoxicillin 1g tds
Ciprofloxacin 400mg bd	Ciprofloxacin 500mg bd
Clarithromycin 500mg bd	Clarithromycin 500mg bd
Clindamycin 450mg to 600mg qds	Clindamycin 450mg to 600mg qds (higher dose in obesity with BMI greater than 30 kg/ m^2)
Co-amoxiclav 1.2g tds	Co-amoxiclav 625mg tds
Flucloxacillin 1g - 2g qds	Flucloxacillin 1g qds (Max oral dose of 1g qds)
Levofloxacin 500mg od/bd	Levofloxacin 500mg od/bd
Linezolid 600mg bd	Linezolid 600mg bd
Metronidazole 500mg tds	Metronidazole 400mg tds
Moxifloxacin 400mg od	Moxifloxacin 400mg od
For other agents or indications see individual guidelines for guidance or speak to a member of the Infection Speciality.	

Avoiding use of Broad Spectrum Antibiotics

- The main risk factor for acquisition of infection with *Clostridioides 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 *Clostridioides difficile* -associated diarrhoea as do quinolones (Yip et al 2001).
- Many studies have shown that outbreaks of *Clostridioides 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).

Allergies - Penicillins, cephalosporins and carbapenems

Penicillin allergy

- Allergic reactions to penicillins and cephalosporins are relatively rare but can be life-threatening. It is therefore important that patients with a true allergy are correctly identified.
- About 6% of the general population in England claim to be allergic to penicillin1,2 However, only 5-10% of these are truly allergic1,3,4. Patients with a penicillin allergy label are more likely to receive a broad-spectrum non-penicillin antibiotic, which are associated with an enhanced risk of MRSA, *Clostridioides difficile* , vancomycin-resistant enterococcus infection, prolonged length of inpatient stay and more expensive treatment5. Alleged penicillin allergy may also delay antibiotic therapy in sepsis management6.
-
- 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 penicillins and cephalosporins allergy

- Cross reactivity between penicillins and first generation (possibly second) cephalosporins is well recognised7.
- If there is a history of immediate allergic reaction to penicillin, 1st and 2nd generation cephalosporins must be avoided (see table 1: allergy classification below).
- Later generation (3rd-5th) cephalosporins may be considered to treat serious infections when there are no suitable alternatives and the index reaction to penicillin is not suggestive of anaphylaxis7. Administration should be undertaken in a graded escalated fashion (see below) under close clinical supervision with immediate access to treatment of anaphylaxis and critical care team support
- 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 and after administration.

Cross reactivity between penicillins 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

Characteristics	Timing of onset	Clinical signs
Immediate, rapidly evolving reactions	Onset usually less than 1 hour after drug Exposure	Anaphylaxis: Wheezing / bronchospasm Hypotension Angioedema Urticaria / pruritus Diffuse erythema
Non-immediate reactions without systemic involvement	Onset usually 6–10 days after first drug exposure or within 3 days of second exposure	Widespread red macules or papules (exanthema-like) Fixed drug eruption (localised inflamed skin)
Non-immediate reactions with systemic involvement	Onset usually 2–6 weeks after first drug exposure or within 3 days of second exposure	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
		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
		Acute generalised exanthematous pustulosis (AGEP) characterised by: widespread pustules fever neutrophilia
		Common disorders caused, rarely, by drug allergy: Eczema, hepatitis, nephritis, photosensitivity, vasculitis

Management of Patients with Suspected Drug Allergy

Refer patients to UHB specialist drug allergy service if at least one of the following applies:

- Label of 'multiple antibiotic allergy/intolerance'
- Label of 'Penicillin allergy' in patients who are likely to need frequent antibiotics (e.g. cystic fibrosis, bronchiectasis, COPD, asthma, immunodeficiency, diabetes etc.) where penicillins are commonly preferred antibiotic choice
- Penicillin allergy in patients with an infection that can only be treated by penicillins (eg: bacterial endocarditis, syphilis in pregnancy, neurosyphillis). For such referrals urgent de-labelling or a rapid desensitisation procedure may be considered. Rapid penicillin desensitisation is a method of administering penicillin to a patient with a previous history of immediate allergic reaction (type-1 hypersensitivity) to penicillins. This should only be undertaken following approval and with guidance from the Immunology department.
- Suspected penicillin allergy as a part of peri-operative anaphylaxis.

Referral mechanism:

- Routine referrals: Email to AllergyAppointments.email@uhb.nhs.uk or a write to any of the Immunology consultants.
- Urgent referrals: Contact an Immunology registrar via Heartlands switchboard bleep 2119.

Table 2: Antimicrobial use in patients with a history of immediate reactions to penicillin

Antimicrobials that should not be used in patients with immediate reactions to penicillin	**Drugs that can be used with caution in patients who are labelled as penicillin allergic but have NO history of anaphylaxis**	**Drugs that are considered safe to use in patients with a penicillin allergy**	
Amoxicillin	Cefotaxime*	Amikacin	Levofloxacin
Cefalexin	Ceftazidime*	Azithromycin	Linezolid
Cefuroxime	Ceftazidime/avibactam*	Aztreonam	Metronidazole
Co-amoxiclav / Augmentin	Ceftolozane/tazobactam*	Chloramphenicol	Moxifloxacin
Benzathine penicillin Penicillin G procaine	Ceftriaxone*	Ciprofloxacin	Nitrofurantoin
Benzylpenicillin	Ertapenem*	Clarithromycin	Ofloxacin
Flucloxacillin	Imipenem*	Clindamycin	Rifampicin
Penicillin V (phenoxymethylpenicillin)	Meropenem*	Colistin	Sodium fusidate
Piperacillin-tazobactam		Co-trimoxazole	Teicoplanin
Pivmecillinam		Dalbavancin	Tetracycline
Temocillin		Daptomycin	Tigecycline
Ticarcillin/clavulanic acid		Doxycycline	Trimethoprim
		Erythromycin	Tobramycin
		Gentamicin	Vancomycin

***** 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

Graded escalating dosing for first dose administration of antibiotic in patient with low likelihood of allergy (see above):

- Document baseline observations: BP, HR, PEFR.
- Administer 1/1000th of the target dose.
- Re-check observations after 30 minutes (or if clinical signs of an allergic reaction occur)
- Administer 1/100th of the target dose.
- Re-check observations after 30 minutes (or if clinical signs of an allergic reaction occur)
- Administer 1/10th of the target dose
- Re-check observations after 30 minutes (or if clinical signs of an allergic reaction occur)
- Administer the remainder of the target dose

Contact the Immunology registrar on call (Heartlands Bleep: 2119) or Allergy CNS Cathryn Melchior (by email) for further advice or guidance if needed.

Patients who have received titrated allergy testing must be clearly documented in the patients medical notes and discharge summary on what has been given and any follow-up or observations that may need to be considered for primary care teams.

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Formulary and Restricted Antimicrobials

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

Unrestricted These drugs are frequently used for common infections, and are relatively narrow spectrum. All prescribers may use the following agents:	**Available for specific indications** 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).		**Restricted** These drugs are not generally available. If they are required, a Registrar or Consultant must discuss the proposed use with an infection specialist who will have to approve the specific indication before it can be supplied and administered.
Amoxicillin Benzylpenicillin Clarithromycin Clindamycin Co-amoxiclav Doxycycline Erythromycin Flucloxacillin Gentamicin Metronidazole Miconazole Nitrofurantoin Nystatin Penicillin V (phenoxymethylpenicillin) Pivmecillinam Trimethoprim Vancomycin	Aciclovir Amikacin Azithromycin Ciprofloxacin Cefalexin Cefotaxime Ceftazidime Ceftriaxone Cefuroxime Co-trimoxazole Fluconazole Fosfomycin (IV / Oral) Levofloxacin Linezolid Meropenem Moxifloxacin Ofloxacin Oseltamivir Piperacillin-tazobactam Rifampicin Sodium Fusidate / Fusidic acid Teicoplanin Tigecycline Tobramycin (IV / Neb)	**<u>Antifungals</u> (Transplant teams)** Ambisome Anidulafungin Caspofungin Flucytosine Itraconazole Posaconazole Voriconazole **<u>Antivirals</u> (Transplant teams)** Cidofovir Foscarnet Ganciclovir Valaciclovir Valganciclovir Zanamivir	Aztreonam Benzathine penicillin Cefaclor Cefadroxil Cefixime Cefradine Chloramphenicol IV/PO Colistin IV Dalbavancin Daptomycin Dapsone Ertapenem Imipenem Norfloxacin Sulfadiazine Temocillin Ceftolozane/tazobactam Ceftazidime/avibactam **<u>GI Tract drugs</u> (Gastroenterology)** Tripotassium dicitratobismuthate Fidaxomicin (*Clostridioides difficile* infection)

Making a Referral to Infection Specialists

<table>
<tr><th colspan="3">Microbiology, Pharmacy and Infection control team</th></tr>
<tr><td colspan="3">Microbiology - QEHB site</td></tr>
<tr><td colspan="2">For routine advice use ‘Infection Advice Request’ PICS referral form Mon-Fri 0900-1700.
For urgent advice (e.g. septic patient) call switchboard for duty microbiologist.</td><td rowspan="2"><u>OUT-OF-HOURS service</u>
(Mon-Thurs 1700-0900h and Fri 1700 till Mon 0900h)
Microbiology Medical Staff out of hours, for urgent clinical advice: Contact via UHB switchboard
Microbiology Biomedical Scientists out of hours, for urgent processing of laboratory specimens: Via UHB switchboard</td></tr>
<tr><td colspan="2">Principal Antimicrobial Pharmacist
BB: 07876 398720, Ext. 13779, Bleep: 2554</td></tr>
<tr><td colspan="3">Microbiology - HGS sites</td></tr>
<tr><td colspan="2">Referrals Mon-Fri 0900-1700
Via email after completion of the online referral template:
<u>https://viewer.microguide.global/guide/1000000186#content,1ea1bcee-a5d0-4b3a-aa07-01ab89299410</u>

If URGENT call Ext 43240 or 43244</td><td><u>OUT-OF-HOURS service</u>
(Mon-Thurs 1700-0900h and Fri 1700 till Mon 0900h)
Microbiology Medical Staff out of hours, for urgent clinical advice: Contact via switchboard</td></tr>
<tr><td colspan="2">Principal Pharmacist Medicine & Anti-Infectives
Contact via switchboard</td><td>No out of hours antimicrobial Pharmacist service. For queries contact on-call pharmacist</td></tr>
<tr><td colspan="3">Infectious disease (ID) – All sites</td></tr>
<tr><td colspan="3">Contact via switchboard</td></tr>
<tr><td colspan="3">Consultant Medical Virologists – All sites</td></tr>
<tr><td colspan="3">Contact via switchboard</td></tr>
<tr><td colspan="3">Infection control team</td></tr>
<tr><td>QEHB site - Monday – Friday 0830 – 1630h
HGS sites - Monday – Friday 0800 – 1600h</td><td>Contact via switchboard</td><td>For advice out of hours please contact on-call infection specialist</td></tr>
</table>

Protocol for Telephone Calls to Microbiology for Antimicrobial Treatment or Diagnosis Advice

Background and indications for standard operating procedure/protocol

Microbiology and Infectious Diseases offer a remote 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 contact the infection specialists 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 infection specialists:

S – Situation

B – Background

A – Assessment

R - Recommendation

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

A call or PICS referral 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)

SITUATION. Be clear why you are calling and explain the purpose of the call

BACKGROUND. Be able to provide details of the medical history including:

a. presenting complaint and date of admission
b. past medical history
c. other prescribed medication (e.g. immunosuppressants)
d. significant events since admission (e.g. surgical interventions, ICU admissions)
e. antimicrobials prescribed during this admission and recently at home (with start and stop dates)
f. 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)

ASSESSMENT

g. Have current observation , prescription details, notes and (for patients with diarrhoea) Bristol stool chart to hand

h. Recent inflammatory markers/bloods
i. Recent microbiology results and advice (if calling out-of-hours)
j. State what you require from the call

RESPONSE. Discuss and agree a course of action

REPEAT the key actions to the infection specialist

RECORD. Immediately after the call, document in the patient's notes: date and time of call, name and grade infection specialist, 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:

- http://uhbpolicies/documents/infection-prevention-and-control.htm (last accessed 16/07/2020)
- http://uhbpolicies/documents/mrsa.htm (last accessed 16/07/2020)
- http://uhbpolicies/documents/infectious-diseases-outbreaks.htm (last accessed 16/07/2020)
- http://uhbpolicies/documents/fever-in-the-returning-traveller.htm . (last accessed 16/07/2020)

Part B. Treatment Guidelines

Gastrointestinal 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 greater than or equal to 1.5) in a patient without cirrhosis or pre-existing liver disease. While the time course that differentiates acute liver failure from chronic liver failure varies between reports, a commonly used cut-off is an illness duration of less than 26 weeks.
- Usual key indicators of infection such as leucocytosis or fever can be absent in up to 30% of patients
- Procalcitonin has not been found to be helpful in identifying bacterial infection in acute liver failure patients
- In light of the poor utility of biomarkers, international guidelines EASL Clinical Practical Guidelines on the management of acute (fulminant) liver failure (journal-of-hepatology.eu) & this trust recommend:
    - Maintaining a high index of suspicion for infection
    - Taking regular surveillance cultures including blood, urine and sputum should be performed Organisms: Aerobic Gram negative, Gram positive bacteria and fungi.
    - Commencing prophylaxis when ALF patients are super-urgently listed for transplantation (if not already on antimicrobials)
    - Commencing empirical antimicrobials on clinical deterioration – e.g. progression of hepatic encephalopathy, clinical signs of infections, or elements of hyperinflammation

First line:

Co-amoxiclav
Dose (oral): – 625mg tds for 5 days
Dose (intravenous): – 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 as a blanket policy for all ALF is an area of contention. It can reduce the incidence of infection in certain groups of patients with acute liver failure, but no actual survival benefit has been shown

References :

- Shingina et al. Acute Liver Failure Guidelines. Am J Gastroenterol 2023).
- Rolando et al. Bacterial and Fungal Infection in Acute Liver Failure. Seminars in Liver Disease 1996
- Rule et al. Procalicitonin identifies cell injury, not bacterial infection in acute liver failure. PLoS One 2015
- Lee et al. AASLD Position Paper: The Management of Acute Liver Failure: Update 2011, Dharel et al 2014, Karvellas et al. 2014, Shingina et al, 2023.

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). The Health Protection Team can be contacted on 0344 225 3560
- Oral rehydration is the treatment of choice for viral gastroenteritis (BMJ Best Practice, 2022)
- 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.

Antibiotics are only indicated in prolonged or severe disease (e.g. bloody stools, fever) or in immunocompromised patients.

First line (if <u>No</u> evidence of systemic disease):

Clarithromycin
Dose - 500mg oral – bd (twice daily) for 5 days (NICE - last updated 2023)

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. The in vitro susceptibility results may not always be available.

Bi) Organisms: Non-typhoid Salmonella spp.

Antibiotics are not indicated unless there is evidence of systemic disease

- Definitive therapy should be based on susceptibility testing.
- Optimal duration of therapy is not established.
    - For patients without risk factors for complications and gastroenteritis, consider 3- to 7-day course.
    - For immunocompromised patients with gastroenteritis, consider 7- to 14-day course.
    - For patients with bacteraemia, consider 7- to 14-day course, with longer duration if there is evidence of or concern for bone and joint infections, endocarditis, or other endovascular complications.

First line:

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

If evidence of systemic infection (such as bacteraemia):

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

Bii) Organisms: *Salmonella typhi* or *paratyphi*.

Practice point:

- This should be suspected in all returned travellers with a fever
- Usually diagnosed from a positive blood culture
- Diarrhoea uncommon
- Due to a rise in antimicrobial resistance, empiric antibiotic choice will depend on travel destination
- Suspected or confirmed cases should be discussed with infection specialists
- Note this is an ACDP category 3 organism so the lab request form needs to include travel history details and that enteric fever is suspected in relevant cases

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 an infection specialist 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 - 500mg oral – od (once a day) for 3 days (off-label)

References:

- Williams P.C.M, Berkley J. A, Guidelines for the treatment of dysentery (shigellosis): a systematic review of the evidence Paediatrics and International Child Health 2018:38(S1);S50-65.
- Christopher PRH et all. Cochrane review _Antibiotic therapy for Shigella dysentery_2010
- DynaMed. Nontyphoidal Salmonellosis. EBSCO Information Services. Accessed February 20, 2023. https://www.dynamed.com/condition/nontyphoidal-salmonellosis

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 and may occur in the older people.

Reference:

Wong CS, Mooney JC, Brandt JR, Staples AO, Jelacic S, Boster DR, Watkins SL, Tarr PI. Risk factors for the hemolytic uremic syndrome in children infected with Escherichia coli O157:H7: a multivariable analysis. Clin Infect Dis. 2012 Jul;55(1):33-41. doi: 10.1093/cid/cis299. Epub 2012 Mar 19. PMID: 22431799; PMCID: PMC3493180.

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

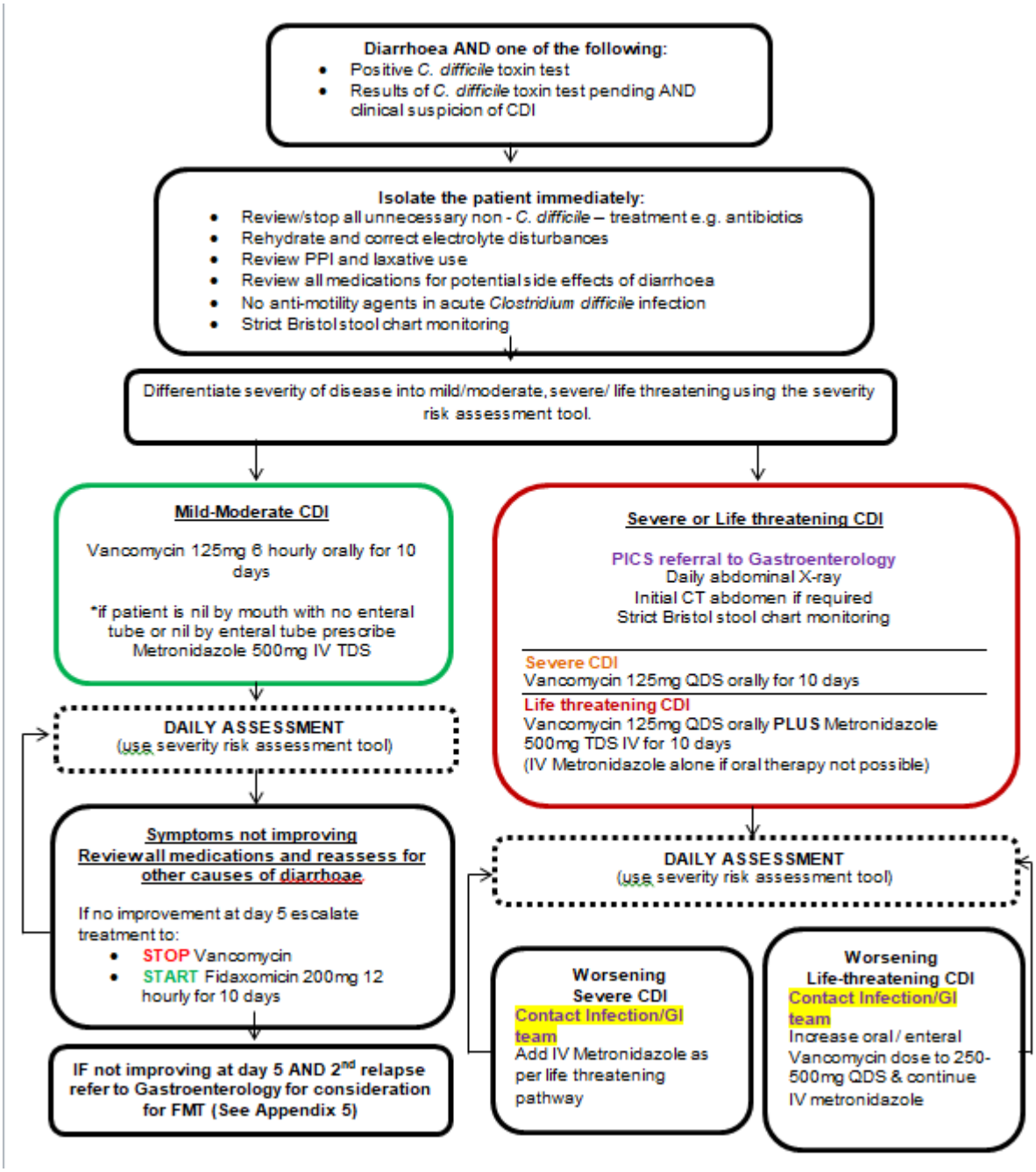
Prevention

- 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 *Clostridioides difficile* infection (CDI) and pseudomembranous colitis. PPIs should be prescribed with care in hospitalized patients to prevent the risk of patient developing CDI.

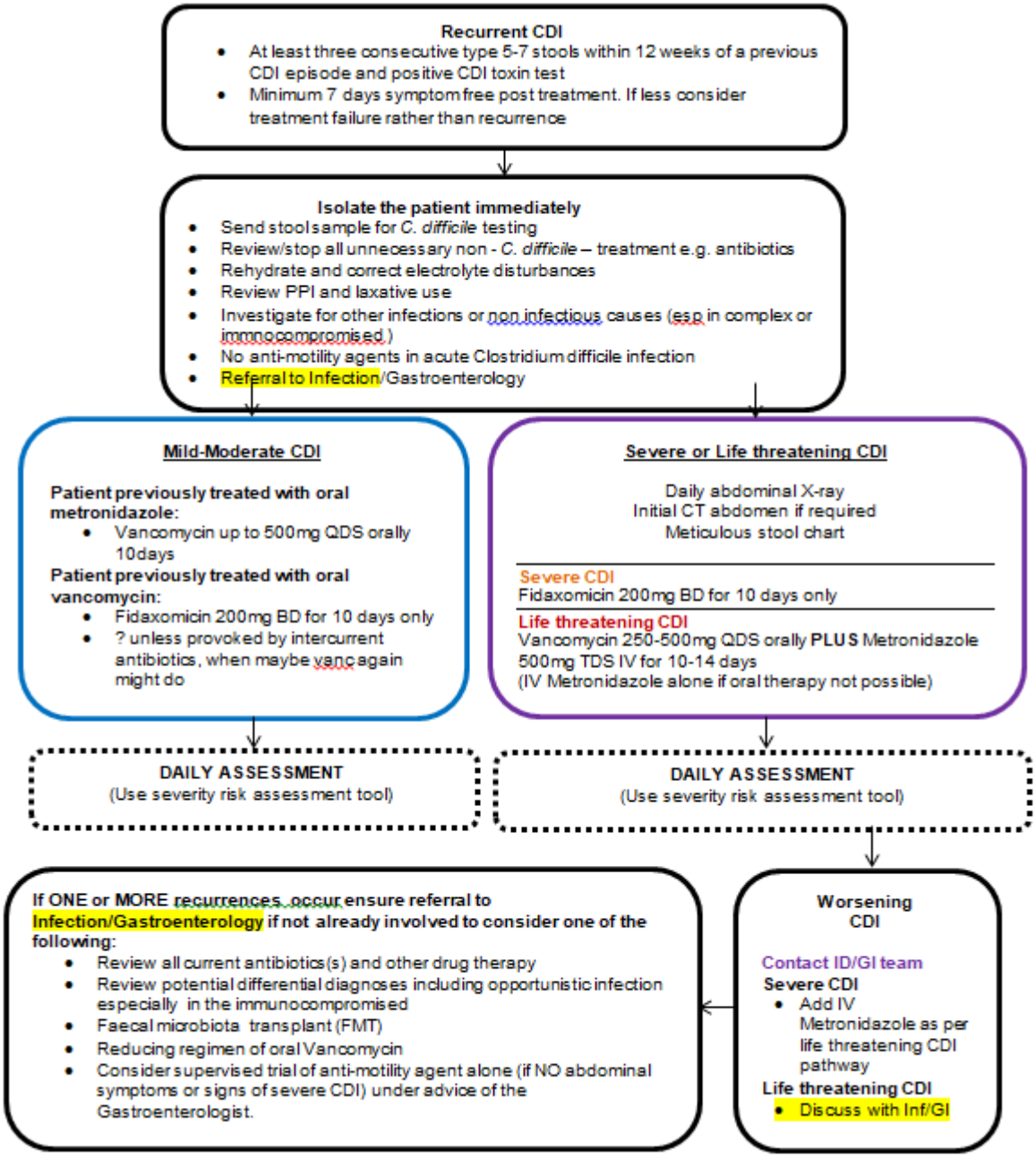
Clostridioides difficile Disease Management

Management of *C. difficile* disease should be according to the UHB guideline, 'Procedure for *Clostridium difficile* infection (CDI), February 2021'. See below for a summary:

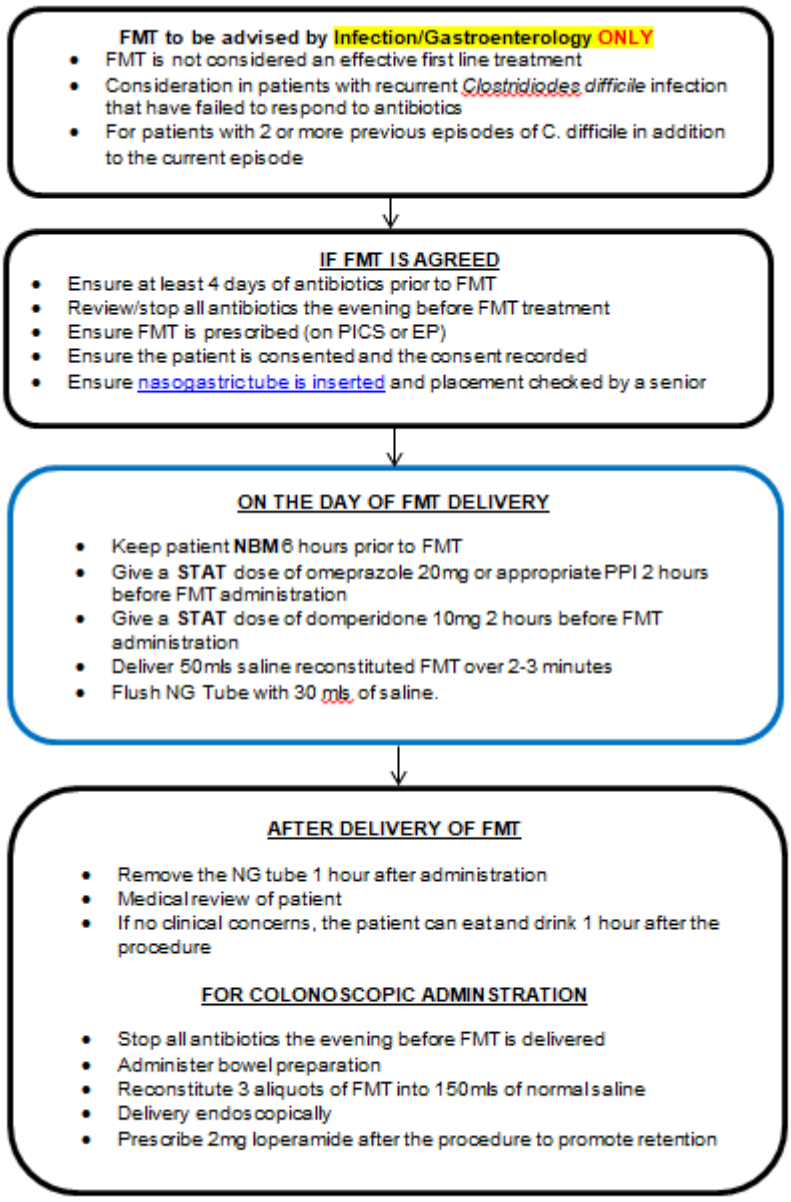
Clostridioides difficile **Treatment Flowchart**



Clostridioides difficile **Treatment Flowchart: Recurrent Infection**



Clostridioides difficile **Treatment Flowchart: Deployment of FMT**



Acute Cholangitis/ Cholecystitis

Practice points:

- Blood cultures to be collected in all febrile or septic patients
- Antibiotics should be combined with drainage of obstructed bile
- The duration of antibiotics should be counted from the date of procedure in relevant cases i.e. date of ERCP or cholecystostomy
- Organisms: Coliforms (mainly Escherichia coli), rarely Pseudomonas aeruginosa or anaerobes

First line:

Piperacillin-tazobactam
Dose: 4.5g intravenous – tds (three times a day)
NB: Review to oral when clinically stable and able to take oral medicines.

Oral switch:
Co-amoxiclav
Dose: 625mg oral – tds (three times a day) for total 7 to 10 days treatment including IV course.

Second line (penicillin allergic):

Ciprofloxacin
Dose: (oral) 500mg bd (twice a day) for 7 to 10 days, duration depending on clinical response
Dose: (intravenous, if unable to take oral) 400mg bd (twice a day), review need for IV daily.

PLUS
Metronidazole
Dose: (oral) 400mg tds (three times a day) for 7 to 10 days, duration depending on clinical response.
Dose: (intravenous, if unable to take oral) 500mg tds (three times a day), review need for IV daily.

Previous ESBL positive (E.coli or Klebsiella) 

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

Diverticulitis/ Peritonitis

Practice points:

- 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 and
- In case of a diverticular abscess, US- or CT-guided drainage may be required.
- Oral antibiotics should be used whenever possible
- Organisms: Mixed infection, coliforms (such as E.coli, Klebsiella sp.) and anaerobes

First line (for community-acquired infections in patients who are not severely ill):

Co-amoxiclav
Dose: 1.2g intravenous – three times daily (tds) for 72 hours then review to oral if appropriate

Oral switch:
Co-amoxiclav
Dose: 625mg – three times daily (tds) to complete 5 day course, depending on clinical response

Penicillin allergy / (for community-acquired infections in patients who are not severely ill):

Ciprofloxacin IV 400mg BD
Plus
Metronidazole 500mg TDS IV
Oral switch
Ciprofloxacin 500mg BD oral
Plus
Metronidazole 400mg TDS oral

If MRSA positive: Discuss with Infection specialist

First line (for hospital-acquired infections or in patients who are severely ill / post operative infection):

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. See above for dosing)

Oral switch:
Ciprofloxacin
Dose (oral): 500mg bd (twice a day) for 5 days, total course duration depending on clinical response

PLUS
Metronidazole
Dose: (oral) 400mg tds (three times a day) for 5 days, total course 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:

- If ESBL positive Gram negative organisms have been previously isolated in a patient, the antibiotic prophylaxis should include adequate cover, such as meropenem or tigecycline.
- In case of a diverticular abscess, US- or CT-guided drainage may be required.

References:

Mazuski JE, Tessier JM, May AK, Sawyer RG et al The Surgical Infection Society Revised Guidelines on the Management of Intra-Abdominal Infection. Surg Infect (Larchmt). 2017 Jan;18(1):1-76. doi: 10.1089/sur.2016.261. PMID: 28085573.

Severe Pancreatitis with Infected Necrosis

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.
- A decision to proceed to ERCP doesn't necessarily mandate prophylactic antimicrobial therapy
- Procalcitonin may be a useful blood marker to delineate inflammation from infection in pancreatitis
- 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):

Piperacillin-tazobactam
Dose: 4.5g 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.
- **The systemic antibiotic treatment must be accompanied by pancreatic drainage, either surgical or percutaneous.**
- **Review the empirical antibiotic choice.** Review after 48-72hours with the culture results
- There is no evidence that early administration of antibiotics, or 'prophylaxis' improves survival (Goodchild G et al. Practical guide to the management of acute pancreatitis Frontline Gastroenterology 2019;10:292–299 and Mazuski JE et al. The Surgical Infection Society Revised Guidelines on the Management of Intra-Abdominal Infection. Surgical Infections Volume 18, Number 1, 2017).
- The' Acute Pancreatitis: Treat the cause' 2016 NCEPOD report highlighted that antibiotics are still prescribed unnecessarily in 20% of cases.

- PROCAP study randomised patients to usual care vs antibiotics based on blood procalcitonin levels. Antibiotic use was 16% lower among the procalcitonin guided group with no significant difference in the frequency of clinical infections or hospital acquired infections. (Siriwardena et al. A procalcitonin-based algorithm to guide antibiotic use in patients with acute pancreatitis (PROCAP): a single centre, patient-blinded, randomised controlled trial. Lancet Gastro Hepatol 2022)

Spontaneous Bacterial Peritonitis (SBP) in Cirrhosis

Practice points:

- **Ascitic neutrophil count of >250cells/mm^3 is compatible with a diagnosis of SBP**
- **Ascitic fluid samples should be inoculated into blood culture bottles, sterile white top universal collection tubes and EDTA tubes, as per the Trust SOP for paracentesis.**
- Organisms: Coliforms and enterococci, rarely may be pneumococci

First line:

Ceftriaxone
Dose: 2g intravenous – od (once daily) for 5 days

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 infection specialist. 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.
- Ackerman et al. Antimicrob agents chemother 2020; 64(6): e00066-20
- -ITU patients with any non CNS infection –treatment failure (mortality or antibiotic escalation) higher in 1g group vs 2g group. Mazer et al. F1000Research 2014, 3:57 found fewer ITU days and improved survival in group who received 2g
- A recent RCT that looked at response-guided therapy found no significant difference in resolution of SBP at 120 hours of treatment or 30-day mortality between ceftriaxone and ciprofloxacin groups. (Yim HJ et al. Response-guided therapy with cefotaxime, ceftriaxone or ciprofloxacin for SBP. Am J Gastro 2022; 10-14309).
- Secondary prophylaxis is recommended for patients after their first episode as it has been shown to reduce recurrence). Due to the limited availability of norfloxacin in the UK, ciprofloxacin (500mg od or co-trimoxazole 960mg od are accepted alternatives. These patients will need follow-up with the gastroenterology or Hepatology Team.

Reference:

- Aithal G. et al. Guidelines on the management of ascites in cirrhosis. Gut 2020: 0; 1-21

Helicobacter 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).
- *H. pylori* infection is a common cause of peptic ulcer disease and is associated with malignancy.
- Inpatient diagnosis is often confirmed in endoscopy with use of a CLO (Campylobacter Like Organism) test which detects presence of urease.

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%.

No Penicillin allergy	**Penicillin allergic**
First line: Amoxicillin 1g oral bd **PLUS** either clarithromycin 500mg oral bd OR metronidazole 400mg oral bd Duration: 7 days **PLUS** Lansoprazole 30mg bd for 7 days then reduce to od thereafter	**First line:** Clarithromycin 500mg oral bd **PLUS** Metronidazole 400mg oral bd Duration: 7 days **PLUS** Lansoprazole 30mg bd for 7 days then reduce to od thereafter
ONGOING SYMPTOMS after first-line ↓	If penicillin allergy AND previous exposure to clarithromycin, OR if ONGOING SYMPTOMS after first-line ↓
Second line: Amoxicillin 1g oral bd **PLUS** second antibiotic not used in first line, either clarithromycin 500mg oral bd OR metronidazole 400mg oral bd Duration: 7 days **PLUS** Lansoprazole 30mg bd for 7 days then reduce to od thereafter	**Second line:** Metronidazole 400mg oral bd **PLUS** Levofloxacin 250mg bd Duration: 10 days **PLUS** Lansoprazole 30mg bd for 7 days then reduce to od thereafter
ONGOING SYMPTOMS after first-line AND previous exposure to metronidazole and clarithromycin ↓	ONGOING SYMPTOMS after first-line AND previous exposure to levofloxacin ↓
Second line: Amoxicillin 1g oral bd **PLUS** either Tetracycline hydrochloride 500mg oral qds OR Levofloxacin 250mg bd Duration: 10 days **PLUS** Lansoprazole 30mg bd for 10 days then reduce to od thereafter	**Second-line:** Seek advice from Gastroenterology

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.
    - NICE CG184. Dyspepsia and gastro oesophageal reflux disease: Investigation and management of dyspepsia, symptoms suggestive of gastro oesophageal reflux disease, or both. http://www.nice.org.uk/guidance/cg184/chapter/1-recommendations#/helicobacter-pylori-testing-and-eradication. National Institute for

Health and Clinical Excellence. September 2014 updated October 2019 (last accessed 30/11/2023)

- 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 2017.

Splenectomy Prophylaxis

Practice Points:

- Asplenia will include patients with an absent spleen as well as dysfunctional spleen.
- Conditions such as sickle cell disease and coeliac disease can lead to hyposplenism.
- These patients are at increased risk of severe infection, particularly with the encapsulated bacteria listed below.

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, vaccine 5 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. Meningococcal group A, C, W135, Y conjugate vaccine – one dose (e.g., Menveo®, Nimenrix®, ACWY Vax®)
   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

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.

Reference

- See ‘The Green Book’ (Immunisation against infectious disease; Chapter 7, ‘Immunisation of individuals with underlying medical conditions’, 2020. Available at : https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/857279/Greenbook_chapter_7_Immunsing_immunosupressed.pdf . Accessed: 18.10.2023.

Native Valve Infective Endocarditis

Practice points:

- Take blood cultures **prior to starting antibiotics**. In stable patients, three sets taken t30 minutes apart, ideally from separate sites, is recommended. Each bottle should contain 10 ml of blood.
- 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 at least 72 hours 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 consideration of echocardiography.
- Common organisms: *Staphylococcus aureus*, viridans group streptococci, coagulase-negative staphylococci, enterococci

Native Valve Endocarditis (NVE):

Indolent presentation (more than 2 weeks symptoms)

Patient not severely septic –:

Following three sets of blood cultures as outlined above:

First Line:

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

PLUS
Ceftriaxone
Dose: 2g intravenous injection – every 12 hours (twice daily)

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 infection specialist.

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

PLUS
Gentamicin
Dose: See Gentamicin Extended Interval (Once Daily) Dosing in Infective Endocarditis for prescribing and monitoring

Native Valve Endocarditis (NVE):

Acute presentation (within 2 weeks of symptom onset) and septic patient

First line:

Ceftriaxone
Dose: 2g intravenous injection – every 12 hours (twice daily)

PLUS
Vancomycin

Dose: see intravenous vancomycin – intermittent infusion guideline for dosing and monitoring.

Aim pre-dose levels between **15-20mg / L**

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

Reference:

Delgado V et al. and ESC Scientific Document Group , 2023 ESC Guidelines for the management of endocarditis: Developed by the task force on the management of endocarditis of the European Society of Cardiology (ESC) *Endorsed by the European Association for Cardio-Thoracic Surgery (EACTS) and the European Association of Nuclear Medicine (EANM)*, *European Heart Journal*, 2023;, ehad193, https://doi.org/10.1093/eurheartj/ehad193

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 **15-20 mg /L**

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

PLUS
Gentamicin
Dose: See Gentamicin Extended Interval (Once Daily) Dosing in Infective Endocarditis for prescribing and monitoring

Reference:

Delgado V et al., ESC Scientific Document Group , 2023 ESC Guidelines for the management of endocarditis: Developed by the task force on the management of endocarditis of the European Society of Cardiology (ESC) *Endorsed by the European Association for Cardio-Thoracic Surgery (EACTS) and the European Association of Nuclear Medicine (EANM)*, *European Heart Journal*, 2023;, ehad193, https://doi.org/10.1093/eurheartj/ehad193

Aortic Graft Infection/ Vascular Surgery Graft Infection

- A minimum of three sets of blood cultures should be collected at least 30 minutes apart from separate sites prior to starting antibiotics.
- For vascular graft infections also take relevant samples prior to starting antibiotics (e.g. pus or wound swab).
- Organisms: *Staphylococcus aureus*, coagulase negative staphylococci, Gram negative organisms

- The management of infected vascular grafts varies with the surgical site; *discuss all patients with an Infection specialist.*

In an acutely unwell septic patient start treatment with:

Piperacillin/tazobactam
Dose: 4.5g intravenous infusion – every 6 hours (four times daily)

PLUS

Vancomycin
Dose: See trust vancomycin guideline for dosing. Aim pre-dose level between **15-20mg/L**

If infection control alert organisms highlighted in patient record (), discuss with infection specialist as optimal empirical treatment regimen may differ to the above

Reference:
Chafke N, Diener H, Lejay A, Assadian O, Berard X, Caillon J. European Society for Vascular Surgery (ESVS) 2020 clinical practice guidelines on the management of vascular graft and endograft infections. Eur J Vasc Endovasc Surg. 2020;59(339):e84

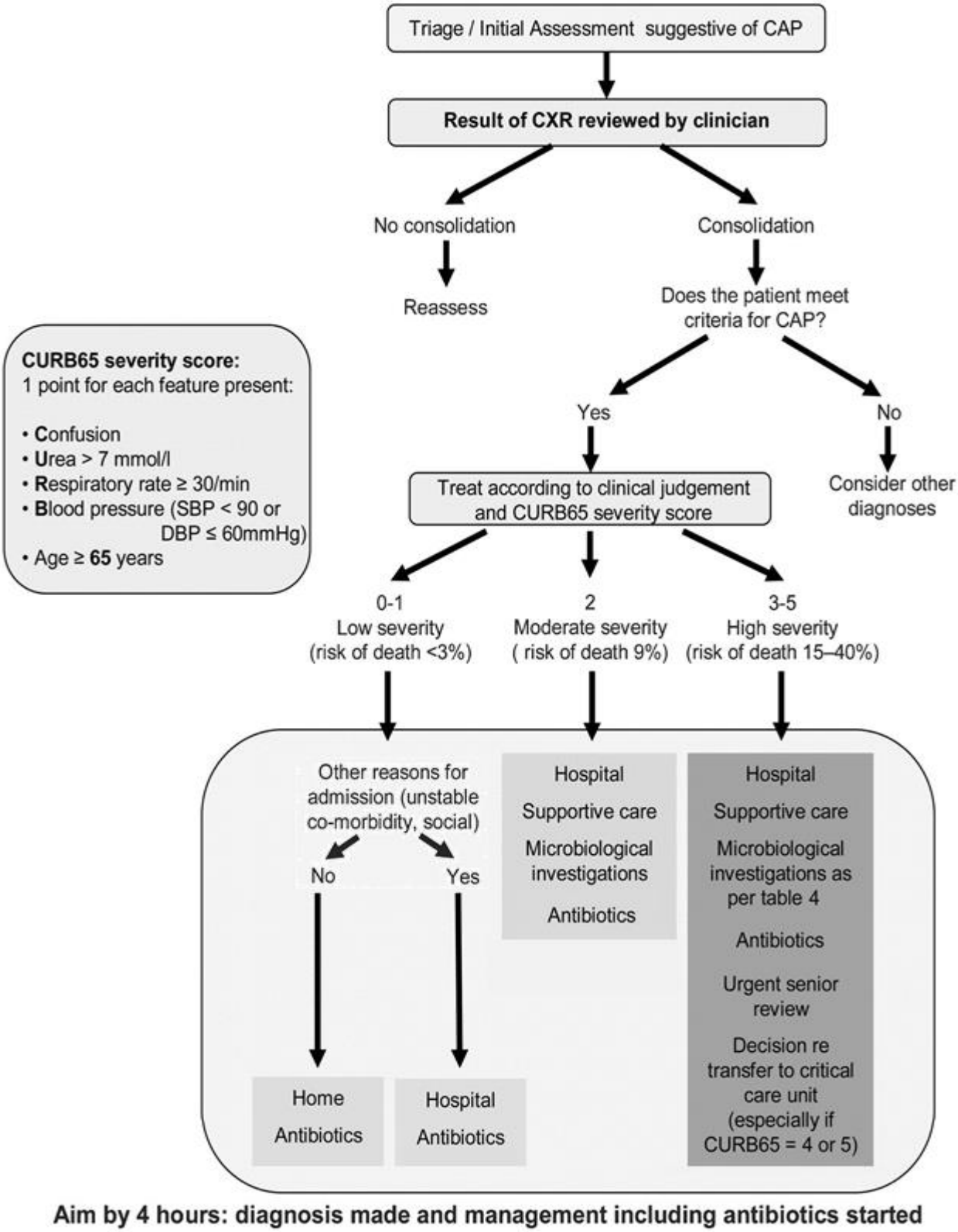
Respiratory System

Community Acquired Pneumonia (CAP)

Practice points:

- Use the flowchart (fig 1: below) for severity assessment and management of patients with CAP
- Risk assess patient for isolation / respiratory precautions
    - Travel history – (MERSCoV, Covid-19, , SARS)
    - Could this be tuberculosis?
    - If above are possible take appropriate samples, use respiratory infection control precautions and isolate patient
- Is the patient immunocompromised e.g. HIV infection – if so consult infection specialist
- **Microbiology investigations for moderate and severe CAP**
    - Blood culture
    - Sputum culture
    - Urine for Legionella antigen testing
    - Viral swabs to diagnose viral respiratory tract infection
    - Use point of care test rapid diagnosis of influenza
    - Sputum for TB investigation for those with risk factors for TB
- Review the choice of antibiotics when microbiology results available and consider changing the antibiotic(s) according to results, using a narrower spectrum antibiotic if appropriate
- Organisms: Streptococcus pneumoniae, 'atypical organisms' (Chlamydophila pneumoniae, Mycoplasma sp., Legionella sp.)
- Definition of CAP is radiological evidence of consolidation. Ensure chest x-ray is performed promptly
- For clarithromycin and levofloxacin, 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 Infection specialist if features suggestive of PVL-positive S. aureus pneumonia (such as extensive necrotizing pneumonia, influenza-like prodrome, haemoptysis) or Klebsiella pneumoniae (such as extensive necrotizing pneumonia, haemoptysis)**

Fig 1: Community acquired pneumonia (CAP) flowsheet



CURB65 score 0 or 1

First choice:

Amoxicillin
Dose: 500mg to 1000mg 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)
NB: Total course including 'stat dose', for 5 days

CURB65 score 2

First line

Amoxicillin
Dose: 1000mg oral – tds (three times a day) for 5 days

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

NB: If no oral / enteral access give above choices intravenously and review to oral once appropriate

Second line (penicillin allergy):

Levofloxacin
Dose: 500mg oral – od (once a day) for 5 days

NB: If patient unable to take medication orally treat with Levofloxacin 500mg – intravenous infusion over 60 minutes – od (once a day).
Switch to oral as soon as patient able to swallow and absorb medication.

CURB65 score 3, 4 or 5

First line:

Co-amoxiclav
Dose: 1.2g intravenous – tds (three times a day) for 5 days

PLUS
Clarithromycin
Dose: 500mg intravenous – bd (twice a day) for 5 days

NB: Switch to oral as soon as patient able to swallow and absorb medication. Duration of antibiotics will need to be extended if proven atypical infection; in this case, discuss with Infection specialist.

Second line: (penicillin allergy):

Levofloxacin
Dose: 500mg intravenous – bd (twice a day) for 5 days

NB: Switch to oral as soon as patient able to swallow and absorb medication:
Duration of antibiotics will need to be extended if proven atypical infection. Discuss with Infection specialist.

Comment:

- The use of broader spectrum penicillins (eg piperacillin-tazobactam), or meropenem, provides no advantages over amoxicillin PLUS clarithromycin in the treatment the majority of community-acquired pneumonias, since they are no more active against pneumococci

References

- 2015 Annotated BTS Guideline for the management of CAP in adults (2009) https://www.brit-thoracic.org.uk/quality-improvement/guidelines/pneumonia-adults/
- Pneumonia (community-acquired): antimicrobial prescribing. NICE guideline NG138. 16 September 2019 https://www.nice.org.uk/guidance/ng138/resources/pneumonia-communityacquired-antimicrobial-prescribing-pdf-66141726069445

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 greater than 38°C or less than 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 an infection specialist if required.
- If the patient fails to respond to treatment or is immunocompromised discuss with infection team.

- **Presence of any of the following indicates a severe illness:**
    - Respiratory failure (PaO2 less than 8 kPa and/or PaCO2 greater than 6 kPa)
    - Respiratory rate greater than 25 breaths/min
    - Rapid radiographic progression, multilobar pneumonia, or cavitation of lung infiltrate
    - Diastolic BP less than 60 mmHg
    - WBC low (less than$4x10^9/L$) or very high (greater than $20x10^9/L$)
    - 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).
- The antibiotic treatment should be for a minimum of 5 days. Stopping the antibiotic should be considered on an individual basis if the patient is judged to be clinically stable.

Mild / moderate HAP

First line:

Co-trimoxazole
Dose: 960mg oral – bd (twice daily)

If patient unable to swallow medication treat with intravenous co-trimoxazole: 960mg bd (twice daily). Review at 48hrs and switch to oral if can swallow medication.

Second line (co-trimoxazoletrimethoprim or sulphonamides allergy):

Doxycycline
Dose: 200mg oral – stat. Followed by: 100mg - oral – od (once a day)

If patient unable to swallow medication treat with:
Levofloxacin
Dose: 500mg intravenous infusion over 60 minutes – od (once daily)

NB: Review at 48hrs and switch to oral agent above if can swallow medication

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)

Second line (penicillin allergy):

Levofloxacin
Dose: 500mg intravenous infusion – bd (twice daily)

NB: Switch to oral as soon as patient able to swallow and absorb medication

Reference:

NICE Pneumonia (hospital-acquired) antimicrobial prescribing. NG139. Published 16 September 2019. Available at: https://www.nice.org.uk/guidance/ng139 Accessed: 6.4.22

Aspiration Pneumonia

Practice points:

- 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**. If antibiotics have been started and clinical resolution occurs rapidly and radiological changes resolve, consider stopping the antibiotics.
- Organisms: Gram-positive aerobic and anaerobic bacteria from the mouth.
- If patient has radiological changes who do not improve after 48hrs after the event treat in line with CAP/HAP guidelines depending on when event occurred:
    - Community-acquired pneumonia (CAP)
    - Hospital-acquired pneumonia (HAP)

Infective Exacerbation of COPD

(Chronic obstructive pulmonary disease)

Practice points:

- See full Trust guidelines for acute exacerbation of chronic obstructive pulmonary disease http://uhbpolicies/documents/pp-copd.htm
- 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:
    - Worsening breathlessness
    - Cough
    - Increased sputum production
    - Change in sputum colour
- In all patients referred to the hospital investigations include – CXR, sputum culture (if sputum is discoloured), 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 community 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 days

Second line:

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

Third line (if doxycycline and co-amoxiclav have been used in the community):

Levofloxacin
Dose (oral): 500mg – od (once a day) for 5 days
Dose (intravenous, if unable to take oral medication): 500mg – intravenous – od (once a day) for 5 days

Reference:

NICE Chronic obstructive pulmonary disease (acute exacerbation): antimicrobial prescribing. Published 5 December 2018.
Vollenweider DJ, Jarrett H, Steurer-Stey CA, Garcia-Aymerich J, Puhan MA. Antibiotics for exacerbations of chronic obstructive pulmonary disease. Cochrane Database Syst Rev. 2012 Dec 12;12:CD010257. doi: 10.1002/14651858.CD010257. Update in: Cochrane Database Syst Rev. 2018 Oct 29;10:CD010257. PMID: 23235687.

Non-CF Bronchiectasis Exacerbation

Practice points:

- Patients need adequate hydration, mucolytics, bronchodilators and chest physiotherapy in addition to antibiotics.
- Previous Microbiology results should be reviewed before prescribing empirical antibiotics. If in doubt, discuss with Respiratory physician/Infection specialist
- Antibiotic courses should be for 14 days
- Send sputum for culture (label that patient has bronchiectasis)
- Assess and treat comorbidities e.g. chronic obstructive pulmonary disease (COPD)

First line (including penicillin allergy):

Doxycycline
Dose: 200mg oral - stat
followed by 100mg oral – od (once a day) for 14 days

Second line:

Co-amoxiclav
Dose (oral): 625mg oral – tds (three times a day) for 14 days
Dose (intravenous, if unable to take oral medication): 1.2g – intravenous – tds (three times a day) for 14 days

If Pseudomonas aeruginosa has been isolated from sputum cultures

Ciprofloxacin
Dose (oral): 500mg - 750mg oral – bd for 14 days.

Ceftazidime
Dose (intravenous, if unable to take oral medication): 2g – intravenous – tds (three times a day) for 14 days

See following hyperlink for full Trust guideline: http://uhbpolicies/documents/bronchiectasis.htm

Empyema

Practice points

- Presence of frankly purulent or turbid/cloudy fluid on pleural aspiration or low pleural pH greater7.2 indicates the need for prompt chest tube drainage.
- Discuss all patients suspected of empyema with a Respiratory consultant. Send pleural fluid sample to Microbiology Laboratory for Microscopy Cultures and Sensitivities (MCS) and TB
- Previous Microbiology results should be reviewed before prescribing empirical antibiotics. If in doubt, discuss with infection specialist
- 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.
- 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 is often implicated in hospital acquired infections.

First line:

Co-amoxiclav
Dose: 1.2g intravenous injection – tds (three times a day) for 3 weeks depending on clinical response

NB: If patient at risk for Pseudomonas infection, discuss with an Infection specialist.

Second line (penicillin allergy):

Clindamycin
Dose: 450mg – qds (four times a day)
Dose (If BMI greater than 30 kg/ m^2): 600mg oral – qds (four times a day)
NB: Only prescribe IV if patient unable to swallow / malabsorption

Duration: For total 3 weeks depending on clinical response

Consider adding if at risk of Gram negative infection (e.g. Pseudomonas)
Ciprofloxacin
Dose: 500mg oral – bd (twice a day) for 3 weeks depending on clinical response

Reference

- BTS Guidelines for the Management of pleural infection (Thorax 2003: 58; ii18-ii28, updated in Thorax 2010;65(Suppl 2):ii41-ii53)

Audiometry Prior to Commencing Nebulised Aminoglycosides

All patients prescribed nebulised aminoglycosides should receive pre-treatment audiometry if they have pre-existing vestibular symptoms.

Influenza A or B

Practice points:

- **To be used in cases of suspected or confirmed influenza.**
- **All confirmed and suspected cases must be isolated in a single room. Respiratory infection control procedures must be employed.**
- 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.
- See UK HSA Guidelines on the use of antiviral agents for the treatment and prophylaxis of seasonal influenza https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1037465/ukhsa-guidance-antivirals-influenza-11v4.pdf
- **Note:** Discuss cases of resistance with consultant virologist.

Definitions:

- **Uncomplicated influenza:** influenza presenting with fever, coryza, headache, malaise, myalgia, arthralgia and sometimes GI symptoms.
- **Complicated influenza:** requiring hospital admission and/or with symptoms and signs of lower respiratory tract infection, CNS involvement or predisposing underlying medical condition (see Table 1)

Table 1: Medical Conditions and Risk Factors Associated with 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 greater than or equal to 40 kg/ m^2)
- Severe Immunosuppression:
    - Severe primary immunodeficiency
    - Current or recent (within six months) chemotherapy or radiotherapy for malignancy
    - Solid organ transplant recipients on immunosuppressive therapy
    - Bone marrow transplant recipients currently receiving immunosuppressive treatment, or who received it within the last 12 months (longer with graft versus host disease).
    - Patients currently receiving high dose systematic corticosteroids (equivalent to greater than or equal to 40 mg prednisolone per day for greater than or equal to 1 week in an adult), and for at least three months after treatment has stopped)
    - Patients currently or recently (within six months) on other types of immunosuppressive therapy
    - HIV infected patients with severe immunosuppression (CD4greater than 200/µl or less than15% of total lymphocytes in an adult or child over five.
    - 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.

Figure: Algorithm for prescribing of antiviral therapy for treatment of influenza

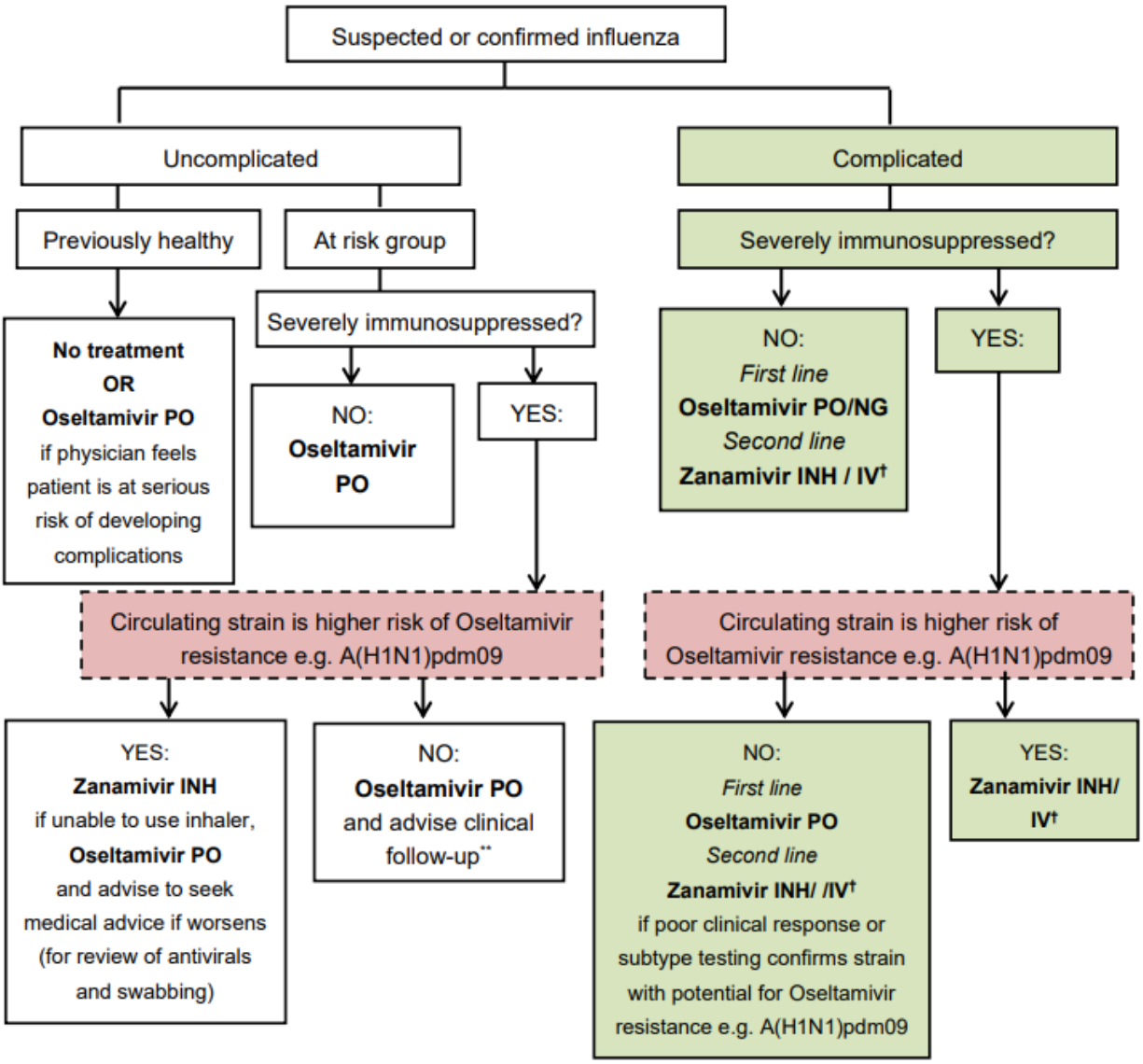


Table 2: Selection of antivirals for severely immunosuppressed patients

	Dominant circulating strain has a **lower risk** of oseltamivir resistance, for example A(H3N2), influenza B*	Dominant circulating strain has a **higher risk** of oseltamivir resistance, for example A(H1N1)pdm09*
Uncomplicated influenza	Oseltamivir PO and clinical follow up. Commence therapy within 48 hours of onset (or later at clinical discretion).	Zanamivir inhaler (INH) (Diskhaler®) Commence therapy within 48 hours of onset (36 for children) or later at clinical discretion OR if unable to take inhaled preparation use oseltamivir PO and clinical follow up. Commence therapy within 48 hours of onset (or later at clinical discretion).
Complicated influenza	First line: oseltamivir PO/NG Second line: zanamivir INH++ Consider switching to zanamivir if: • poor clinical response • evidence of gastrointestinal dysfunction • subtype testing confirms a strain with potential oseltamivir resistance, for example A(H1N1)pdm09	Zanamivir inhaler or IV if clinically appropriate Commence therapy within 48 hours of onset (36 for children) or later at clinical discretion.

***** Virology team can provide further understanding regarding the dominant circulating local strain

Treatment regimens:

First line:

Oseltamivir
Dose: 75 mg oral – bd (twice a day) for 5 days
Dose must be adjusted in renal impairment sepsis (should we include the Table for dosing in relation to renal function-it is Table 4 in the UKHSA guidelines document)

Note:

- Treatment of complicated influenza in severely immunosuppressed is sometimes extended to 10 days Contact Consultant Medical Virologist to discuss individual patient cases
- Treatment of pregnant women or of patients on Critical Care for whom NG/PO oseltamivir cannot be used: contact Consultant Medical Virologist

Second line (Immunocompromised patients and on advice of Medical Virologist):

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

Note:

- If inhaled Zanamivir is not suitable for patients on critical care, please refer to the UK HSA Guidelines on the use of antiviral agents for the treatment and prophylaxis of seasonal influenza https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1037465/ukhsa-guidance-antivirals-influenza-11v4.pdf [last accessed 06/12/2021]

Reserve Line: Zanamivir (Intravenous administration)

Zanamivir (treatment – see criteria and management algorithm)
Dose: 600mg bd for 5-10 days by IV infusion

Note:

- Only to be prescribed on advice of the Medical Virologist (Contact through switchboard)
- Zanamivir IV solution **MUST NOT** be administered as a nebule.
- Only available via ward pharmacy team or on-call pharmacist (via switchboard). Contact Pharmacy as soon as agreed with consultant virologist to arrange delivery of medication. This responsibility is with the physician who contacts virology.

Prescribing Zanamivir Intravenously

Suspected or confirmed diagnosis of influenza (FLU)

↓

Complicated influenza with consideration for Zanamivir.

To be discussed and approved by **medical virologist** (available through switchboard)

↓

Prescribe dose based on renal function (See Renal Drug Database via PICS)

↓

Member of clinical team (e.g. doctor or nurse) to contact ward pharmacy team. If out of hours contact on-call pharmacists via switchboard

Pharmacy to check dose prescribed correct for patient renal function and to arrange urgent delivry of treatment to ward

↓

Vials contain 200mg/20ml. Take require volume based on dose prescribed and give either undiluted or mix in sodium chloride 250ml and give over 30mins

Influenza Post-Exposure Prevention

Hospital patients or staff contacts of influenza:

Oseltamivir
Dose: 75 mg oral – od (once daily) for 10 days
Dose must be adjusted in renal impairment sepsis

PEP should start within 48 hours of exposure to an infected individual or after 48 hours on specialist advice only.
Viral swabs should be collected for any contacts who develop respiratory symptoms.

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 anyone who is at risk of severe illness and/or complications from influenza if not treated.

References:

Guidance on the use of antiviral agents for the treatment and prophylaxis of seasonal influenza. Available at : Guidance on use of antiviral agents for the treatment and prophylaxis of seasonal influenza https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1037465/ukhsa-guidance-antivirals-influenza-11v4.pdf Accessed: 09.12.21

Central Nervous System

Meningitis (Community Acquired)

Practice points:

- **Meningitis and encephalitis (whether suspected or proven) are notifiable infections**: UKHSA 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.
    - Please phone laboratory to inform them that a sample has been sent
- Therapy should be modified according to microscopy and culture results.
- **Initial adjunctive therapy with steroids should be given in all suspected bacterial 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 an infection specialist.
- 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) to 21 days (Listeria infection). Discuss with an Infection specialist.
- Commonest organisms: Neisseria meningitidis, Streptococcus pneumoniae, Listeria monocytogenes

First line (empiric treatment):

Ceftriaxone
Dose: 2g intravenous injection – bd (twice a day)

PLUS
Dexamethasone
Dose: 8.25mg - 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 over60 years of age, pregnant or immunocompromised (including alcohol dependency and diabetes)

Amoxicillin
Dose: 2g - intravenous infusion - every 4 hours

Second line (non-severe penicillin allergy):

Ceftriaxone
Dose: 2g intravenous injection – bd (twice a day)

PLUS
Dexamethasone
Dose: 8.25mg - 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 over60 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 an Infection specialist)

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

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

PLUS
Dexamethasone
Dose: 8.25mg - 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 over60 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 an Infection specialist)

Note: 8.25mg 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.

Viral Encephalitis

Practice points:

- **Meningitis and encephalitis (whether suspected or proven) are notifiable infections:** UKHSA 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)
NB: Dose must be reduced in renal impairment (See antiviral dosing guideline for dose adjustment).

Renal function must be monitored and good hydration must be maintained.

Duration: 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:

- Solomon et al. Management of suspected viral encephalitis in adults – Association of British Neurologists and British Infection Association National Guidelines. J Infect 2012:64;347-373

Post-Neurosurgical Meningitis/ EVD - Associated Meningitis and Ventriculitis / CSF Shunt Associated Infections

Practice points:
Empirical antibiotics must be reviewed when microbiology results are known.

Post-Neurosurgical 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

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.

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.

Post Neurosurgical Empyema and Brain Abscess

- These can follow craniotomy, craniectomy, ventriculostomy, ventriculo-peritoneal shunt placement or intracranial monitor placement
- The antibiotic treatment should be undertaken in conjunction with surgical treatment and sampling
- Commonest organisms include: S. aureus, coagulase-negative staphylococci, Enterobacterales

First line (empirical therapy):

Meropenem
Dose: 2g intravenous infusion – 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 (Carbapenem allergy or severe penicillin allergy such as anaphylaxis):

Ciprofloxacin
Dose: 600mg intravenous infusion – 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.

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**
- Dose is calculated based on ventricle size and frequency based on CSF drainage:

	DOSE (Ventricle size)				**ANTIBIOTIC FREQUENCY** (CSF drainage since previous dose (ml))				
Antibiotic	**Ventricles less than normal size**	**Ventricles normal size**	**Ventricles moderately larger than normal**	**Ventricles markedly larger than normal**	**Less than 50ml over 3 days**	**50-99ml over 2 days**	**100-149ml in 24 hours**	**150-199 ml in 24 hours**	**200-250ml in 24 hours**
Vancomycin	5mg	10mg	15mg	20mg	Every third day	Alternate days	Daily	Daily and increase the dosage by 5mg	Daily and increase the dosage by 10mg
Gentamicin	2mg	3mg	4mg	5mg	Every third day	Alternate days	Daily	Daily + increase the dosage by 1mg	Daily + increase the dosage by 2mg
Colistin	50,000 units	100,000 units	150,000 units	200,000 units	Every third day	Alternate days	Daily	Daily and increase the dosage by 25,000 units	Daily and increase the dosage by 50,000 units

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.

- 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.

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 an infection specialist but initial empiric therapy should be:**

First line:

Ceftriaxone
Dose: 2g - intravenous injection – bd (twice a day)

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)

Second line (severe penicillin allergy or 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: 600mg intravenous – bd (twice daily)

PLUS
Metronidazole
Dose: 500mg intravenous – tds (three times daily)

Spinal Epidural Abscess (SEA)

See Guideline

Neurosurgical 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

First choice:

Flucloxacillin
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.

Second line (penicillin allergy):

Clindamycin
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.
Duration: 7 to14 days (review clinical response)

Second line (MRSA positive) :

Oral options:

Doxycycline (only use if MRSA is tetracycline sensitive)
Dose: 200mg STAT dose followed by 100mg - oral - once a day thereafter (review clinical response).

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).

For more severe infections:

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) 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.

Empirical treatment:

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 - twice a day

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

Empirical treatment:

Meropenem
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)

Genito-urinary System

Lower Urinary Tract Infections (UTI)

(Excluding patients with a catheter in situ)

Practice points:

- Common organisms: *Escherichia coli*, *Enterococcus* spp., *Proteus* spp, *Klebsiella* spp, Staphylococcus saprophyticus
- **ALWAYS** send urine sample (MSU) for MC&S
- Check previous cultures and sensitivities including multiresistant organisms 
- **Urinary dipstick tests will be positive in the majority of older patients (over 65 years) and those with a catheter. DO NOT UNDERTAKE A URINE DIP IN PATIENTS OVER 65 YEARS OF AGE. This is NOT an indication for starting antimicrobial therapy. Below treatment not appropriate for patients with a catheter. See upper UTI guideline**
- Nitrofurantoin is only to be used in the **ABSENCE** of systemic illness (i.e. Fever) and is not recommended for men with suspected prostate involvement because it is unlikely to reach therapeutic levels in the prostate.
- Consider a pregnancy test is females of childbearing ages prior to starting therapy

First line (eGFR greater than or equal to 45ml/min):

Nitrofurantoin modified release (MR) capsules
Dose: 100mg oral – bd (twice daily),

Duration: 3 days non-pregnant woman **OR** 7 days in male patients

Second line (eGFR less than 45ml/min):

Trimethoprim (if low risk of resistance)
Dose: 200mg oral – bd (twice a day)

Duration: 3 days non-pregnant woman **OR** 7 days in male patients

Pregnancy
Please refer to UHB ObstetricAndGynaecologyAntimicrobialGuide.pdf.

Reference:

NICE Guideline [NG109] Urinary tract infection (lower): antimicrobial prescribing October 2018

Pyelonephritis (Upper UTI) / Complicated UTI including UTI in a catheterised patient (CA-UTI)

Practice points:

- Organisms: *Escherichia coli*, *Klebsiella* spp., *Proteus* spp., *Enterococcus* sp., *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 older patients (over 65 years) and those with a catheter. DO NOT UNDERTAKE A URINE DIP IN PATIENTS OVER 65 YEARS OF AGE. This is NOT an indication for starting antimicrobial 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, including:
    - New costovertebral (renal angle) tenderness
    - Rigors
    - New onset delirium
    - Fever
- 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 and 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 7-10 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)

Non-pregnant: First line (C.G.GFR greater than or equal to 20ml/min)

Amoxicillin
Dose: 1g IV (intravenous infusion) - tds (three times a day)

PLUS
Gentamicin – IV Dose: See gentamicin once-daily dosing guideline for prescribing and monitoring

NB: Review therapy after 24-72hrs and check MSU / CSU results and adjust treatment accordingly. See oral switch advice below.

Oral switch (see IV to oral switch guideline for advice on switching**):**

- Check MSU / CSU results and adjust treatment according to sensitivities
- Consider following for empirical oral switch if no positive culture result is available:

Dose: 500mg oral – tds (three times daily)

Cefalexin 500mg TDS (up to 1 g to 1.5 g three or four times a day for severe infections)

Non-pregnant: Second line (Penicillin allergy)

Ciprofloxacin
Dose (oral): 500mg – bd (twice daily)
Dose (intravenous if patient unable to swallow medication): 400mg – bd (twice daily)
NB: Review therapy after 48-72hrs and check MSU / CSU results and adjust treatment accordingly.

Patient with history / suspected MRSA colonisation

Add to regimen selected based on renal function and allergy status

Vancomycin
Dose: see intravenous vancomycin – intermittent infusion guideline for dosing and monitoring.

Patient with history of ESBL colonisation

Ertapenem
Dose: 1g intravenous – od (once daily).

Reduce dose in patients with renal impairment –

Pregnancy

See UHB ObstetricAndGynaecologyAntimicrobialGuide.pdf

Reference:

- NICE Guideline[NG111] Pyelonephritis (acute): antimicrobial prescribing October 2018

Pelvic Inflammatory Disease (PID)

Practice points:

- The trust has a specific PID guideline covering different PID scenarios which can be accessed http://uhbpolicies/documents/pelvic-inflammatory-disease.htm
- Please ensure that a referral to GU Medicine (Umbrella Sexual Health) for initial assessment, extensive STI screen testing, contact tracing and follow up, occurs.
- Use specialist vulvovaginal swab for NAAT. Send swab also for Gram stain, culture and sensitivity.
- Perform a pregnancy test and HIV screening.
- Organisms: *Neisseria gonorrhoeae*, *Chlamydia trachomatis*, anaerobes, *Mycoplasma genitalium* however pathogen-negative PID is common

Epididymo-orchitis

Practice points:

- **EXCLUDE TESTICULAR TORSION**
- The trust has a specific epididymo-orchitis guideline covering different scenarios which can be accessed http://uhbpolicies/documents/epidiymo-orchitis.htm
- Organisms: *Neisseria gonorrhoeae*, *Chlamydia trachomatis*, *Enterobacterales*
- Send MSU
- Send urine specimen for *Chlamydia trachomatis* and gonorrhoea nucleic acid amplification testing (NAAT).
- Review therapy once results available
- Consider mumps and 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

Acute Prostatitis

Practice points:

- Organisms: *Enterobacterales* , *Pseudomonas aeruginosa*, enterococci, *Staphylococcus aureus*
- Take blood cultures and MSU for MCS.
- Do not perform prostatic massage as this is very painful and may precipitate bacteraemia.
- Referral to Urology is recommended
-
- Give oral antibiotics first-line if people can take oral medicines, and the severity of their condition does not require intravenous antibiotics
- See MHRA advice Fluoroquinolone antibiotics: new restrictions and precautions for use due to very rare reports of disabling and potentially long-lasting or irreversible side effects - GOV.UK (www.gov.uk) for restrictions and precautions for using fluoroquinolone antibiotics due to very rare reports of disabling and potentially long-lasting or irreversible side effects affecting musculoskeletal and nervous systems. Warnings include: stopping treatment at first signs of serious adverse reaction (such as tendonitis), prescribing with special caution in people over 60 years and avoiding coadministration with a corticosteroid (March 2019).

Oral treatment / oral switch
Ciprofloxacin
Dose: 500mg oral – bd (twice a day)

First choice iv antibiotics (severely unwell or unable to swallow medication):
Ceftriaxone
Dose: 1g intravenous – bd (twice a day).
Aim to switch to oral once patient able to swallow.

Duration:
Treatment for Acute prostatitis should be given for a minimum of 14 days, extended to 28 days if clinically indicated (review microbiology results).

Whether to continue treatment or not would be based on the person's history or risk of developing chronic prostatitis, their current symptoms and any recent examination, urine and blood test results. Continued symptoms, such as fever or lower urinary tract symptoms (dysuria, frequency, urgency, or acute urinary retention) require ongoing treatment.

Reference:

- NICE Guideline [NG110] Prostatitis (acute): antimicrobial prescribing October 2018 updated September 2019

Musculo-skeletal System

Native Joint Septic Arthritis

Practice points:

- Organisms (typical): Staphylococcus aureus, beta-haemolytic streptococci
- **All cases must be discussed with an Infection specialist; in particular in immunocompromised patients, previous joint surgery, people who inject drugs, recurrent UTIs – seek opinion from an Infection specialist regarding antibiotics** as other organisms may play a role.
- Blood cultures must be taken before treatment in all cases.
- The synovial fluid must be aspirated prior to starting antibiotics for Gram stain and crystal microscopy as well as culture.
- Orthopaedic referral for consideration of washout
- Joints must be aspirated to dryness or surgically washed out, may require repeat procedure
- Treatment duration minimum 3 weeks, but guided by expert review and clinical progress

First line
Total <u>minimum</u> duration of antibiotics is 3 weeks - patient needs review by an Infection specialist before stopping antibiotics

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

(Use benzylpenicillin 1.2 – 2.4g - intravenous - four times a day as an alternative to IV flucloxacillin, if the organism is sensitive to penicillin)

Oral switch option to be based on culture results and advice from the Infection service.

NB: Switch to oral flucloxacillin <u>must not be made</u>, since flucloxacillin gastrointestinal absorption is unpredictable and may not provide adequate tissue levels.

Second line (penicillin allergy):
Total <u>minimum</u> duration of antibiotics is 3 weeks - patient needs review by an Infection specialist before stopping antibiotics

Clindamycin
Dose: 600mg intravenous – qds (four times a day) for minimum of 2 weeks

Oral switch option: to be based on culture results and advice from the Infection service

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

Second line (If current or past MRSA colonisation):

Vancomycin
Dose: see <u>intravenous vancomycin – intermittent infusion</u> 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

If the MRSA isolate shows resistance to rifampicin or the patient is unable to tolerate the rifampicin, please discuss with an Infection specialist.

Comment:

- Antibiotic courses of 3-4 weeks duration are generally adequate for uncomplicated bacterial arthritis. Treatment duration should be extended to 6 weeks if there is imaging evidence of accompanying osteomyelitis. .
- 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).
- Patients should be reviewed by an experienced clinician before antibiotics are stopped.

References:

Coakley G, Mathews C, Field M, Jones A et al. BSR & BHPR, BOA, RCGP and BSAC guidelines for management of the hot swollen joint in adults. Rheumatology, Volume 45, Issue 8, August 2006, Pages 1039–1041

Trauma-Related and/or Chronic Osteomyelitis

- Antibiotic treatment should be delayed until specimens have been obtained if possible.
- 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:

- Li H-K, Rombach I, Zambellas R, Walker S et al. Oral versus intravensou antibiotics for bone and joint infection. NEJM 2019;380:425-436.
- British Orthopaedic Association Standard. Fracture Related Infections (FRI). September 2019

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 an Infection specialist

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:

- Neurosurgery 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 risks:
    - 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 haemodynamic status, the empiric antimicrobial therapy should be withheld until a microbiologic diagnosis is established
- Organisms: Staphylococcus aureus (commonest), Gram negative organisms, anaerobes or M. tuberculosis.
- A total duration of 6 weeks of antibiotics for most patients with bacterial NVO or discitis is required. Note this must be either parenteral or highly bioavailable oral antimicrobial therapy.

A. Empirical treatment for native vertebral osteomyelitis, discitis or SEA in patients who are septic or have neurological compromise

First line:

Ceftriaxone
Dose: 2g intravenous – od (once daily)
(some patients may be able to step down to 2g od based on weight/progress/size of collection)

Second line (cephalosporin allergy or severe 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: 300mg oral – bd (twice daily)

B. Post-operative (i.e. infection at contiguous anatomical site / including metal work at site of infection)

Meropenem
Dose: 1g intravenous – tds (three times daily)

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

References:

- Tiltnes TS, Kehrer M, Hughes H, Morris TE, Justesen US. Ceftriaxone treatment of spondylodiscitis and other serious infections with Cutibacterium acnes. J Antimicrob Chemother. 2020 Oct 1;75(10):3046-3048. doi: 10.1093/jac/dkaa259. PMID: 32591800.

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, Pseudomonas spp*

First line:

Chloramphenicol 0.5% eye drops
Dose: 1 drop in affected eye(s) - every 2 hours until infection controlled then reduce frequency to qds (four times daily)
Duration: Continue for 48 hours after healing.

Second line:

Ofloxacin 0.3% eye drops
1 drop in affected eye(s) - every 2 hours until infection controlled then reduce frequency to qds (four times daily)
Duration: Continue for 48 hours after healing.

Second line / alternative:

Chloramphenicol 1% eye ointment
Apply to the lower eye lid of the affected eye(s) qds (four times daily) - continue for 48hrs after healing.
Duration: Continue for 48 hours after healing.

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

First line:

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)

Second line (severe penicillin allergy):

Levofloxacin

Dose: 500mg oral – od (once a day)
NB: if unable to use oral route, dose: Levofloxacin 500mg – intravenous infusion over 60 minutes – once a day.

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

Ear, Nose and Oropharynx

Acute Epiglottitis

Organisms: Group A Streptococci, H influenzae type b.

First choice:

Ceftriaxone
Dose: 1g intravenous injection - twice a day (bd) for 7 days.

(switch to oral therapy when clinically indicated)

Second choice (cephalosporin allergy or severe penicillin allergic):

Chloramphenicol
Dose: 50 mg/kg per day - intravenous injection in 4 divided doses for 7 days

(switch to oral therapy when clinically indicated)

Oral Switch
Co-amoxiclav
Dose: 625mg – three times daily (tds) to complete 7 day course including IV course given

Oral switch (penicillin allergy):
Levofloxacin
Dose: 500mg – once daily (od) to complete total 7 day course including IV treatment given

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.

The first step in treatment is cleaning out the ear canal, which is usually best performed by an ENT specialist. This will allow penetration of topical antibiotics and anti-inflammatory agents.

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% ear drops
Dose: 2 to 3 ear drops - topically - twice a day - 7 days.

In case of malignant otitis externa or severe immunocompromise, contact ENT Surgeon and an Infection specialist 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.

First choice:

Co-amoxiclav
Dose: 1.2g intravenous – tds (three times a day) for 14 to 21 days.

NB: IV to Oral switch when appropriate

Second choice (penicillin allergy):

Vancomycin
Dose: see intravenous vancomycin – intermittent infusion guideline for dosing and monitoring.
Treat for 14 to 21 days

PLUS
Ciprofloxacin
Dose: 400mg intravenous – bd (twice a day) for 14 to 21 days

PLUS
Metronidazole
Dose: 500mg intravenous – tds (three times a day) for 14 to 21 days

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:

Most patients do not need antibiotics, analgesia only.

Penicillin V
Dose: 500mg oral – qds (four times a day) for 10 days

In patients unable to swallow:

Benzylpenicillin
Dose: 1.2g - intravenous injection - four times a day - 10 days.

When clinical condition improves, the iv regimen can be converted to oral therapy

Second choice (penicillin allergic) :

Most patients do not need antibiotics, analgesia only.

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.[2]

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:

[1] PHE Management of infection guidance for primary care for consultation and local adaptation 2015 https://www.england.nhs.uk/south/wp-content/uploads/sites/6/2014/06/PHE-Primary-Care-Guidance-for-Gateway-2.pdf

[2] NICE Clinical Knowledge Summary. Management of acute sore throat. Available at: https://www.nice.org.uk/guidance/ng84 Accessed: 6.4.22

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.

Non-severe
First choice: Co-amoxiclav Dose: 1.2g intravenous - three times a day (oral follow-on: 625mg oral - three times a day
Second Line (penicillin allergy): Clindamycin Dose: 600mg intravenous – four times a day **Oral switch:** • BMI less than or equal to 30 kg/ m^2: 450mg - oral - four times a day (qds) • BMI greater than 30 kg/ m^2: 600mg – oral – four times a day (qds)

Severe infection
First line: Co-amoxiclav Dose: 1.2g intravenous - three times a day (oral follow-on: 625mg oral - three times a day) **PLUS** Metronidazole Dose: 500 mg intravenous - three times a day

(oral follow-on: 400mg – oral – three times a day

Second line (severe penicillin allergy):

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

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

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

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

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

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

Immunocompromised patient

First line:

Piperacillin-tazobactam
Dose: 4.5g intravenous– tds (three times a day)

Second choice (non-severe penicillin allergy):

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

PLUS
Ciprofloxacin
Dose: 400mg intravenous – bd (twice daily)

PLUS
Metronidazole
Dose: 500mg intravenous – tds (three times a day)

References:

- Jevon, P., Abdelrahman, A. & Pigadas, N. Management of odontogenic infections and sepsis: an update. BDJ Team **8,** 24–31 (2021). https://doi.org/10.1038/s41407-021-0520-4.
- Al-Qamachi LH, Aga H, McMahon J, Leanord A & Hammersley N. (2010). Microbiology of odontogenic infections in deep neck spaces: a retrospective study. Brit J Oral Maxfax Surg 48: 37-39.

- Al-Qamachi LH, Aga H & Hammersley N. (2010). The empirical therapy of benzylpenicillin and metronidazole for deep neck spaces odontogenic infections. Five years prospective follow up study. Brit J Oral Maxfax Surg 48: S2

Acute Bacterial Sinusitis

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

First choice:

Most need analgesia only

Doxycycline
Dose: 200mg oral - stat
followed by 100mg oral – od (once a day) – total course, including 'stat' dose, 5-7 days

Second choice :

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

Reference:
https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/362394/PHE_Primary_Care_guidance_09_10_14.pdf

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 qds (four times a day) for 14 days.
Dose (if BMI over 30 kg/ m^2): 600mg - qds (four times a day)
NB: Use injection only if unable to swallow / malabsorption as oral bioavailability is excellent.

Duration: 14 days

Quinsy (Peritonsillar abscess)

Practice points:

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

First Choice:

Benzylpenicillin
Dose: 1.2g - intravenous injection - four times a day - 10 days.

When clinical condition improves, the regime can be converted to oral amoxicillin
Amoxicillin dose: 1g - oral - three times a day in order to complete the course.

Second choice (penicillin allergic):

Clindamycin
Dose: 600mg intravenous – qds (four times daily) for 10 days.

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

Clindamycin
Dose: 450mg - oral - qds in order to complete the course
Dose (if BMI over 30 kg/ m^2): 600mg - oral - qds in order to complete the course

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.

First line:

Flucloxacillin
Dose: 1-2g (dose depending on severity and body weight) - intravenous injection – qds (four times a day)

NB: Review clinical response and switch to oral after 24-48hours as long as patient can swallow medication or consider referral to OPAT team if otherwise clinically stable.

Oral switch
Flucloxacillin
Dose: 1g – qds (four times a day). Total duration depends on progress, typically 7-14 days

Second line (penicillin allergic):

Clindamycin
Dose: 450mg – qds (four times a day)
Dose (if BMI over 30 kg/ m^2): 600mg – qds (four times a day)

NB: bioavailability is same for IV and oral.
Only start with IV for the most severe cases, or if patient is unable to swallow.
A switch to oral within 48hrs should be possible for even severe cases.

Complete 7 to 14 day course (including intravenous therapy)

NB: A minority of cases of cellulitis will be caused by organisms resistant to clindamycin. If not improving, or for the most severe cases, contact an Infection specialist.

Vancomycin
Dose: see intravenous vancomycin – intermittent infusion guideline for dosing and monitoring. Aim pre-dose levels between 10 - 15mg/L)

Second line (MRSA positive): 

Mild / moderate infection / oral option:

Doxycycline
Dose: 200mg – oral STAT **followed** by 100mg - oral - once a day thereafter
NB: only use if MRSA is known to be tetracycline sensitive

OR

Clindamycin
Dose: 450mg – orally – qds (four times a day)
Dose (if BMI greater than 30 kg/ m^2): 600mg – orally – qds (four times a day)
NB: only use if MRSA is known to be erythromycin or clindamycin sensitive

Severe infection in MRSA carriers:

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:

- NICE guideline: Cellulitis and erysipelas: antimicrobial prescribing (NG141) – Published 27th September 2019
- 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 monotherapy.
- Any patient known to be colonised with MRSA in the past should be treated as though this is the cause of the cellulitis or wound infection unless there is evidence to the contrary e.g. positive blood cultures growing a Group A Streptococcus.
- For diabetic foot infections please refer to the relevant section in these Guidelines.

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.

First line:

Benzylpenicillin
Dose: 1.2 - 2.4g - intravenous injection – qds (four times a day)

When clinical condition improves, the regime can be converted to oral
Patients with severe erysipelas should have minimum 4 days of intravenous therapy before oral switch to minimise the chances of relapse.

Oral switch:
Amoxicillin
Dose: 1g – tds (three times a day) to complete 7 to 14 day course (including IV therapy given)

Second line (penicillin allergic):

Clindamycin
Dose: 450mg – qds (four times a day)
Dose (if BMI greater than 30 kg/ m^2): 600mg – qds (four times a day)

NB: The bioavailability of clindamycin is same for IV and oral.
Only start with IV for the most severe cases, or if patient is unable to swallow.
A switch to oral within 48hrs should be possible for even severe cases.

To complete 7 to 14 day course (including the IV therapy given)

Human and Animal Bites (excluding insects)

Practice points:

- Surgical toilet is most important but antibiotic administration is recommended especially if:
  - Over 50years
  - Hand wound
- Organisms: Staphylococcus aureus, Group A beta-haemolytic streptococci, Pasteurella multocida, anaerobes
- Not all bite wounds need antibiotic treatment.[1]
- **Assess risk of tetanus, rabies or blood-borne virus infection (HIV, hepatitis B and C) and take appropriate action.**
- If bite occurred overseas or a bat bite is suspected, consult the consultant to assess the risk of rabies, and therefore the need for post-exposure vaccination.
- For insect bites see cellulitis / wound infection guideline. Swelling and / or erythema is usually non-infection reaction, best treated with antihistamines or a few days of steroids.

Table: Antibiotic Prophylaxis for an Uninfected Bite

Type of bite	Bite has not broken the skin	Bite has broken skin but not drawn blood	Bite has broken the skin and drawn blood
Human bite	Do not offer antibiotics	Consider antibiotics if bite is in a high-risk area or person is at high risk	Offer antibiotics
Cat bite	Do not offer antibiotics	Consider antibiotics if wound could be deep	Offer antibiotics
Dog or other traditional pet bite	Do not offer antibiotics	Do not offer antibiotics	Offer antibiotics if bite has caused considerable, deep tissue damage or is visible contaminated. Consider antibiotics if bite is in a high-risk area or person is at high risk

High risk areas include: hands, feet, genitals, skin overlying cartilaginous structures or an area of poor circulation.

People at high risk include: those at risk of a serious wound infection because of a co-morbidity e.g. diabetes, immunosuppression, asplenia or decompensated liver disease

A) Antibiotic choice for prophylaxis following human or traditional pet bite

First line:

Co-amoxiclav
Dose: 625mg oral - tds (three times a day) for 3 days

OR if patient unable to swallow prescribe intravenous co-amoxiclav 1.2 g intravenous three times a day.

Second line (penicillin allergy):

Doxycycline
Dose: 200mg oral - STAT dose **followed by** 100mg – od (once a day) for total 3 days

PLUS
Metronidazole
Dose: 400 mg oral – tds (three times a day) for total 3 days.

B) Antibiotic choice for treatment of infected human or traditional pet bite

First line:

Co-amoxiclav
Dose: 625mg oral - tds (three times a day) for 5 days

OR if patient unable to swallow prescribe intravenous co-amoxiclav 1.2 g intravenous three times a day.

Second line (penicillin allergy):

Doxycycline
Dose: 200mg oral - STAT dose **followed by** 100mg – od (once a day) for total of 5 days

PLUS
Metronidazole
Dose: 400 mg oral – tds (three times a day) for total 5 days.

Reference:

NICE Guideline: Human and animal bites: Antimicrobial Prescribing . November 2020. Available at: https://www.nice.org.uk/guidance/ng184/resources/human-and-animal-bites-antimicrobial-prescribing-pdf-66142021681861

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 with DFI must be referred to the Diabetes Foot Team
- 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).
- Ulcer assessment should include the "probe to bone" test with a sterile metal probe: if this can touch bone, then osteomyelitis is almost certainly present.
- 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:

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

Infection severity IWGDF grade (IDSA classification)	Clinical classification of infection (IDSA), with definitions
Grade 1 (Uninfected)	Uninfected: • No systemic or local symptoms or signs of infection

Grade 2 (Mild infection)
Link to empirical antibiotics
	Infected
	• At least 2 of the following items are present:
	  ○ Local swelling or induration
	  ○ Erythema greater than 0.5 cm but less than 2cm (in any direction) around the ulcer
	  ○ Local tenderness or pain
	  ○ Local warmth
	  ○ Purulent discharge
	• Other causes of an inflammatory response of the skin should be excluded (eg. trauma, gout, acute Charcot neuro-osteoarthropathy, fracture, thrombosis, venous stasis)
	• Infection involving the skin/ or subcutaneous tissue only No systemic signs or symptoms of infection

Grade 3 (Moderate infection) Link to empirical antibiotics	• Infection involving structures deeper than skin and subcutaneous tissues (eg. bone, joint, tendon) or erythema extending Greater than2cm from the wound margin • No systemic signs or symptoms of infection
Grade 4 (Severe infection) Link to empirical antibiotics	• Any foot infection with the following signs of a systemic inflammatory response syndrome (SIRS)
Osteomyelitis in the diabetic foot – link to empirical antibiotics	• Positive probe to bone test is presumed to be osteomyelitis • Xray or MRI (more sensitive) evidence of osteomyelitis

DIABETIC FOOT INFECTION: Grade 2 (Mild infection)

Practice points:

- **Patient must be referred to the Diabetes Foot Team**
- **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.
- Biopsies for microbiological sampling not routinely required unless recent antimicrobial therapy or previous antibiotic resistant organisms

First line:

Flucloxacillin
Dose: 1g oral – qds (four times a day)

Second line (penicillin allergy):

Clindamycin
Dose: 450mg oral – qds (four times a day)
Dose (BMI greater than 30 kg/ m^2): 600mg oral – qds (four times daily)

Second line (MRSA positive):

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 is the same as doxycycline sensitive

DIABETIC FOOT INFECTIONS: Grade 3 (Moderate infection)

Practice points:

- **Patient must be referred to the Diabetes Foot Team**
- 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
- Organisms: Usually polymicrobial, Staphylococcus aureus, Group B streptococci, Enterococcus spp., coliforms, anaerobes.

First line:

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

Second line (penicillin allergy):

Co-trimoxazole
Dose: 960mg oral – bd (twice daily)

OR, if and infection with Pseudomonas aeruginosa is suspected or confirmed:

Clindamycin
Dose (oral): 450mg – qds (four times a day)
Dose (if BMI greater than 30 kg/ m^2): 600mg – qds (four times a day)
NB: Use IV only if unable to swallow as oral bioavailability is excellent.

PLUS
Ciprofloxacin
Dose (oral): 500mg oral – bd (twice a day)
NB: Use IV only if unable to swallow as oral bioavailability is excellent.

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

If current or past MRSA – check susceptibilities and select one of the below two agent regimens it is sensitive to. If this is unknown, the combination should include Vancomycin:

Clindamycin (only if MRSA is erythromycin and/or clindamycin sensitive)
Dose (oral): 450mg oral – qds (four times a day)
Dose (if BMI greater than 30 kg/ m^2): 600mg oral – qds (four times a day)
NB: Use IV only if unable to swallow as oral bioavailability is excellent.

PLUS
Ciprofloxacin
Dose: 500mg oral – bd (twice a day)
NB: Use IV only if unable to swallow as oral bioavailability is excellent.

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
NB: Use IV only if unable to swallow as oral bioavailability is excellent.

PLUS
Ciprofloxacin
Dose: 500mg - oral - twice a day
NB: Use IV only if unable to swallow as oral bioavailability is excellent.

NB: If the MRSA is resistant to rifampicin or the patient is not tolerating treatment, seek advice from an Infection specialist

DIABETIC FOOT INFECTIONS: Grade 4 (Severe infection)

Practice points:

- **Patient must be referred to the Diabetes Foot Team**
- 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 systemic symptoms have settled and adjust after tissue culture results
- Treatment duration 2 to 4 weeks in the absence of osteomyelitis

First line:

Piperacillin-tazobactam
Dose: 4.5g intravenous injection – tds (three times a day)

Second line (mild penicillin allergy):

Meropenem
Dose: 1g intravenous – tds (three times a day)

Carbapenem allergy or severe penicillin allergy:

Clindamycin
Dose: 600mg intravenous injection – qds (four times a day)

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

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

If MRSA positive: 

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

The choice and duration of oral step-down antibiotics to be discussed with an Infection specialist

DIABETIC FOOT INFECTIONS: Osteomyelitis

Practice points:

- **Patient must be referred to the Diabetes Foot Team**
- **If the patient is clinically stable, starting antibiotics should be delayed until appropriate surgical or radiological bone tissue 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 usually be guided by bone biopsy and should be discussed with an Infection specialist.
- 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 an infection specialist prior to the formulation of treatment plan.

Acute osteomyelitis

First line:
Piperacillin-tazobactam
Dose: 4.5g intravenous – tds (three times daily)

Chronic osteomyelitis – should always be guided by deep tissue biopsy result

Flucloxacillin
Dose: 2g intravenous injection – qds (four times a day)

PLUS
Ciprofloxacin
Dose: 750mg oral – bd (twice a day)
NB: Use IV only if unable to swallow as oral bioavailability is excellent.

PLUS
Metronidazole
Dose: 400mg - oral – tds (three times a day)
NB: Use IV only if unable to swallow as oral bioavailability is excellent.

Penicillin allergic:
Tigecycline
Dose: 100mg intravenous infusion over 60 minutes - stat as loading dose.
Followed by 50mg – bd (twice a day) for 2-7 days (including 'stat dose)

OR
Clindamycin
Dose: 600mg intravenous injection – qds (four times a day)

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

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

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

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
- Diabetic foot problems: prevention and management. NICE guideline. 26August 2015. Last updated 11October 2019. www.nice.org.uk/guidance/ng19
- University Hospital Birmingham NHS Foundation Trust. Sepsis guideline , http://uhbpolicies/documents/sepsis-and-septic-shock.htm

Necrotising Fasciitis / Synergistic Gangrene/ Gas 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.**
- Not all patients with necrotising infections have severe systemic symptoms. Necrotising disease should always be strongly considered in patients with "cellulitis" in atypical areas, e.g. groin, or with pain out of proportion to appearance of the skin changes.
- MRI are not sufficiently sensitive to exclude a diagnosis of necrotising skin and soft tissue infection
- Organisms: Group A streptococci or mixed coliforms and anaerobes.

First line:
Meropenem
Dose: 1g intravenous injection – tds (three times a day)

PLUS
Clindamycin
Dose: 600 - 1200mg - intravenous infusion – qds (four times a day)

Second line (MRSA carrier):

Meropenem
Dose: 1g intravenous injection – tds (three times a day)

PLUS
Linezolid
Dose: 600mg oral or intravenous – bd (twice daily)

Second line (severe penicillin allergy):

Contact an infection specialist

Reference:

- IDSA - Practice Guidelines for the Diagnosis and Management of Skin and Soft Tissue Infections: 2014 Update by the Infectious Diseases Society of America"; CID 2014:59 (15 July).

Chicken Pox (Varicella)

Practice points:

- **Does not apply to VZV encephalitis**
- Notify the Infection Prevention & Control Team and isolate into side-room. Varicella 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

First line:

Aciclovir
Dose: 800mg - oral - **five times a day** until rash scabs over

OR

Valaciclovir
Dose: 1g – oral – **three times a day** until rash scabs over

NB: If patient unable to swallow / malabsorption use intravenous (see antiviral dosing guideline for dosing and monitor patient's renal function daily)

Herpes zoster (Shingles) in Immunocompetent Patients

Practice points:

- **Discuss an immunocompromised patient with the Medical Virologist.**
- Notify the Infection Prevention & Control Team.
- There is no clear evidence that treatment below reduces the incidence of post-herpetic neuralgia).
- **Treatment should only be given to the below patients:**
    - Over 60 years
    - Patients with ophthalmic zoster
    - Immunocompromised
- The incidence of post-herpetic neuralgia under 60 years is less than7%, but 21-34% for those over 60 years (Prodigy guidelines).
- Treatment should be started within the first 72 hours.
- Organisms: Varicella zoster virus

Valaciclovir Dose: 1g - oral - three times a day for 7 days

Antibiotics for Staphylococcus aureus Bacteraemia (MSSA / MRSA)

Practice points:

- See Trust guideline for management and treatment of staphylococcus aureus bacteraemia http://uhbpolicies/documents/staphylococcus-aureus-bacteraemia.htm . Includes information on:
  - Line removal
  - Cardiology referral
  - Categories patient as high risk and low risk
- **Duration of antimicrobial treatment:**
  - Uncomplicated bacteraemia; Intravenous antibiotic for 14 days. For oral step-down discuss with an infection specialist
  - Complicated bacteraemia; 4 – 6 weeks intravenous antibiotics. For oral step-down discuss with an infection specialist

Meticillin Sensitive Staphylococcus aureus (MSSA)

First line:

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

Second line (penicillin allergy and if vancomycin MIC less than or equal to1mg/L):

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

Second choice (penicillin allergy), and if vancomycin MIC greater than 1mg/L, and if daptomycin sensitive:

Daptomycin
Dose: 6mg/kg – intravenous infusion – once a day

NB: See Daptomycin guideline for dosing and monitoring. Ensure baseline CK level is taken and renal function calculated.

Meticillin Resistant Staphylococcus aureus (MRSA)

First line (if vancomycin MIC less than to equal to1mg/L):

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

Second line (if vancomycin MIC greater than1mg/L and if daptomycin sensitive):

Daptomycin
Dose: 6mg/kg – intravenous infusion – once a day

NB: See Daptomycin guideline for dosing and monitoring. Ensure baseline CK level is taken and renal function calculated.

Infestations

Head Lice

- See Trust procedure for head lice http://uhbpolicies/documents/lice.htm 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

Second line:
Malathion 0.5% liquid

References:

- NICE clinical knowledge summaries. Available at: https://cks.nice.org.uk/topics/head-lice/ Accessed: 6.4.22
- Specific product characteristics (SPC) – dimeticone 4%. Available at: https://www.medicines.org.uk/emc/product/4860/smpc#gref Accessed: 6.4.22
- Specific product characteristics (SPC) – Malathion 0.5%. Available at: https://www.hpra.ie/img/uploaded/swedocuments/Licence_PA22702-001-001_09122019114749.pdf Accessed 6.4.22

Body and Pubic Lice

- See Trust procedure for Body & Pubic lice http://uhbpolicies/documents/lice.htm 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

Pubic Lice:
Malathion 0.5% liquid

References:

- NICE clinical knowledge summaries. Available at: https://cks.nice.org.uk/topics/pubic-lice/ Accessed: 6.4.22
- Specific product characteristics (SPC) – dimeticone 4%. Available at: https://www.medicines.org.uk/emc/product/4860/smpc#gref Accessed: 6.4.22
- Specific product characteristics (SPC) – Malathion 0.5%. Available at: https://www.hpra.ie/img/uploaded/swedocuments/Licence_PA22702-001-001_09122019114749.pdf Accessed 6.4.22

Scabies

- See Trust procedure for Scabies http://uhbpolicies/documents/lice.htm 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. Available at: https://cks.nice.org.uk/topics/scabies/management/management-of-scabies/ Accessed: 6.4.22
- Specific product characteristics (SPC) – dimeticone 4%. Available at: https://www.medicines.org.uk/emc/product/4860/smpc#gref Accessed: 6.4.22
- Specific product characteristics (SPC) – Malathion 0.5%. Available at: https://www.hpra.ie/img/uploaded/swedocuments/Licence_PA22702-001-001_09122019114749.pdf Accessed 6.4.22

Sepsis

Sepsis of Unknown Origin

Follow hyperlink for management of '**Patients with Physiological Decompensation (Septic shock)**'

Practice points:

- See **UHB Sepsis guideline** for definition, assessment and management including sepsis six steps
- 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 patient record is checked to look for alert organisms (e.g. MRSA, ESBL) and at previous cultures and sensitivities. See below for guideline specific treatment.
- Patients with multidrug resistant organisms, such as MDR Acinetobacter, Vancomycin resistant Enterococci, Carbapenemase producing Enterobacterales, other alert Organism: Contact an infection specialist for advice.

First line (C.G.GFR greater than or equal to 20ml/min):

Give for first 48-72hours and review cultures and sensitivities and then adjust treatment accordingly

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

PLUS
Gentamicin
Dose: See intravenous gentamicin guidelines for dosing and monitoring

Second line (mild penicillin allergy):

Give for first 48-72hours and review cultures and sensitivities and then adjust treatment accordingly)

Ceftriaxone
Dose: 2g intravenous infusion – od (once daily)

PLUS
Gentamicin
Dose: See intravenous gentamicin guidelines for dosing and monitoring

Second line (Cephalosporin allergy or severe penicillin allergy):

Give for first 48-72hours and review cultures and sensitivities and then adjust treatment accordingly:

Gentamicin
Dose: See intravenous gentamicin guidelines for dosing and monitoring
PLUS

Vancomycin
Dose: See vancomycin dosing guidelines. Aim pre-dose levels between 15-20mg/L

Second line (Previous solid organ transplant):

Piperacillin-tazobactam
Dose: 4.5g intravenous infusion – tds (three times a day)

Give for first 48-72hours and review cultures and sensitivities and then adjust treatment accordingly

Second line (C.G. GFR less than 20ml/min):

Piperacillin-tazobactam
Dose: 4.5g intravenous infusion – bd (twice daily)

Give for first 48-72hours and review cultures and sensitivities and then adjust treatment accordingly

If previous or suspected MRSA positive 

ADD
Vancomycin to the previously selected regime above
Dose: See vancomycin dosing guidelines. Aim pre-dose levels between 15-20mg/L

If previous or suspected ESBL positive 

Meropenem
Dose: 1g intravenous injection – tds (three times a day)

For Patients with Physiological Decompensation (Septic shock)

- Septic shock defined as:
    - Low blood pressure despite adequate fluid replacement (Patient completed sepsis six), and organ dysfunction or failure
    - Hypotension requiring vasopressors to maintain a mean arterial pressure (MAP) of 65 mmHg or more and having a serum lactate level of greater than 2 mmol/l despite adequate volume resuscitation
- **Discuss patient with critical care Consultant or SpR for transfer to ITU**

Escalate therapy to:

Meropenem
Dose: 1g intravenous injection – tds (three times a day)

PLUS
Vancomycin
Dose: See vancomycin dosing guidelines. Aim pre-dose levels between 15-20mg/L.

In patients with septic shock and severe penicillin allergy (such anaphylaxis): discuss with Infection specialist

Febrile Neutropenia and Infection in Oncology and Haematology Patients

Febrile neutropenia is a medical emergency.
Contact the relevant Haematology or Oncology Registrar or Consultant on-call.
Antibiotics should be commenced within 60 minutes of arrival

See Guideline for the management of febrile neutropenia and infection in oncology and haematology patients. A summary of pharmacological management of febrile neutropenia is found below:

Antibiotic Choice:
First line therapy (C.G. GFR greater than 30ml/ min, patient is passing urine and the creatinine is stable ie. there is no evidence of AKI Piperacillin-tazobactam Dose: 4.5g intravenous – every 6 hours (qds) **PLUS** Gentamicin Dose: see Trust Gentamicin guideline for dosing and monitoring **NB:** • **If oncology patient review at 24 hours to stop gentamicin and continue with piperacillin-tazobactam as monotherapy.** • If Haematology patient review at 24hours to decide treatment choice.
Suspected line infection or known MRSA colonisation: **Add** Vancomycin IV infusion to first line therapy regimen Dose: (see Trust Vancomycin guideline for dosing and monitoring)
Baseline C.G. GFR is less than or equal to 30ml/ min or there is evidence of acute kidney injury Piperacillin-tazobactam Dose: 4.5 g intravenous – every 6 hours (qds). Continue at this dose for 24 - 48 hours before amending dose in line with renal function **PLUS** Ciprofloxacin Dose: 400mg intravenous twice daily (bd) **NB:** • **If oncology patient review at 24 hours to stop ciprofloxacin and continue with piperacillin-tazobactam as monotherapy.** • If Haematology patient review at 24hours to decide treatment choice.
Penicillin allergy and C.G. GFR greater than 30ml/min (administer in below order): Gentamicin IV infusion Dose: see Trust Gentamicin guideline for dosing and monitoring **PLUS** Ciprofloxacin 400mg intravenous – every 12 hours (BD)

PLUS Vancomycin IV infusion Dose: see Trust Vancomycin guideline for dosing and monitoring
Penicillin allergy and C.G. GFR less than 30ml/min: Contact Infection service for advice

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 infection specialist

Candida Infections

- Oral candidiasis is uncommon in people other than infants, denture wearers, and the elderly.
- 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 an infection specialist to ensure that patient sampling occurs so that candida identification and antifungal drug susceptibility testing take place, to guide therapy.

Oropharyngeal Candidiasis

First line:

Miconazole oral gel (24mg/ml)
Dose: 2.5 mL (1/2 measuring spoon) of gel applied four times a day after meals.
, retained near oral lesions before swallowing - usually 7-10 days, continued for at least 7 days after lesions have healed.

Or

Nystatin oral suspension (100,000 units/ml)
Dose: 100,000units (1ml) – four times a day, after food or drink, use pipette as per packaging instructions - usually 7-10 days, continued for 48h after lesions have healed.

Patients who cannot tolerate topical treatment:

Fluconazole
Dose: 50 - 100mg oral – od (once a day) for 14 days depending on clinical response.

Severe or refractory infection or immunocompromised patients:

Fluconazole
Dose: 100mg oral or (intravenous infusion, if cannot tolerate oral) – once a day – for 7-14 days depending on clinical response.

Comments:

- Pappas et al. Clinical Practice Guideline for the Management of Candidiasis: 2016 Update by the Infectious Diseases Society of America. CID 2016:62, , e1-e50
- British National Formulary
- NICE CKS summaries [accessed 11/12/2023]
- BMJ Best practice Oral Candidiasis Oral candidiasis.pdf (bmj.com) August 2023

Oesophageal Candidiasis

- Most infections will be *Candida albicans* and therefore sensitive to fluconazole. If the infection is in a patient with a different Candida species isolated e.g. *C. glabrata* please contact Infection service for advice
- Evidence of infection may be a marker of immunosuppression. Ensure HIV testing advised
- If upper GI endoscopy is performed, a lesion biopsy may be submitted for culture confirmation of Candida sp.
- Please discuss dosing in obese patients with the Pharmacist.

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 but change to oral as soon as possible (90% bioavailability)

Reference:

- Pappas et al. Clinical Practice Guideline for the Management of Candidiasis: 2016 Update by the Infectious Diseases Society of America. CID 2016:62, e1-e50
- Oesophageal Candidiasis Treatment for Adult Patients. NHS Tayside guidance Feb 2021

Candida Urinary Tract Infection (UTI)

Practice points:

- common risk factors for candiduria: increased age, female sex, antibiotic use, urinary catheterisation, previous surgery, diabetes mellitus.
- most candiduria represents colonisation and does not need antifungal drug treatment.
- removing predisposing factors (catheter removal, stopping antibiotics, correcting hyperglycaemia) clears candiduria in most cases.
- after correction of predisposing factors, repeat urine culture). 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
- For fluconazole resistant Candida isolates, contact the Infection service for advice on treatment

Symptomatic cystitis (lower UTI) with a fluconazole susceptible isolate:

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

Pyelonephritis (upper UTI) with a fluconazole susceptible isolate :

Fluconazole
Dose: 800mg (or 12mg/kg) IV on day 1 then 400mg (or 6mg/kg to a maximum of 800mg) IV/PO – 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 (round to nearest 50mg vial)) intravenous – once a day - for 14 days after the last positive blood/urine culture and resolution of signs and symptoms and resolved neutropenia.

References

- Pappas et al. Clinical Practice Guideline for the Management of Candidiasis: 2016 Update by the Infectious Diseases Society of America. CID 2016:62, e1-e50
- South Yorkshire and Bassetlaw Antifungal Guidelines for adult patients Nov 2022 South Yorkshire and Bassetlaw Antifungal Guidelines for adult patients (dbth.nhs.uk) [accessed 10.01.2024]

Candidaemia and Invasive Candidiasis

- The management of these cases is usually undertaken in discussion with the Infection service
- 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 antifungal agent 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 neutropenic patients, , echocardiography (preferably TOE), ophthalmological examination and abdominal imaging for disseminated infection recommended.

First line:

Caspofungin
Dose – 70mg on first day - intravenous; followed by 70mg the next day if weight greater than 80kg (or 50mg if weight less than or equal to 80kg), 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 (round to nearest 50mg vial) – intravenous – 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.

Moderate to Severe Liver Impairment (Child Pugh B or C)

Anidulafungin
Dose:
Day 1: 200mg STAT than 100mg od

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
http://uhbpolicies/assets/ProphylaxisTreatmentFungalInfectionHaemoOncology.pdf .

Aspergillosis
(Pulmonary and extrapulmonary infections)

- population at greatest risk for invasive aspergillosis are solid organ and haematopoietic stem cell 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.
Patients who have responded to treatment with parenteral voriconazole can be switched to oral voriconazole (200-300mg BD) after therapeutic trough (pre-dose) voriconazole levels have been achieved.

Duration of therapy is usually prolonged , at least 4 weeks and will be tailored according to the patient's clinical progress in conjunction with an Infection specialist

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 (round to nearest 50mg vial)(to a maximum of 5mg/kg) – intravenous infusion – once daily –

OR

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

OR

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

Or Dose: 300mg – **oral, gastro resistant tablets** - twice 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

OR

Combination therapy (salvage 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:

- Misch E.A, Safdar N. Updated guidelines for the diagnosis and management of aspergillosis. Journal of Thoracic Disease 2016;8(12)E1771-6.
- Patterson et al. Practice Guidelines for the Diagnosis and Management of Aspergillosis: 2016 Update by the Infectious Diseases Society of America. *Clinical Infectious Diseases*, Volume 63, Issue 4, 15 August 2016, Pages e1–e60, https://doi.org/10.1093/cid/ciw326

Mucormycosis

Practice points:

- risk factors: severe immunocompromise, diabetes mellitus, iron overload treated with deferoxamine, injecting drug users
- rapid invasive infections with high mortality
- voriconazole and caspofungin are not active against Mucorales

Management

- all patients must be discussed with an Infection specialist
- **prompt surgical debridement and** prompt antifungal therapy are essential, as well asreduction or stopping of immunosuppression, including steroids, plus correction of hyperglycaemia and acidosis

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 (round to nearest 50mg vial) – 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:

- Chen et al Cryptococcosis in Australia and the treatment of cryptococcal and other fungal infections with liposomal amphotericin B. JAC 2002: 49: Suppl. S1: 57-61
- Perfect et al. Clinical Practice Guidelines for the Management of Cryptococcal Disease: 2010 Update by the Infectious Diseases Society of America. CID 2010; 50: 291- 322.

Part C. Surgical Management and Prophylaxis

General Guidance

- Screen all patients for MRSA prior to surgery according to the UHB MRSA policy http://uhbpolicies/documents/mrsa.htm
- Review previous Microbiology results and PICS alerts for other multi-drug resistant organisms 
- For best efficacy **antibiotics should be given within 60minutes prior to incision**
- Depending on the half-life of the antibiotics given for surgical prophylaxis doses will need to be re-dosed in extended surgery (i.e. over 4 hours). See specific guideline below for advice on when to re-dose antibiotics.
- In the event of major intra-operative blood loss in adults (more than 1,500 ml) additional dosage of prophylactic antibiotic should be given 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” http://www.nice.org.uk/guidance/cg64/chapter/Recommendations ; (first published March 2008; reviewed August 2015 – no changes made from 2008 guideline)

Antimicrobial Prophylaxis Guidance for Bomb Blast Victims

- Antimicrobial guidance has been put together to support clinical teams treating casualties
- Please see the following link to the national PHE guidance:

  https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/616113/Antimicrobial_prophylaxis_guidance_for_bomb_blast_victims.pdf

Cardiology- Cardiothoracic Surgery

Practice points

- The below practice points and antibiotic prophylaxis should be used in conjunction with other peri-operative management as detailed in the NICE guidelines for preventing surgical site infections. For example:
    - If an incise drape is required, use an iodophor-impregnated drape unless the patient has an iodine allergy. Consider using gentamicin-collagen implants in cardiac surgery
- Screen all patients for MRSA prior to surgery according to the UHB MRSA policy http://uhbpolicies/documents/mrsa.htm
- Review previous Microbiology results and PICS alerts for other multi-drug resistant organisms
- For best efficacy **antibiotics should be given within 60minutes prior to incision**
- Depending on the half-life of the antibiotics given for surgical prophylaxis doses will need to be re-dosed in extended surgery (i.e. over 4 hours). See specific guideline below for advice on when to re-dose antibiotics.
- In the event of major intra-operative blood loss in adults (more than 1,500 ml) additional dosage of prophylactic antibiotic should be given after fluid replacement
- All aspects of antibiotic prophylaxis, for example, where prophylaxis is not given as recommended, should be clearly recorded in the case records.
- For patients under active treatment for endocarditis or other infections , please discuss with an Infection specialist for tailored antibiotic prophylaxis
-
- These guidelines have been revised on the basis of consensus by UHB infection specialist and Antimicrobial Pharmacist on available guidelines from other cardiac centres in UK and literature reviews.

References

- Surgical site infections: prevention and treatment. NICE guideline [NG125] Published date: April 2019. Available at: https://www.nice.org.uk/guidance/ng125/chapter/recommendations Accessed: 6.4.22
- EACTS Guidelines on perioperative medication in adult cardiac surgery; European journal of cardio-thoracic surgery (2017) 1-29 https://academic.oup.com/ejcts/article/53/1/5/4360955#
- BSAC Guidelines for the diagnosis, prevention and management of implantable cardiac electronic device infection (J Antimicrob Chemother (2015), 70: 325-359)
- Kusne S, Staley and Arabia F. Prevention and Infection Management in Mechanical Circulatory Support Device Recipients. Clinical Infectious Diseases 2017;64(2):222–8
- Dale W. Bratzler, E. Patchen Dellinger, Keith M. et al, Clinical practice guidelines for antimicrobial prophylaxis in surgery, American Journal of Health-System Pharmacy, Volume 70, Issue 3, 1 February 2013, Pages 195–283, https://doi.org/10.2146/ajhp120568
- The society of thoracic surgeons practice guideline series: Antibiotic prophylaxis in cardiac surgery, part I: Duration. Edwards F.H., Engelman R.M., Houck P., et al (2006) Annals of Thoracic Surgery, 81 (1) , pp. 397-404. https://www.annalsthoracicsurgery.org/article/S0003-4975(05)01039-8/fulltext
- The Society of Thoracic Surgeons Practice Guideline Series: Antibiotic Prophylaxis in Cardiac Surgery, Part II: Antibiotic Choice. Engelman R., Shahian D., Shemin R., et al (2007) Annals of Thoracic Surgery, 83 (4) , pp. 1569-1576. https://www.annalsthoracicsurgery.org/article/S0003-4975(06)01840-6/abstract

Pacemaker Insertion Prophylaxis

First line (includes MRSA cover): Give within 60 minutes before skin incision

Teicoplanin
Dose (Weight less than 80 kg): 600 mg - intravenous injection over 3 to 5 minutes
Dose (Weight greater than or equal to 80 kg): 800 mg - intravenous infusion over 30 mins

PLUS
Gentamicin
Dose: 160 mg STAT bolus dose (give over 3-5 mins) – Dose does not need to be adjusted for renal dysfunction.

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 an infection specialist when planning for pacemaker insertion.

Cardiac Surgery

(Including CABG/ Valve insertion / Aortic surgery and other cardiac surgery)

First line: Give within 60 minutes before skin incision

Flucloxacillin
Dose: 2g STAT.

PLUS

Gentamicin
Dose: 160mg STAT bolus dose (give over 3-5mins)
Dose does not need to be adjusted for renal dysfunction

In addition:

- If patient remains on bypass at 4 hours re-dose patient with **flucloxacillin 2G IV**.
- If patient remains on bypass at 10 hours re-dose patient with **flucloxacillin 2G IV**. Repeat every 6 hours until the end of procedure.

- Give an additional dose of Flucloxacillin 1g IV when the patient comes off cardio-pulmonary bypass.

- If patient has **over 1500ml of blood loss, promptly prescribe and administer**: Flucloxacillin 1g IV **PLUS** Gentamicin 80mg.
  Do not repeat for further losses.

Four further doses of flucloxacillin IV should be prescribed and administered as follows:

1**. Flucloxacillin 1G IV** promptly once the patient comes off cardio-pulmonary bypass.

2,3 &4. Three further **flucloxacillin 2G IV** doses should be given every **6 hours** (6,12 and 18 hours) post-op

Notes: No monitoring of Gentamicin levels required for surgical prophylaxis doses.

Penicillin allergic / MRSA positive: Give within 60 minutes before skin incision

Teicoplanin
Dose (Weight less than 80 kg): 600 mg - intravenous injection over 3 to 5 minutes
Dose (Weight greater than or equal to 80 kg): 800 mg - intravenous infusion over 30mins

PLUS
Gentamicin
Dose: 160mg STAT bolus dose (give over 3-5mins)
Dose does not need to be adjusted for renal dysfunction.

Two further doses of teicoplanin IV should be prescribed and administered as follows:

1**. P**romptly once the patient comes off cardio-pulmonary bypass.

2. One further dose should be given at 12 hours post-op

In addition:

- If patient has **over 1500ml of blood loss, promptly prescribe and administer**: Give Teicoplanin 200mg dose **PLUS** Gentamicin 80mg. Do not repeat.

Thoraco-abdominal aortic aneurysm repair surgery (TAAA repair)

First line: Give within 60 minutes before skin incision

Co-amoxiclav
Dose: 1.2g STAT.

In addition:

- If patient still undergoing surgery **8 hours** after the initial dose
  Give a **second** co-amoxiclav 1.2g IV.
  This should be repeated every 8 hours while in theatre.

Three further doses of co-amoxiclav 1.2 G IV should be prescribed and administered as follows:

1. Promptly once the patient comes off cardio-pulmonary bypass.

2 & 3. Two further doses should be given every 8 hours for 24 hours post-op

In addition:

- If patient has **over 1500ml of blood loss, promptly administer**:
  Co-amoxiclav 1.2g IV . Do not repeat for further blood losses.

Penicillin allergic / MRSA positive:

First line: Give within 60 minutes before skin incision

Teicoplanin
Dose (Weight less than 80 kg): 600 mg - intravenous injection over 3 to 5 minutes
Dose (Weight greater than or equal to 80 kg): 800 mg - intravenous infusion over 30mins

PLUS
Gentamicin
Dose: 160mg STAT bolus dose (give over 3-5mins)
Dose does not need to be adjusted for renal dysfunction.

PLUS:
Metronidazole
Dose: 500mg STAT

Two further doses of teicoplanin IV should be prescribed and administered as follows:

1. Promptly once the patient comes off cardio-pulmonary bypass.
2. One further teicoplanin dose should be given 12 hours post-op

In addition:

- If patient has **over 1500ml of blood loss, promptly administer**:
  Teicoplanin 200mg IV **PLUS** Gentamicin 80mg IV **PLUS**
  Metronidazole 500mg IV.
  Do not repeat for further blood losses.

Transcatheter Procedures

including transcatheter aortic valve implantation (**TAVI) and Transcatheter pulmonary valve implantation** (**TPVI)**

First Line: Give within 60 minutes before skin incision

Teicoplanin
Dose (Weight less than 80 kg): 600 mg - intravenous injection over 3 to 5 minutes
Dose (Weight greater than or equal to 80 kg): 800 mg - intravenous infusion over 30mins

PLUS
Gentamicin
Dose: 160mg STAT bolus dose (give over 3-5mins) – Dose does not need to be adjusted for renal dysfunction.

Two further doses of teicoplanin IV should be prescribed and administered as follows:

- Promptly once the patient comes off cardio-pulmonary bypass.
- One further dose should be given at 12 hours post-op

In addition:

- If patient has **over 1500ml of blood loss, promptly prescribe and administer**:
  Give Teicoplanin 200mg dose **PLUS** Gentamicin 80mg. Do not repeat for further losses.

High Risk of Cardiac Infection

(Previous cardiac surgery / Previous Endocarditis)

Previous cardiac surgery / Previous endocarditis (not on current treatment):
Give antibiotics within 60 minutes before skin incision

Teicoplanin
Dose (Weight less than 80 kg): 600 mg - intravenous injection over 3 to 5 minutes
Dose (Weight greater than or equal to 80 kg): 800 mg - intravenous infusion over 30mins

PLUS
Gentamicin
Dose: 160mg STAT bolus dose (give over 3-5mins) – Dose does not need to be adjusted for renal dysfunction

In addition:

Two further doses of teicoplanin IV should be prescribed and administered as follows:

1. Promptly once the patient comes off cardio-pulmonary bypass.
2. One further teicoplanin dose should be given 12 hours post-op

- If patient has **over 1500ml of blood loss, promptly prescribe and administer**: Give Teicoplanin 200mg dose **PLUS** Gentamicin 80mg. Do not repeat for further losses.

Re-Exploration

First Line including if MRSA positive **:** Give within 60 minutes before skin incision

Piperacillin-tazobactam
Dose: 4.5 g - intravenous infusion over 30 minutes - four times a day
Continue for up to a maximum of 48 hours

PLUS
Teicoplanin- Continue for up to 48 hours

Dose (Weight less than 80 kg): 600 mg - intravenous injection over 3 to 5 minutes – ONCE daily.
Dose (Weight greater than or equal to 80 kg): 800 mg - intravenous infusion over 30mins – ONCE daily.

In addition:

- If patient remains in theatre for **over 6 hours**:
  Give piperacillin-tazobactam 4.5g IV dose. This should be repeated every 6 hours while in theatre.

- If patient has **over 1500ml of blood loss promptly prescribe and administer**:
  Piperacillin-tazobactam 2.25g IV dose **PLUS** Teicoplanin 200mg dose. Do not repeat for further losses.

Penicillin allergy: Give within 60 minutes before skin incision.

Ciprofloxacin
Dose: 400mg - intravenous infusion over 60 minutes - three times a day **or** 750mg – enterally (oral/NG) – twice a day**.**
Continue for up to a maximum of 48 hours

PLUS
Teicoplanin
Dose (Weight less than 80 kg): 600 mg - intravenous injection over 3 to 5 minutes – ONCE daily.
Dose (Weight greater than or equal to 80 kg): 800 mg - intravenous infusion over 30mins – ONCE daily.
Continue for up to a maximum of 48 hours

In addition:

- If patient remains in theatre for **over 8 hours**:
  Give Ciprofloxacin 400mg IV infusion. This should be repeated every 8 hours while in theatre.

- If patient has **over 1500ml of blood loss, promptly prescribe and administer**:
  Ciprofloxacin 200mg IV dose **PLUS** Teicoplanin 200mg dose. Do not repeat for further losses.

Lung Transplantation (Non-Cystic Fibrosis Patients)

Comment: Recipients with a documented history of antibiotic resistances should have targeted regimes prescribed until perioperative BAL cultures return

MUST CHECK PREVIOUS MICROBIOLOGY RESULTS AND SENSITIVITY FOR NEED TO MODIFY BELOW STANDARD PROPHYLAXIS:

First Line: Give within 60 minutes before skin incision

Piperacillin-tazobactam
Dose: 4.5 g - intravenous infusion over 30minutes - four times a day.
Continue until donor BAL cultures available, up to a maximum of 5 days

PLUS
Teicoplanin
Continue until donor BAL cultures available, up to a maximum of 5 days

Dose (Weight less than 80 kg): 600 mg - intravenous injection over 3 to 5 minutes – ONCE daily.
Dose (Weight greater than or equal to80 kg): 800 mg - intravenous infusion over 30mins – ONCE daily.

In addition:

- If patient remains in theatre for **over 6 hours**:
  Give piperacillin-tazobactam 4.5g IV dose. This should be repeated every 6 hours while in theatre.
- If patient has **over 1500ml of blood loss, promptly prescribe and administer**:
  Give piperacillin-tazobactam 2.25g IV dose **PLUS** Teicoplanin 200mg dose. Do not repeat for further losses.

Penicillin allergic patients: Give 60 minutes before skin incision

Ciprofloxacin
Continue until donor BAL cultures available up to a maximum of 5 days

Dose: 400mg – Intravenous infusion over 60mins – three times daily (TDS).

PLUS
Teicoplanin
Continue until donor BAL cultures available up to a maximum of 5 days

Dose (Weight less than 80 kg): 600 mg - intravenous injection over 3 to 5 minutes – ONCE daily.
Dose (Weight greater than or equal to 80 kg): 800 mg - intravenous infusion over 30mins – ONCE daily.

In addition:

- If patient in theatre for **over 8 hours**:
  Give Ciprofloxacin 400mg IV infusion. This should be repeated every 8 hours while in theatre.
- If patient has **over 1500ml of blood loss, promptly prescribe and administer**:
  Ciprofloxacin 200mg IV dose **PLUS** Teicoplanin 200mg dose. Do not repeat for further losses.

Lung Transplantation (Cystic Fibrosis/ Bronchiectasis Patients)

DISCUSS WITH TRANSPLANT TEAM FOR TAILORED SURGICAL PROPHYLAXIS BASED ON PREVIOUS MICROBIOLOGY RESULTS AND SENSITIVITIES

Heart Transplant

First line: Give within 60 minutes before skin incision

Flucloxacillin
Dose: 2g STAT.

PLUS
Gentamicin
Dose: 160mg STAT bolus dose (give over 3-5mins) – Dose does not need to be adjusted for renal dysfunction

In addition:

- If patient remains on bypass at 4 hours re-dose patient with **flucloxacillin 2G IV**.
- If patient remains on bypass at 10 hours re-dose patient with **flucloxacillin 2G IV**. Repeat every 6 hours until the end of procedure.

- Give an additional dose of Flucloxacillin 1g IV when the patient comes off cardio-pulmonary bypass.

- If patient has **over 1500ml of blood loss, promptly prescribe and administer**: Flucloxacillin 1g IV **PLUS** Gentamicin 80mg.
  Do not repeat for further losses.

Four further doses of flucloxacillin IV should be prescribed and administered as follows:

1**.** **Flucloxacillin 1G IV** promptly once the patient comes off cardio-pulmonary bypass.

2,3 & 4. Three further **flucloxacillin 2G IV** doses should be given every **6 hours** (6,12 and 18 hours) post-op

Notes: No monitoring of Gentamicin levels required for surgical prophylaxis doses.

Penicillin allergic / MRSA positive: Give 60 minutes before skin incision

Teicoplanin
Dose (Weight less than 80 kg): 600 mg - intravenous injection over 3 to 5 minutes
Dose (Weight greater than or equal to 80 kg): 800 mg - intravenous infusion over 30mins

PLUS
Gentamicin
Dose: 160mg STAT bolus dose (give over 3-5mins) – Dose does not need to be adjusted for renal dysfunction

Two further doses of teicoplanin IV should be prescribed and administered as follows:
1. Promptly once the patient comes off cardio-pulmonary bypass.

2. One further dose should be given at 12 hours post-op

In addition:

- If patient has **over 1500ml of blood loss, promptly prescribe and administer**: Give Teicoplanin 200mg dose **PLUS** Gentamicin 80mg. Do not repeat for further losses.

Ventricular Assist Device (VAD) / Extracorporeal Membrane Oxygenation (ECMO)

Practice Points

- ALL patients undergoing VADs and ECMO must have a complete line change in the peri-operative period. Ideally this should occur at the outset i.e. in the anaesthetic room. Other long term lines (such as PICC lines) should also be removed.
- Reduce the number and duration of lines for IV therapy and monitoring:
    - Establish which invasive line would be most suitable, consider: medication to be administered, duration of therapy, risk of infection and patient comfort etc.
    - ALL lines are to be inserted with strict aseptic techniques (using gloves, gowns and masks)
    - Remove lines and urinary catheters whenever possible
- **MRSA decolonisation with Mupirocin nasal ointment and Octenisan body wash for 48hours prior to surgery and continue for 72hours postoperatively.**

First Line: Give within 60 minutes before skin incision

Piperacillin-tazobactam
Dose: 4.5 g - intravenous infusion over 30minutes - four times a day.
Continue for up to a maximum of 48 hours

PLUS
Teicoplanin
Continue for up to a maximum of 48 hours

Dose (Weight less than 80 kg): 600 mg - intravenous injection over 3 to 5 minutes – ONCE daily.
Dose (Weight greater than or equal to 80 kg): 800 mg - intravenous infusion over 30 mins – ONCE daily.

In addition:

- If patient in theatre for **over 6 hours**:
  Give a piperacillin-tazobactam 4.5g IV dose.
  This should be repeated every 6 hours while in theatre.

- If patient has **over 1500ml of blood loss, promptly prescribe and administer**:
  Piperacillin-tazobactam 2.25g IV **PLUS** Teicoplanin 200mg IV.
  Do not repeat for further losses.

Penicillin allergic patients: Give within 60 minutes before skin incision

Ciprofloxacin
Dose: 400mg – Intravenous infusion over 60 mins – three times daily (TDS).
Continue for up to a maximum of 48 hours

PLUS
Teicoplanin
Dose (Weight less than 80 kg): 600 mg intravenous injection over 3 to 5 minutes – ONCE daily. Continue for up to a maximum of 48 hours
Dose (Weight greater than or equal to 80 kg): 800 mg intravenous infusion over 30 mins – ONCE daily.
Continue for up to a maximum of 48 hours

Note:

- If patient in theatre for **over 8 hours**:
  Give Ciprofloxacin 400mg IV infusion. This should be repeated every 8 hours while in theatre.
- If patient has **over 1500ml of blood loss**:
  Give Ciprofloxacin 200mg IV dose **PLUS** Teicoplanin 200mg dose.
  Do not repeat for further losses.

Thoracic Surgery

Practice Points:

- Preoperative administration of prophylactic antibiotics decreases surgical site infection (SSI) after thoracic surgery but does not demonstrate any effect on the rate of postoperative pneumonia or empyema.
- Intravenous antibiotics should be given no more than 60 min prior to skin incision, usually at the time of anaesthesia induction.
- Antibiotic doses during prolonged operations or when blood loss exceeds 1500 ml may be repeated according to the half-life of the chosen medication.

- When procedures occur in patients already in hospital and on antibiotics(e.g. haemothorax/mediastinal washouts etc), if patients are already on antimicrobials then additional dosing in theatre outside of their normal schedule may not be required. Please contact Infection service if in doubt.

Conventional Cancer Surgery (via VATs, RATs or thoracotomy)

LUNG RESECTION (WEDGE, SEGMENT, LOBE), SLEEVE OPERATION (SINGLE OR DOUBLE)

First line:
Co-amoxiclav 1.2g at induction

Second line (MRSA colonisation  **or penicillin allergy):**

Teicoplanin
One stat dose at induction

Dose
Weight less than 80 kg: 600 mg intravenous injection over 3 to 5 minutes
Weight greater than or equal to 80 kg: 800 mg intravenous infusion over 30 mins

Plus

Gentamicin 120mg dose at induction

PNEUMONECTOMY, SLEEVE LOBECTOMY

First line:
Co-amoxiclav 1.2g every 9 hours for 3 doses (24 hours)

Second line (MRSA colonisation  **or penicillin allergy):**

Teicoplanin
Two doses 12 hours apart

Dose
Weight less than 80 kg: 600 mg intravenous injection over 3 to 5 minutes
Weight greater than or equal to 80 kg: 800 mg intravenous infusion over 30 mins

Plus

Gentamicin 300mg

Pleural Surgery (via VATs, RATs or thoracotomy)

PLEURAL BIOPSY + INDWELLING PLEURAL CATHETER INSERTION, PNEUMOTHORAX SURGERY (PLEURECTOMY, TALC PLEUROEDESIS), DECORTICATION (ASSUMING PT IS NOT ON TREATMENT ANTIBIOTICS)

First line:
Co-amoxiclav 1.2g at induction

Second line (MRSA colonisation  **or penicillin allergy):**

Teicoplanin
One stat dose at induction

Dose
Weight less than 80 kg: 600 mg intravenous injection over 3 to 5 minutes
Weight greater than or equal to 80 kg: 800 mg intravenous infusion over 30 mins

Plus

Gentamicin 120mg dose at induction

PLEURAL BIOPSY ALONE

No antibiotic prophylaxis required.

Trauma Surgery (via VATs, RATs or thoracotomy)

WASH OUT OF HAEMOTHORAX (FOR TRAUMA), RIB FRACTURE REPAIR.

First line:
Co-amoxiclav 1.2g at induction

Second line (MRSA colonisation  **or penicillin allergy):**

Teicoplanin
One stat dose at induction

Dose
Weight less than 80 kg: 600 mg intravenous injection over 3 to 5 minutes
Weight greater than or equal to 80 kg: 800 mg intravenous infusion over 30 mins

Plus

Gentamicin 120mg dose at induction

Mediastinal Surgery (via VATs, RATs or thoracotomy)

[NB. for procedures via median sternotomy - relevant section]

THYMUS RESECTION, ANTERIOR MEDIASTINAL MASS RESECTION, POSTERIOR MEDIASTINAL MASS RESECTION, MEDIASTINOSCOPY

First line:
Co-amoxiclav 1.2g at induction

Second line (MRSA colonisation or penicillin allergy):

Teicoplanin
One stat dose at induction

Dose
Weight less than 80 kg: 600 mg intravenous injection over 3 to 5 minutes
Weight greater than or equal to 80 kg: 800 mg intravenous infusion over 30 mins

Plus

Gentamicin 120mg dose at induction

Mediastinal Surgery (via median sternotomy)

THYMUS RESECTION, ANTERIOR MEDIASTINAL MASS RESECTION, POSTERIOR MEDIASTINAL MASS RESECTION

First line:
Co-amoxiclav 1.2g every 9 hours for 3 doses (24 hours)

Second line (MRSA colonisation  **or penicillin allergy):**

Teicoplanin
Two doses 12 hours apart

Dose
Weight less than 80 kg: 600 mg intravenous injection over 3 to 5 minutes
Weight greater than or equal to 80 kg: 800 mg intravenous infusion over 30 mins

Plus

Gentamicin 300mg

Emphysema Surgery (via VATs, RATs or thoracotomy)

LUNG VOLUME REDUCTION, ENDOBRONCIAL VALVES

First line:
Co-amoxiclav 1.2g every 9 hours for 3 doses (24 hours)

Second line (MRSA colonisation  **or penicillin allergy):**

Teicoplanin
Two doses 12 hours apart

Dose
Weight less than 80 kg: 600 mg intravenous injection over 3 to 5 minutes
Weight greater than or equal to 80 kg: 800 mg intravenous infusion over 30 mins

Plus

Gentamicin 300mg

For these procedures the 24 hours prophylaxis is followed by 5 days of oral antibiotics as per UHB guidelines (CG972) EmphysemaGuideline.pdf.

PRIMARY CLOSURE, WITH MUSCLE FLAP, WITH SPINAL INVOLVEMENT

First line:
Co-amoxiclav 1.2g every 9 hours for 3 doses (24 hours)

Second line (MRSA colonisation  **or penicillin allergy):**

Teicoplanin
Two doses 12 hours apart

Dose
Weight less than 80 kg: 600 mg intravenous injection over 3 to 5 minutes
Weight greater than or equal to 80 kg: 800 mg intravenous infusion over 30 mins

Plus

Gentamicin 300mg

These cases are often joint with plastics or neurosurgery so cross-referencing with speciality specific guidelines may be required.

Airway Surgery

TRACHEAL RESECTION

First line:
Co-amoxiclav 1.2g every 9 hours for 3 doses (24 hours)

Second line (MRSA colonisation  **or penicillin allergy):**

Teicoplanin
Three doses 12 hours apart (total 24 hours)

Dose
Weight less than 80 kg: 600 mg intravenous injection over 3 to 5 minutes
Weight greater than or equal to 80 kg: 800 mg intravenous infusion over 30 mins

Plus

Gentamicin 300mg

RIGID BRONCHOSCOPY (WITH OR WITHOUT INTERVENTION)

No antibiotic prophylaxis required.

References

- Dale W. Bratzler, E. Patchen Dellinger, et al. Clinical practice guidelines for antimicrobial prophylaxis in surgery, *American Journal of Health-System Pharmacy*, Volume 70, Issue 3, 1 February 2013, Pages 195–283

- Batchelor T et. Al Guidelines for enhanced recovery after lung surgery: recommendations of the Enhanced Recovery After Surgery (ERAS®) Society and the European Society of Thoracic Surgeons (ESTS). *European Journal of Cardio-Thoracic Surgery*, Volume 55, Issue 1, January 2019, Pages 91–115

Ear, Nose and Throat (ENT)

- Screen all patients for MRSA prior to surgery according to the UHB MRSA policy http://uhbpolicies/documents/mrsa.htm
- Review previous Microbiology results for other multi-drug resistant organisms 
- For best efficacy **antibiotics should be given within 60minutes prior to incision**
- Depending on the half-life of the antibiotics given for surgical prophylaxis doses will need to be re-dosed in extended surgery (i.e. over 4 hours). See specific guideline below for advice on when to re-dose antibiotics.
- In the event of major intra-operative blood loss in adults (more than 1,500 ml) additional dosage of prophylactic antibiotic should be given 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

Cochlear Implant Insertion Prophylaxis

First choice:

Flucloxacillin
Dose: 1g intravenous injection - one dose within 60 minutes before incision.

PLUS
Gentamicin
Dose: 160mg intravenous bolus dose (give over 3-5mins) – Give within 60 minutes before incision. Dose does not need to be adjusted for renal dysfunction

Second choice (penicillin allergic or colonised with MRSA): 

Teicoplanin
Dose (Weight less than 80 kg): 600 mg intravenous injection over 3 to 5 minutes
Dose (Weight greater than or equal to 80 kg): 800 mg intravenous infusion over 30 mins

PLUS
Gentamicin
Dose: 160mg intravenous bolus dose (give over 3-5mins) – Give within 60 minutes before incision. Dose does not need to be adjusted for renal dysfunction

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 all patients for MRSA prior to surgery according to the UHB MRSA policy http://uhbpolicies/documents/mrsa.htm
- Review previous Microbiology results for other multi-drug resistant organisms 
- For best efficacy **antibiotics should be given within 60minutes prior to incision**
- Depending on the half-life of the antibiotics given for surgical prophylaxis doses will need to be re-dosed in extended surgery (i.e. over 4 hours). See specific guideline below for advice on when to re-dose antibiotics.
- In the event of major intra-operative blood loss in adults (more than 1,500 ml) additional dosage of prophylactic antibiotic should be given 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 less than 80 kg): 600 mg - intravenous injection over 3 to 5 minutes
Dose (Weight greater than or equal to80 kg): 800 mg - intravenous infusion over 30mins

PLUS
Gentamicin
Dose: 160mg – intravenous bolus dose (give over 3-5mins) – Give within 60 minutes before incision. Dose does not need to be adjusted for renal dysfunction

Gastro-Intestinal Surgery

Practice points:

- Screen all patients for MRSA prior to surgery according to the UHB MRSA policy http://uhbpolicies/documents/mrsa.htm
- Review previous Microbiology results for other multi-drug resistant organisms
- For best efficacy **antibiotics should be given within 60minutes prior to incision**
- Depending on the half-life of the antibiotics given for surgical prophylaxis doses will need to be re-dosed in extended surgery (i.e. over 4 hours). See specific guideline below for advice on when to re-dose antibiotics.
- In the event of major intra-operative blood loss in adults (more than 1,500 ml) additional dosage of prophylactic antibiotic should be given 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.

'Clean' Surgery

Hernia Repair With or Without Mesh/ Benign Laparoscopic Oesophageal Surgery (ALL)/ Laparoscopic Ventral Rectopexy

- No antibiotic prophylaxis recommended
- Recommendations based on SIGN Guideline 104, 2014.

'Clean Contaminated' or 'Contaminated' surgery

Appendectomy Without Perforation/ Oesophageal, Duodenal, Gastric Surgery

First choice:

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

If procedure lasts more than 4 hours: Give a second dose of 600mg IV.

Second choice (penicillin allergic):

Gentamicin
Dose: 160mg intravenous bolus dose (give over 3-5mins) – Give within 60 minutes before incision. Dose does not need to be adjusted for renal dysfunction

PLUS
Metronidazole
Dose: 500mg - intravenous injection – one dose within 30 minutes before incision.

Second choice (MRSA positive):

Gentamicin
Dose: 160mg intravenous bolus dose (give over 3-5mins) – Give within 60 minutes before incision. Dose does not need to be adjusted for renal dysfunction

PLUS
Metronidazole
Dose: 500mg intravenous injection – one dose within 30 minutes before incision.

PLUS
Teicoplanin
Dose (Weight less than 80 kg): 600 mg - intravenous injection over 3 to 5 minutes
Dose (Weight greater than or equal to 80 kg): 800 mg - intravenous infusion over 30mins

Comment: If ESBL positive Gram negative organisms have been previously isolated in a patient, the antibiotic prophylaxis should include adequate cover, such as Meropenem 1g STAT followed by 500mg after 4 hours if procedure last longer than 4 hours.
Recommendations based on SIGN Guideline 104, 2008 and BNF 65, March 2013.

Surgery with Established Infection

Appendicitis with Perforation/ Closure of Perforated Duodenal Ulcer/ Hartmann's Procedure for Colonic Perforation

First line:

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

If procedure lasts more than 4 hours: Give a second dose of 600mg IV.
May need to be continued with three times a day dosing for up to 5 days

In addition for septic patients

Add: 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.

Second line (penicillin allergic):

Gentamicin
Dose: 160mg intravenous bolus dose (give over 3-5mins) – Give within 60 minutes before incision. Dose does not need to be adjusted for renal dysfunction

PLUS
Metronidazole
Dose: 500mg intravenous infusion – One dose 30mins before incision.

Post operatively:
Continue ciprofloxacin 400mg intravenously – three times daily (tds) for up to 5 days
PLUS

Metronidazole 500mg intravenously – three time daily (tds)
May need to be continued with once a day dosing for up to 5 days.

Second line (if MRSA positive):

Gentamicin
Dose: 160mg – intravenous bolus dose (give over 3-5mins) – Give within 60 minutes before incision. Dose does not need to be adjusted for renal dysfunction

PLUS
Metronidazole
Dose: 500mg - intravenous injection – one dose within 30 minutes before incision.

PLUS
Teicoplanin
Dose (Weight less than 80 kg): 600 mg - intravenous injection over 3 to 5 minutes
Dose (Weight greater than or equal to 80 kg): 800 mg - intravenous infusion over 30mins

Post operatively:
Continue ciprofloxacin 400mg intravenously – three times daily (tds) for up to 5 days
PLUS
Metronidazole 500mg intravenously – three time daily (tds)
May need to be continued with once a day dosing for up to 5 days.

Comment:

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

Surgical Prophylaxis in Peritonitis

Continue antibiotics for treatment of Peritonitis – see guideline

Hand Surgery – Prophylaxis and Treatment

- Screen all patients for MRSA prior to surgery according to the UHB MRSA policy http://uhbpolicies/documents/mrsa.htm
- Review previous Microbiology results for other multi-drug resistant organisms
- For best efficacy **antibiotics should be given within 60minutes prior to incision**
- Depending on the half-life of the antibiotics given for surgical prophylaxis doses will need to be re-dosed in extended surgery (i.e. over 4 hours). See specific guideline below for advice on when to re-dose antibiotics.
- In the event of major intra-operative blood loss in adults (more than1,500 ml) additional dosage of prophylactic antibiotic should be given 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.
- If microbiological sampling is needed in the case of suspected infection, prophylaxis should be delayed until the sampling has been done.
- 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):
Teicoplanin
Dose (Weight less than 80 kg): 600 mg - intravenous injection over 3 to 5 minutes
Dose (Weight greater than or equal to 80 kg): 800 mg - intravenous infusion over 30mins

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

If the last known MRSA was clindamycin (erythromycin) sensitive:
Clindamycin
Dose: 450mg oral – four times a day

PLUS at induction (within 30 minutes before incision):
Clindamycin
Dose: 600mg intravenous infusion – one dose.

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

OR

If the last known MRSA was neither tetracycline nor clindamycin sensitive:

Linezolid
Dose: 600mg two times a day - oral

PLUS at induction (within 30 minutes before incision):
Teicoplanin
Dose (Weight less than 80 kg): 600 mg - intravenous injection over 3 to 5 minutes
Dose (Weight greater than or equal to 80 kg): 800 mg - intravenous infusion over 30mins

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

Heavily contaminated hand wounds (or those from contaminated environment)

Immunisation

Review patient's tetanus immunisation history. Consider giving tetanus booster and immunoglobulin to high risk patients as per 'The Green Book' https://www.gov.uk/government/collections/immunisation-against-infectious-disease-the-green-book

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
Gentamicin
Dose: 160mg intravenous bolus dose (give over 3-5mins) – Give within 60 minutes before incision. Dose does not need to be adjusted for renal dysfunction

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
Gentamicin
Dose: 160mg intravenous bolus dose (give over 3-5mins) – Give within 60 minutes before incision. Dose does not need to be adjusted for renal dysfunction

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

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

Soft tissue infection/Cellulitis

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

Closed fracture fixation

See orthopaedic prophylaxis guidelines for fixation of closed fractures

Elective Hand Surgery

- Screen all patients for MRSA prior to surgery according to the UHB MRSA policy http://uhbpolicies/documents/mrsa.htm
- Review previous Microbiology results for other multi-drug resistant organisms
- For best efficacy **antibiotics should be given within 60minutes prior to incision**
- Depending on the half-life of the antibiotics given for surgical prophylaxis doses will need to be re-dosed in extended surgery (i.e. over 4 hours). See specific guideline below for advice on when to re-dose antibiotics.
- In the event of major intra-operative blood loss in adults (more than 1,500 ml) additional dosage of prophylactic antibiotic should be given 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.

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 (Weight less than 80 kg): 600 mg - intravenous injection over 3 to 5 minutes
Dose (Weight greater than or equal to 80 kg): 800 mg - intravenous infusion over 30mins

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

Arthroplasty including bone grafting

Use orthopaedic prophylaxis guideline for arthroplasty/implant insertion

Amputation

Use orthopaedic prophylaxis guideline for amputation

Hepatology and Hepato-Biliary Surgical Prophylaxis

Laparoscopic Cholecystectomy and Open Cholecystectomy

- Screen all patients for MRSA prior to surgery according to the UHB MRSA policy http://uhbpolicies/documents/mrsa.htm
- Review previous Microbiology results for other multi-drug resistant organisms
- For best efficacy **antibiotics should be given within 60minutes prior to incision**
- Depending on the half-life of the antibiotics given for surgical prophylaxis doses will need to be re-dosed in extended surgery (i.e. over 4 hours). See specific guideline below for advice on when to re-dose antibiotics.
- In the event of major intra-operative blood loss in adults (more than 1,500 ml) additional dosage of prophylactic antibiotic should be given 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: Coliforms and anaerobes

First choice:

Co-amoxiclav
Dose: 1.2g intravenous injection – single dose within 60 minutes before incision.

If procedure lasts more than 4 hours, a second dose of 600mg IV should be given

Second choice (penicillin allergic):

Ciprofloxacin
Dose: 400mg intravenous infusion – single dose , infusion to complete within 60 minutes before incision

PLUS
Metronidazole
Dose: 500mg intravenous injection single dose within 60 minutes before incision

Second line (If MRSA positive):

Ciprofloxacin
Dose: 400mg intravenous infusion – single dose , infusion to complete within 60 minutes before incision

PLUS
Metronidazole
Dose: 500mg intravenous injection single dose within 60 minutes before incision

PLUS
Teicoplanin
Dose (Weight less than 80 kg): 600 mg - intravenous injection over 3 to 5 minutes
Dose (Weight greater than or equal to 80 kg): 800 mg - intravenous infusion over 30mins

If ESBL positive Gram negative organisms have been previously isolated in a patient, the antibiotic prophylaxis should include adequate cover, in accordance with sensitivities results.

Reference:

- ECDC . Systematic review and evidence based guidance on perioperative antibiotic prophylaxis 2013 https://www.ecdc.europa.eu/sites/default/files/media/en/publications/Publications/Perioperative%20antibiotic%20prophylaxis%20-%20June%202013.pdf
- NICE NG 125 guideline. Surgical site infections: prevention and Treatment. 2019
- Sang Hoon Kim et al. Role of prophylactic antibiotics in elective laparoscopic cholecystectomy: A systematic review and meta-analysis Ann Hepatobiliary Pancreat Surg 2018;22:231-247

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:

- Neuberger J, Patel J, Caldwell H, Davies S et al Guidelines on the use of liver biopsy in clinical practice from the British Society of Gastroenterology, the Royal College of Radiologists and the Royal College of Pathology.Gut 2020. Available at: https://www.bsg.org.uk/wp-content/uploads/2020/06/gutjnl-2020-321299.full_.pdf Accessed: 6.4.22
- Venkatesan et al. Practice Guideline for Adult Antibiotic Prophylaxis during Vascular and Interventional Radiology Procedures. J Vasc Interv Radiol 2010; 21:1611–1630.

Liver Resection Prophylaxis

- Screen all patients for MRSA prior to surgery according to the UHB MRSA policy http://uhbpolicies/documents/mrsa.htm
- Review previous Microbiology results for other multi-drug resistant organisms 
- For best efficacy **antibiotics should be given within 60minutes prior to incision**
- Depending on the half-life of the antibiotics given for surgical prophylaxis doses will need to be re-dosed in extended surgery (i.e. over 4 hours). See specific guideline below for advice on when to re-dose antibiotics.
- In the event of major intra-operative blood loss in adults (more than 1,500 ml) additional dosage of prophylactic antibiotic should be given 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.
- **Patients with a pre-operative biliary stent receive also in addition a dose of Fluconazole 100mg**
- Organisms: Coliforms and anaerobes

First choice:

Co-amoxiclav
Dose: 1.2g intravenous injection – single dose within 60 minutes before incision.

If procedure lasts more than 4 hours, a second dose of 600mg IV should be given

Second choice (penicillin allergy):

Ciprofloxacin 400mg BD for 24hrs (i.e. 2 doses in total)

PLUS
Metronidazole 500mg TDS for 24hrs (i.e. 3 doses in total)

Pancreatic Resection Prophylaxis

- Screen all patients for MRSA prior to surgery according to the UHB MRSA policy http://uhbpolicies/documents/mrsa.htm
- Review previous Microbiology results for other multi-drug resistant organisms 
- For best efficacy **antibiotics should be given within 60minutes prior to incision**
- Depending on the half-life of the antibiotics given for surgical prophylaxis doses will need to be re-dosed in extended surgery (i.e. over 4 hours). See specific guideline below for advice on when to re-dose antibiotics.
- In the event of major intra-operative blood loss in adults (more than 1,500 ml) additional dosage of prophylactic antibiotic should be given 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.
- **Patients with a pre-operative biliary stent receive also in addition a dose of Fluconazole 100mg**
- Organisms: Coliforms and anaerobes

First choice:

Piperacillin-tazobactam
Dose: 4.5g intravenous – three times a day, for 24 hours (i.e. 3 doses in total). First infusion to complete within 60 minutes before incision.

Second choice (penicillin allergic):

Ciprofloxacin
Dose: 400mg intravenous infusion – twice a day, for 24 hours (i.e. 2 doses in total). First infusion to complete within 60 minutes before incision.

PLUS
Metronidazole
Dose: 500mg intravenous injection – three times a day, for 24 hours (i.e. 3 doses in total)

Second line (If MRSA positive): 

Ciprofloxacin
Dose: 400mg intravenous infusion – twice a day, for 24 hours (i.e. 2 doses in total). First infusion to complete within 60 minutes before incision.

PLUS
Metronidazole
Dose: 500mg intravenous injection single dose within 60 minutes before incision

PLUS
Teicoplanin
Dose (Weight less than 80 kg): 600 mg - intravenous injection over 3 to 5 minutes
Dose (Weight greater than or equal to 80 kg): 800 mg - intravenous infusion over 30mins

If ESBL positive Gram negative organisms have been previously isolated in a patient, the antibiotic prophylaxis should include adequate cover according to sensitivities results.

Comments:

- If intraoperatively, the bile appears clinically infected, the antibiotics should continue for up to five days and modified according to bile culture results. Consider IV to oral switch after 24-48 hours

Liver Transplant Prophylaxis

- Screen all patients for MRSA prior to surgery according to the UHB MRSA policy http://uhbpolicies/documents/mrsa.htm
- Review previous Microbiology results for other multi-drug resistant organisms
- For best efficacy **antibiotics should be given within 60minutes prior to incision**
- Depending on the half-life of the antibiotics given for surgical prophylaxis doses will need to be re-dosed in extended surgery (i.e. over 4 hours). See specific guideline below for advice on when to re-dose antibiotics.
- In the event of major intra-operative blood loss in adults (more than 1,500 ml) additional dosage of prophylactic antibiotic should be given 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: Coliforms and anaerobes

First choice:

Piperacillin-tazobactam
Dose: 4.5g intravenous – three times a day, for 24 hours (i.e. 3 doses in total). In operations lasting more than 4 hrs, repeat a dose intraoperatively

PLUS
Fluconazole IV 100mg od for 5 days (or until leaving ITU if earlier)

In operations lasting over 6 hrs, repeat 2.25g IV dose intraoperatively

Second choice (penicillin allergy):

Ciprofloxacin
Dose: 400mg intravenous – twice a day, for 24 hours (i.e. 2 doses in total). First infusion to complete within 60 minutes before incision.

PLUS
Metronidazole
Dose: 500mg intravenous – three times a day, for 24 hours (i.e. 3 doses in total)

PLUS
Fluconazole IV 100mg od for 5 days (or until leaving ITU if earlier)

Second choice (MRSA positive):

Ciprofloxacin
Dose: 400mg intravenous infusion – twice a day, for 24 hours (i.e. 2 doses in total). First infusion to complete within 60 minutes before incision.

PLUS
Metronidazole
Dose: 500mg intravenous injection – three times a day, for 24 hours (i.e. 3 doses in total)

PLUS
Fluconazole IV 100mg od for 5 days (or until leaving ITU if earlier)

PLUS
Teicoplanin

Dose (Weight less than 80 kg): 600 mg - intravenous injection over 3 to 5 minutes
Dose (Weight greater than or equal to 80 kg): 800 mg - intravenous infusion over 30mins

Third choice (Penicillin allergy and MRSA positive): 

Ciprofloxacin
Dose: 400mg intravenous infusion – twice a day, for 24 hours (i.e. 2 doses in total). First infusion to complete within 60 minutes before incision.

PLUS
Metronidazole
Dose: 500mg intravenous injection – three times a day, for 24 hours (i.e. 3 doses in total)

PLUS
Fluconazole IV 100mg od for 5 days (or until leaving ITU if earlier)

PLUS
Teicoplanin
Dose (Weight less than 80 kg): 600 mg - intravenous injection over 3 to 5 minutes
Dose (Weight greater than or equal to 80 kg): 800 mg - intravenous infusion over 30mins

Antifungal prophylaxis:

High risk patients with fulminant liver failure or re-transplantation should have the above fluconazole replaced with:

Ambisome® IV 50mg od (Make up 50mg dose and give 1mg test dose over 10mins. Monitor for 15mins. If no reaction continue with infusion of rest of 49mg). Ensure completed within 60mins prior to surgery

Comments:

- For further information, including PCP and CMV prophylaxis, refer to http://uhbpolicies/documents/microbiological-considerations-liver-transplant-and-hpb-patients.htm

Transjugular intrahepatic portosystemic shunt (TIPS) procedures /

Percutaneous cholangiogram (including stents/dilation) /

T-Tube removal in transplant patients

Ciprofloxacin
Dose: 750mg oral - one dose, one hour before procedure

If patient MRSA positive  **:**
As above PLUS:
Teicoplanin
Dose (Weight less than 80 kg): 600 mg - intravenous injection over 3 to 5 minutes
Dose (Weight greater than or equal to 80 kg): 800 mg - intravenous infusion over 30mins

References

- Tripathi D, Stanley A, Hayes P, Travis S et al. Transjugular intrahepatic portosystemic stent-shunt in the management of portal hypertension. Gut 2020. Available at: https://www.bsg.org.uk/wp-content/uploads/2019/10/TIPSS_Gut_2020.pdf Accessed: 6.4.22
- Venkatesan AM et al. Practice Guideline for Adult Antibiotic Prophylaxis during Vascular and Interventional Radiology Procedures. J Vasc Interv Radiol 2010; 21:1611–1630
- Huang SY et al. Prevention and Management of Infectious Complications of Percutaneous Interventions. Semin Intervent Radiol 2015;32:78–88

Neurosurgery

- Screen all patients for MRSA prior to surgery according to the UHB MRSA policy http://uhbpolicies/documents/mrsa.htm
- Review previous Microbiology results for other multi-drug resistant organisms 
- For best efficacy **antibiotics should be given within 60minutes prior to incision**
- Depending on the half-life of the antibiotics given for surgical prophylaxis doses will need to be re-dosed in extended surgery (i.e. over 4 hours). See specific guideline below for advice on when to re-dose antibiotics.
- In the event of major intra-operative blood loss in adults (more than 1,500 ml) additional dosage of prophylactic antibiotic should be given 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.

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 less than 80 kg): 600 mg - intravenous injection over 3 to 5 minutes
Dose (Weight greater than or equal to 80 kg): 800 mg - intravenous infusion over 30mins

PLUS
Gentamicin
Dose: 160mg intravenous bolus dose (give over 3-5mins) – Give within 60 minutes before incision. Dose does not need to be adjusted for renal dysfunction

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 80mg - intravenous injection should be given **8 hourly during the operation**

References

- ‘Infection in Neurosurgery Working Party of British Society for Antimicrobial Chemotherapy’. Use of antibiotics in penetrating craniocerebral injuries. Lancet 2000:1813-17
- ‘Infection in Neurosurgery Working Party of the British Society for Antimicrobial Chemotherapy’ Antimicrobial prophylaxis in neurosurgery and after head injury. The Lancet 1994:1547-51
- Ratilal et al. Antibiotic prophylaxis for preventing meningitis in patients with basilar skull fractures Cochrane Database of Systematic review 2009
- NICE Clinical diagnosis and management of tuberculosis, and measures for its prevention and control 2006
- SIGN. Antibiotic prophylaxis in Surgery. A national clinical guideline July 2008
- Brown, EM et al. for the British Society of Antimicrobial Chemotherapy Working Part on Neurosurgical Infections Spine Update: Prevention of postoperative Infection in Patients Undergoing Spinal Surgery. Spine 29(8): 938-945, April15, 2004
- Zabranski JM, Whiting D, Darouiche RO et al. Efficacy of antimicrobial-impregnated external ventricular drain catheters: a prospective, randomised, controlled trial. J Neurosurg 2003; 98(4):725-30

Operations with Foreign Body Implantation

(craniotomies or spinal operations)

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 less than 80 kg): 600 mg - intravenous injection over 3 to 5 minutes
Dose (Weight greater than or equal to80 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 less than 80 kg): 600 mg - intravenous injection over 3 to 5 minutes
Dose (Weight greater than or equal to80 kg): 800 mg - intravenous infusion over 30mins

PLUS
Gentamicin
Dose: 160mg – intravenous bolus dose (give over 3-5mins) – Give within 60 minutes before incision. Dose does not need to be adjusted for renal dysfunction

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 80mg - intravenous injection should be given **8 hourly during the operation.**

Deep Brain Stimulation (DBS) / Vagus Nerve Stimulation (VNS) / Insertion / Battery Change Prophylaxis

- Screen all patients for MRSA prior to surgery according to the UHB MRSA policy http://uhbpolicies/documents/mrsa.htm
- Review previous Microbiology results for other multi-drug resistant organisms
- For best efficacy **antibiotics should be given within 60minutes prior to incision**
- Depending on the half-life of the antibiotics given for surgical prophylaxis doses will need to be re-dosed in extended surgery (i.e. over 4 hours). See specific guideline below for advice on when to re-dose antibiotics.
- In the event of major intra-operative blood loss in adults (more than 1,500 ml) additional dosage of prophylactic antibiotic should be given 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.
- Elective patients must wash hair with chlorhexidine 4% on day of surgery. For patients with known/suspected allergy to chlorhexidine patient should use Octenisan wash.

First line (includes MRSA cover):

Teicoplanin
Dose (Weight less than 80 kg): 600 mg - intravenous injection over 3 to 5 minutes
Dose (Weight greater than or equal to80 kg): 800 mg - intravenous infusion over 30mins

PLUS
Gentamicin
Dose: 160mg – intravenous bolus dose (give over 3-5mins) – Give within 60 minutes before incision. Dose does not need to be adjusted for renal dysfunction

No further doses of antibiotic to be given after skin closure

References:

- J.Pepper et al. The Risk of Hardware Infection in Deep Brain Stimulation Surgery Is Greater at Impulse Generator Replacement than at the Primary Procedure. Stereotact Funct Neurosurg 2013;91:56–65.
- S.Bjerknes et al. Surgical Site Infections after Deep Brain Stimulation Surgery: Frequency, Characteristics and Management in a 10-Year Period. PLoS One. 2014; 9(8): e105288.

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

First choice :

Cefuroxime
Dose: 1.5g intravenous - one dose within 30 minutes before incision.

PLUS
Metronidazole
Dose: 500mg - intravenous injection - one dose within 30 minutes before incision.

In prolonged operative procedures (more than 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**

Second choice (in cephalosporin - or severe penicillin allergic patients or in patients colonised with MRSA):

Teicoplanin
Dose (Weight less than 80 kg): 600 mg - intravenous injection over 3 to 5 minutes
Dose (Weight greater than or equal to 80 kg): 800 mg - intravenous infusion over 30mins

PLUS
Gentamicin
Dose: 160mg – intravenous bolus dose (give over 3-5mins) – Give within 60 minutes before incision. Dose does not need to be adjusted for renal dysfunction

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 80mg 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.

First choice:

Ceftriaxone
Dose: 2g - intravenous injection - twice a day - one dose within 30 minutes before incision and continued for up to 5 days postoperatively.

PLUS
Metronidazole
Dose: 500mg - intravenous injection - three times a day - one dose within 30 minutes before incision and continued for up to 5 days postoperatively.

Second choice (in case of severe/immediate penicillin allergy or cephalosporin allergy):

Vancomycin
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.
(adjust dose in renal impairment)

PLUS
Ciprofloxacin
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.

PLUS
Metronidazole
Dose: 500mg - intravenous injection - every 8 hours - one dose within 30 minutes before incision and continued for up to 5 days postoperatively.

Note: Antibiotic regimen may differ if there is a risk of an unusual environmental source, in particular with battlefield injuries. Please discuss with infection specialist in these situations.

Early Re-Operation/ Re-Opening of Surgical Wounds

Teicoplanin
Dose (Weight less than 80 kg): 600 mg - intravenous injection over 3 to 5 minutes one dose at induction.
Dose (Weight greater than or equal to 80 kg): 800 mg - intravenous infusion over 30mins one dose at induction.

PLUS
Gentamicin
Dose: 160mg – intravenous bolus dose (give over 3-5mins) – Give within 60 minutes before incision. Dose does not need to be adjusted for renal dysfunction

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 80mg - 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 (Weight less than 80 kg): 600 mg - intravenous injection over 3 to 5 minutes one dose at induction.
Dose (Weight greater than or equal to 80 kg): 800 mg - intravenous infusion over 30mins one dose at induction.

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 an infection specialist to discuss.

CSF Leaks

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 infection specialist

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 infection specialist

Spontaneous CSF leak

Pneumococcal polysaccharide vaccine (PPV23) should be given and the cause for CSF leak should be investigated.

Post-operative CSF leak (transsphenoidal 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 ventriculoatrial 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.

Orthopaedic Surgery Prophylaxis

Arthroplasty/ Implant Insertion

- Screen all patients for MRSA prior to surgery according to the UHB MRSA policy http://uhbpolicies/documents/mrsa.htm
- Review previous Microbiology results for other multi-drug resistant organisms
- For best efficacy **antibiotics should be given within 60minutes prior to incision**
- Depending on the half-life of the antibiotics given for surgical prophylaxis doses will need to be re-dosed in extended surgery (i.e. over 4 hours). See specific guideline below for advice on when to re-dose antibiotics.
- In the event of major intra-operative blood loss in adults (more than 1,500 ml) additional dosage of prophylactic antibiotic should be given 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 60 minutes before incision. To continue to give 1g six hourly for 3 doses post-op

PLUS
Gentamicin
Dose: 160mg – intravenous bolus dose (give over 3-5mins) – Give within 60 minutes before incision. Dose does not need to be adjusted for renal dysfunction

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

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

Teicoplanin
Dose (Weight less than 80 kg): 600 mg - intravenous injection over 3 to 5 minutes
Dose (Weight greater than or equal to 80 kg): 800 mg - intravenous infusion over 30mins

PLUS
Gentamicin
Dose: 160mg – intravenous bolus dose (give over 3-5mins) – Give within 60 minutes before incision. Dose does not need to be adjusted for renal dysfunction

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 80mg - 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.

Reference:

Yates A. J, For the American Association of Hip and Knee Surgeons Evidence-Based Medicine Committee . Postoperative prophylactic antibiotics in total joint arthroplasty. Arthroplasty Today, 2018; 4 (1): 130-1.

Fixation of Closed Fractures

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 less than 80 kg): 600 mg - intravenous injection over 3 to 5 minutes
Dose (Weight greater than or equal to 80 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 maximum 1 additional dose

Open Fractures

- **Intravenous prophylactic antibiotics should be administered as soon as possible, ideally within 1 hour of injury.**
  Review tetanus status and need for vaccination and immunoglobulin.

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 patient known or high risk of MRSA add below to above regimen depending on patient allergy status:

PLUS
Teicoplanin
Dose (Weight less than 80 kg): 600 mg - intravenous injection over 3 to 5 minutes
Dose (Weight greater than or equal to 80 kg): 800 mg - intravenous infusion over 30mins

IN ADDITION:

1. **At time of first debridement:**

Co-amoxiclav **or** clindamycin (+/- vancomycin)– to continue as above

PLUS
Gentamicin
Dose: 160mg – intravenous bolus dose (give over 3-5mins) – Give within 60 minutes before incision. Dose does not need to be adjusted for renal dysfunction

2. **At the time of skeletal stabilisation and definitive soft tissue closure:**

Teicoplanin (unless has had vancomycin within last 8 hours)
Dose (Weight less than 80 kg): 600 mg - intravenous injection over 3 to 5 minutes
Dose (Weight greater than or equal to 80 kg): 800 mg - intravenous infusion over 30mins
Not to be continued

PLUS
Gentamicin
Dose: 160mg – intravenous bolus dose (give over 3-5mins) – Give within 60 minutes before incision. Dose does not need to be adjusted for renal dysfunction
Not to be continued

Reference:
British Orthopaedic Association & British Association of Plastic, Reconstructive &Aesthetic Surgeons Audit Standards for Trauma. Open fractures guideline. December 2017

Lower Limb Amputation

Click the following hyperlink for LOWER LIMB AMPUTATION

Upper Limb Amputation

First choice:

Flucloxacillin
Dose: 2g - intravenous injection over 10mins - one dose within 30 minutes before incision.
Followed by 2g four times daily for total 24 hours (3 further doses) and then review wound.

In operations lasting more than 6 hrs or more

Further doses of Flucloxacillin 2g - 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 less than 80 kg): 600 mg - intravenous injection over 3 to 5 minutes
Dose (Weight greater than or equal to 80 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 review wound.

Plastic Surgery Prophylaxis

- Screen all patients for MRSA prior to surgery according to the UHB MRSA policy http://uhbpolicies/documents/mrsa.htm
- Review previous Microbiology results for other multi-drug resistant organisms
- For best efficacy **antibiotics should be given within 60minutes prior to incision**
- Depending on the half-life of the antibiotics given for surgical prophylaxis doses will need to be re-dosed in extended surgery (i.e. over 4 hours). See specific guideline below for advice on when to re-dose antibiotics.
- In the event of major intra-operative blood loss in adults (more than 1,500 ml) additional dosage of prophylactic antibiotic should be given 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.

BREAST SURGERY

Procedure(s)	Recommendation	Penicillin allergy or MRSA colonised
• Mastectomy without reconstruction and no neoadjuvant chemo • Breast reduction (more than 25% breast volume)	No antibiotics indicated	
• Mastectomy with implant placement • Mastectomy with flap reconstruction • Wire guided wide local excision with removal of more than 25% of breast	Co-amoxiclav 1.2 g IV single dose at induction	Teicoplanin Dose (Weight less than 80 kg): 600 mg - intravenous injection over 3 to 5 minutes Dose (Weight greater than or equal to 80 kg): 800 mg - intravenous infusion over 30mins

Urological Procedures - Prophylaxis

- The below guidelines applies to patients who do **NOT** have systemic symptoms or signs of infection (e.g. fever more than 38ºC, rigors, chills, unexplained new confusion etc) or symptoms of urinary tract infection. If the patient has signs and symptoms of urinary tract infection this should be treated in-line with the following guidelines depending on likely source:
- Lower urinary tract infection (LUTI)
- Upper UTI / Pyelonephritis / UTI in a catheterised patient
- 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.

For VRE, use linezolid or teicoplanin (if not already doing so for MRSA), dependent on susceptibilities.

Transurethral Ultrasound and Biopsy of Prostrate / Transperineal Biopsy of Prostrate and Brachytherapy

First line:

Ciprofloxacin
Dose: 750mg – orally – 1-2 hours prior to procedure and two further doses at 12h and 24h after this dose.

If ciprofloxacin resistance detected the antibiotic choice should be directed by the results of susceptibility testing

If patient unable to swallow:
Gentamicin
Dose: 160mg – intravenous bolus dose (give over 3-5mins) – Give within 60 minutes before incision. Dose does not need to be adjusted for renal dysfunction

Second line (MRSA positive):

Teicoplanin
Dose (Weight less than 80 kg): 600 mg - intravenous injection over 3 to 5 minutes
Dose (Weight greater than or equal to 80 kg): 800 mg - intravenous infusion over 30mins

PLUS
Ciprofloxacin
Dose: 750mg – PO – 30-60min prior to procedure and two further doses at 12h and 24h after this dose.

Second line (ESBL positive):

Meropenem

Dose: 1g - intravenous injection - one dose less than 1 hour prior to procedure and two further doses at 8h and 16h after this dose.

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.
- Ensure MSU results are checked and treatment given matches sensitivities. Contact microbiology for further advice.

Asymptomatic bacteriuria

Single dose of prophylaxis according to organism susceptibility

OR

Gentamicin
Dose: 160mg – intravenous bolus dose (give over 3-5mins) – Give within 60 minutes before incision. Dose does not need to be adjusted for renal dysfunction

PLUS
Amoxicillin 1g - intravenous injection - single dose less than 1 hour prior to procedure

Second choice (if asymptomatic bacteriuria and MRSA positive; or penicillin allergy): 

Teicoplanin
Dose (Weight less than 80 kg): 600 mg - intravenous injection over 3 to 5 minutes
Dose (Weight greater than or equal to 80 kg): 800 mg - intravenous infusion over 30mins

PLUS
Gentamicin
Dose: 160mg – intravenous bolus dose (give over 3-5mins) – Give within 60 minutes before incision. Dose does not need to be adjusted for renal dysfunction

Second choice (if asymptomatic bacteriuria and ESBL positive): 

Gentamicin sensitive:
Amoxicillin
Dose: 1g – Intravenous bolus dose – Give within 60 minutes before incision. Single dose.

PLUS
Gentamicin
Dose: 160mg – intravenous bolus dose (give over 3-5mins) – Give within 60 minutes before incision. Dose does not need to be adjusted for renal dysfunction

Gentamicin resistant:
Meropenem
Dose: 1g - intravenous injection – Give within 60 minutes before incision.

Urodynamic Studies (UDS)
(Including Video, Standard and Urethral pressure profilometry)

Antibiotic prophylaxis not recommended

References:

- European association of urology (EAU) Pocket Guidelines. Edn. presented at the EAU Annual Congress Copenhagen 2018. ISBN 978-94-92671-02-8.
- Foon R, Toozs-Hobson P, Latthe P. Cochrane Review. Prophylactic antibiotics to reduce the risk of urinary tract infections after urodynamic studies. 2012. Available at: https://www.cochranelibrary.com/cdsr/doi/10.1002/14651858.CD008224.pub2/full Accessed: 6.4.22

Endo-Urological Procedures

Extracorporeal Shock Wave Lithotripsy

Prophylaxis not routinely required unless asymptomatic bacteriuria or immunocompromised.

Ureterorendoscopy (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 / Ureteroendoscopy/ Transurethral resection of Prostrate (TURP)/ Transurethral Resection of Bladder Tumour (TURBT)

First choice:

Amoxicillin
Dose: 1g – Intravenous bolus dose – Give within 60 minutes before incision. Single dose.

PLUS
Gentamicin
Dose: 160mg – intravenous bolus dose (give over 3-5mins) – Give within 60 minutes before incision. Dose does not need to be adjusted for renal dysfunction

Second choice (MRSA positive; or penicillin allergy):

Teicoplanin
Dose (Weight less than 80 kg): 600 mg - intravenous injection over 3 to 5 minutes
Dose (Weight greater than or equal to 80 kg): 800 mg - intravenous infusion over 30mins

PLUS
Gentamicin
Dose: 160mg – intravenous bolus dose (give over 3-5mins) – Give within 60 minutes before incision. Dose does not need to be adjusted for renal dysfunction

Second choice (ESBL positive): 

Meropenem
Dose: 1g - intravenous injection – Give within 60 minutes before incision.

Percutaneous Nephrolithotomy/ Percutaneous Nephrostomy

Percutaneous nephrolithotomy

Always give prophylaxis below.

Percutaneous nephrostomy with stenting

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

First choice:

Amoxicillin
Dose: 1g – Intravenous bolus dose – Give within 60 minutes before incision. Single dose.

PLUS
Gentamicin
Dose: 160mg – intravenous bolus dose (give over 3-5mins) – Give within 60 minutes before incision. Dose does not need to be adjusted for renal dysfunction

Second choice (MRSA positive; or penicillin allergy):

Teicoplanin
Dose (Weight less than 80 kg): 600 mg - intravenous injection over 3 to 5 minutes
Dose (Weight greater than or equal to 80 kg): 800 mg - intravenous infusion over 30mins

PLUS
Gentamicin
Dose: 160mg – intravenous bolus dose (give over 3-5mins) – Give within 60 minutes before incision. Dose does not need to be adjusted for renal dysfunction

Second choice (ESBL positive):

Meropenem
Dose: 1g - intravenous injection – Give within 60 minutes before incision.

Open and Laparoscopic Procedures

Clean-contaminated (opening of intestine)

First choice (also first choice if MRSA positive):

Teicoplanin
Dose (Weight less than 80 kg): 600 mg - intravenous injection over 3 to 5 minutes
Dose (Weight greater than or equal to 80 kg): 800 mg - intravenous infusion over 30mins

PLUS
Gentamicin
Dose: 160mg – intravenous bolus dose (give over 3-5mins) – Give within 60 minutes before incision. Dose does not need to be adjusted for renal dysfunction

PLUS
Metronidazole
Dose: 500mg - intravenous injection - single dose less than 1 hour prior to procedure.

Second choice (ESBL positive):

Meropenem
Dose: 1g - intravenous injection – Give within 60 minutes before incision.

Clean-contaminated (opening of urinary tract e.g. nephrectomy, prostatectomy , cystectomy)

First choice:

Amoxicillin
Dose: 1g – Intravenous bolus dose – Give within 60 minutes before incision. Single dose.

PLUS
Gentamicin
Dose: 160mg – intravenous bolus dose (give over 3-5mins) – Give within 60 minutes before incision. Dose does not need to be adjusted for renal dysfunction

Second choice (MRSA positive or penicillin allergy): 

Teicoplanin
Dose (Weight less than 80 kg): 600 mg - intravenous injection over 3 to 5 minutes
Dose (Weight greater than or equal to 80 kg): 800 mg - intravenous infusion over 30mins

PLUS
Gentamicin
Dose: 160mg – intravenous bolus dose (give over 3-5mins) – Give within 60 minutes before incision. Dose does not need to be adjusted for renal dysfunction

Second choice (ESBL positive): 

Meropenem
Dose: 1g - intravenous injection – Give within 60 minutes before incision.

Implantation of Prosthetic Penile/ Testicular Devices

First choice (also first choice if MRSA positive):

Teicoplanin
Dose (Weight less than 80 kg): 600 mg - intravenous injection over 3 to 5 minutes
Dose (Weight greater than or equal to 80 kg): 800 mg - intravenous infusion over 30mins

PLUS
Gentamicin
Dose: 160mg – intravenous bolus dose (give over 3-5mins) – Give within 60 minutes before incision. Dose does not need to be adjusted for renal dysfunction

Comment:

- Recommendations based on SIGN (Scottish Intercollegiate Guideline Network) Guideline Antibiotic prophylaxis in Surgery 2008, updated 2014
- Bootsma AM, Laguna Pes MP, Geerlings SE, Goosens A. Antibiotic Prophylaxis in Urologic Procedures: A Systematic Review. European Urology. 2008.
- Batura D, Rao GG, Nielsen PB. Prevalence of antimicrobial resistance in intestinal flora of patients undergoing prostatic biopsy: implications for prophylaxis and treatment of infections after biopsy. BJU Int. 2010 Oct; 106(7): 1017-20.
- Taylor AK, Zembower TR, Nadler RB, Scheetz MH, Cashy JP, Bowen D, Murphy AB, Dielubanza E, Schaeffer AJ. Targeted antimicrobial prophylaxis using rectal swab cultures in med undergoing transrectal ultrasound guided prostate biopsy is associated with reduced incidence of postoperative infectious complications and cost of care. J Urol. 2012 Apr; 187(4):1275-9.
- Zani EL, Clark OA, Rodrigues Netto N Jr. Antibiotic prophylaxis for transrectal prostate biopsy. Cochrane Database Syst Rev. 2011 May 11; (5); CD006576.
- Brewster SF, MacGowan AP, Gingell JC. Antimicrobial prophylaxis for transrectal prostatic biopsy: a prospective randomized trial of cefuroxime versus piperacillin-tazobactam. Br J Urol. 1995 Sep; 76(3):351-4.
- NICE. Prophylaxis against infective endocarditis: antimicrobial prophylaxis against infective endocarditis in adults and children undergoing interventional procedures. NICE clinical guideline 64. National Institute for Health and Clinical Excellence; 2008.
- Leaper D, Collier M, Evans D, Farrington M, Gibbs E, Gould K, et al. Surgical site infection: prevention and treatment of surgical site infection. In: health editor: Royal College of Obstetrics and Gynaecology, Pres; 2008.

Vascular Surgery

- Screen all patients for MRSA prior to surgery according to the UHB MRSA policy http://uhbpolicies/documents/mrsa.htm
- Review previous Microbiology results for other multi-drug resistant organisms 
- For best efficacy **antibiotics should be given within 60minutes prior to incision**
- Depending on the half-life of the antibiotics given for surgical prophylaxis doses will need to be re-dosed in extended surgery (i.e. over 4 hours). See specific guideline below for advice on when to re-dose antibiotics.
- In the event of major intra-operative blood loss in adults (more than 1,500 ml) additional dosage of prophylactic antibiotic should be given 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.

Varicose Veins

No antibiotics 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 less than 80 kg): 600 mg - intravenous injection over 3 to 5 minutes
Dose (Weight greater than or equal to 80 kg): 800 mg - intravenous infusion over 30mins

PLUS
Gentamicin
Dose: 160mg – intravenous bolus dose (give over 3-5mins) – Give within 60 minutes before incision. Dose does not need to be adjusted for renal dysfunction

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 80mg - 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: 160mg – intravenous bolus dose (give over 3-5mins) – Give within 60 minutes before incision. Dose does not need to be adjusted for renal dysfunction

In operations lasting more than 8 hrs:

Gentamicin 80mg - 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 less than 80 kg): 600 mg - intravenous injection over 3 to 5 minutes
Dose (Weight greater than or equal to 80 kg): 800 mg - intravenous infusion over 30mins

PLUS
Gentamicin
Dose: 160mg – intravenous bolus dose (give over 3-5mins) – Give within 60 minutes before incision. Dose does not need to be adjusted for renal dysfunction

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 80mg- intravenous injection **8 hourly** during the operation

If open wound then antibiotics based on recent swabs.

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 less than 80 kg): 600 mg - intravenous injection over 3 to 5 minutes
Dose (Weight greater than or equal to 80 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: 160mg – intravenous bolus dose (give over 3-5mins) – Give within 60 minutes before incision. Dose does not need to be adjusted for renal dysfunction

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.

Open Repair Abdominal Aortic Aneurysm (AAA)/ Endovascular Abdominal Aortic Aneurysm Repair (EVAR)

First choice

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

In operations lasting more than 8 hrs:

Co-amoxiclav 1.2g - intravenous injection **8 hourly** during the operation

Second choice, if penicillin allergic or previous MRSA: 

Teicoplanin
Dose (Weight less than 80 kg): 600 mg - intravenous injection over 3 to 5 minutes
Dose (Weight greater than or equal to 80 kg): 800 mg - intravenous infusion over 30mins

PLUS
Gentamicin
Dose: 160mg – intravenous bolus dose (give over 3-5mins) – Give within 60 minutes before incision. Dose does not need to be adjusted for renal dysfunction

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 80mg - intravenous injection **8 hourly** during the operation

Angiographic Puncture of Synthetic Vascular Grafts (PTFE OR DACRON) for Angioplasty/ Stenting/ Radiological Intervention Post-EVAR

First choice

Co-amoxiclav
Dose: 1.2g - intravenous injection - single dose at induction

PLUS
Gentamicin
Dose: 160mg – intravenous bolus dose (give over 3-5mins) – Give within 60 minutes before incision. Dose does not need to be adjusted for renal dysfunction

Second choice, if penicillin allergic or previous MRSA:

Teicoplanin
Dose (Weight less than 80 kg): 600 mg - intravenous injection over 3 to 5 minutes
Dose (Weight greater than or equal to 80 kg): 800 mg - intravenous infusion over 30mins

PLUS
Gentamicin
Dose: 160mg – intravenous bolus dose (give over 3-5mins) – Give within 60 minutes before incision. Dose does not need to be adjusted for renal dysfunction

1. Pounds et al. A Changing Pattern of Infection After Major Vascular Reconstructions Vasc. Endovascular Surg. 2005 Nov-Dec;39(6):511-7
2. Sharif M et al. Prosthetic stent graft infection after endovascular abdominal aortic aneurysm repair. Journal of Vascular Surgery 2007;46:442-8.2007;46:442-8
3. **McIntosh J and Earnshaw JJ.** Antibiotic Prophylaxis for the Prevention of Infection after Major Limb Amputation. http://www.ncbi.nlm.nih.gov/pubmed/19328028## 2009 Jun;37(6):696-703
4. Turtiainen J. Surgical wound infections after vascular surgery: prospective multicenter observational study. Scandinavian Journal of Surgery 99: 167–172, 2010
5. Stewart A, Eyers PS, Earnshaw JJ. Prevention of infection in arterial reconstruction. Cochrane Database of Systematic Reviews 2006, Issue 3
6. Herbst et al. Infections and Antibiotic Prophylaxis in Reconstructive Vascular Surgery EurJ Vasc Surg 3, 303-307 (1989)

Patients with Badly Soiled Wounds to Prevent Tetanus or Gas Gangrene

- **Wound toilet and tetanus immunization are more important than antibiotics.**
- Organisms: Clostridium tetani, Clostridium perfringens

Immunisation

Consider giving tetanus immunoglobulin to high risk patients as per 'The Green Book' https://www.gov.uk/government/collections/immunisation-against-infectious-disease-the-green-book

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.

Endoscopic procedures prophylaxis

Gastrointestinal Endoscopy

Antibiotic prophylaxis is no longer recommended for the prevention of infective endocarditis in patients with cardiac risk factors who undergo diagnostic or therapeutic endoscopy. (Antibiotic Prophylaxis in Gastrointestinal Endoscopy - British Society for Gastroenterology 2009 - Allison et al. Gut 2009; 58:869-880.)

Percutaneous Endoscopic Gastrostomy (PEG) Prophylaxis Including radiographically inserted gastrostomy (RIG)

Patients having a PEG/RIG should usually receive a single dose of intravenous antibiotics during the 60minutes pre-procedure if not already on antibiotics

First choice:

Co-amoxiclav
Dose: 1.2g - intravenous injection - one dose within 60 minutes before procedure.

Second choice (non-severe penicillin allergy):

Cefuroxime
Dose: 750 mg - intravenous injection - one dose within 60 minutes before procedure.

If severe penicillin allergic (such as anaphylaxis or angioedema):

Teicoplanin
Dose (Weight less than 80 kg): 600 mg - intravenous injection over 3 to 5 minutes
Dose (Weight greater than or equal to 80 kg): 800 mg - intravenous infusion over 30mins

PLUS
Gentamicin
Dose: 160mg – intravenous bolus dose (give over 3-5mins) – Give within 60 minutes before procedure. Dose does not need to be adjusted for renal dysfunction

Reference:

Antibiotic Prophylaxis in Gastrointestinal Endoscopy - British Society for Gastroenterology 2009 - Allison et al. Gut 2009; 58:869-880

Biliary Endoscopic Procedures Prophylaxis

Summary of prophylactic antibiotic regimens on ERCP for the following patient groups (adapted from Allison at al. Antibiotic prophylaxis in gastrointestinal endoscopy, Gut 2009)

Ensure previous cultures are reviewed. If ESBL positive Gram negative organisms have been previously isolated in a patient, the antibiotic prophylaxis should be discussed with infection specialist prior to surgery.

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 infection specialist

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

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: 160mg – intravenous bolus dose (give over 3-5mins) – Give within 60 minutes before incision. Dose does not need to be adjusted for renal dysfunction

Ensure previous cultures are reviewed. If ESBL positive Gram negative organisms have been previously isolated in a patient, the antibiotic prophylaxis should be discussed with infection specialist prior to surgery.

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: 160mg – intravenous bolus dose (give over 3-5mins) – Give within 60 minutes before incision. Dose does not need to be adjusted for renal dysfunction

Ensure previous cultures are reviewed. If ESBL positive Gram negative organisms have been previously isolated in a patient, the antibiotic prophylaxis should be discussed with infection specialist prior to surgery.

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, but the choices of agents are as above.

Endoscopic Ultrasound Intervention Prophylaxis

Summary of prophylactic antibiotic regimens for the following patient groups:

Fine needle aspiration solid lesions

Rationale: Prevention of local infection

Recommendation: Not indicated

Fine needle aspiration of cystic lesions in or near pancreas, or drainage of cystic cavity

Rationale: Prevention of cyst infection

No antibiotics needed

Reference

- Facciorusso, A., Buccino, V.R., Turco, A. et al. Dig Dis Sci (2019) 64: 2308. https://doi.org/10.1007/s10620-019-05655-x

Variceal Bleeding Prophylaxis

Rationale: Prevention of infections such as bacterial peritonitis

First line:

Ceftriaxone
Dose: 1g – intravenous infusion – od (once daily) for 5-7 days

Second line (severe penicillin or cephalosporin allergy and not on quinolone prophylaxis already):

Ciprofloxacin
Dose: 400mg – intravenous infusion - bd (twice a day) for 5-7 days

Oral switch (Consider once patient can tolerate tablets):

Ciprofloxacin
Dose: 500mg – oral - bd (twice a day) for total 5-7 days including IV therapy

References:

- Tripathi et al, UK Guidelines for the Management of Variceal Haemorrhage in Cirrhotic Patients Gut 2015;0:1–25)
- Garcia-Tsao et al., Portal Hypertensive Bleeding in Cirrhosis: Risk Stratification, Diagnosis, and Management: 2016 Practice Guidance by the American Association for the Study of Liver Diseases. AASLD 2017;1:310-335

Part D: Obstetrics and Gynaecology

See UHB Trust Guidelines

Part E: Prophylaxis of Contacts of Infectious Diseases

- Meningococcal Disease
- Diptheria
- Pertussis
- Influenza

Close Contacts of Cases of Meningococcal Disease

First line:

Ciprofloxacin Dose: 500mg - oral - single dose

OR

Rifampicin Dose: 600mg – oral- twice daily – for 2 days

OR

Azithromycin (pregnant/breastfeeding women) Dose: 500mg – oral – single dose

Prophylaxis to be administered on advice from the CCDC (Consultant in Communicable Disease Control), UKHSA.
Guidance is available at:
https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/829326/PHE_meningo_disease_guideline.pdf

Close Contacts of Cases of Diphtheria

Erythromycin Dose: 500mg - oral – qds (four times a day) for 14 days

Prophylaxis to be administered on advice from the CCDC (Consultant in Communicable Disease Control), UKSHA
Guidance is available at:
https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/774753/Diphtheria_Guidelines_Final.pdf

Close Contacts of Cases of Pertussis

Erythromycin Dose: 500mg - oral - four times a day - 7 days Consider vaccination in vulnerable groups.

Prophylaxis to be administered on advice from the CCDC (Consultant in Communicable Disease Control), UKHSA. Guidance is available at:
https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/762766/Guidelines_for_the_Public_Health_management_of_Pertussis_in_England.pdf

Close Contacts of Cases of Influenza

See Influenza Post-Exposure Prevention guideline.

Part F: Antimicrobial Drug Dosing and Therapeutic Monitoring

Gentamicin, Amikacin and Tobramycin

- GENTAMICIN Extended Interval (Once Daily) Dosing (excluding Infective Endocarditis)
- GENTAMICIN Extended Interval (Once Daily) Dosing in Infective Endocarditis
- TOBRAMYCIN Extended Interval (Once Daily) Dosing
- GENTAMICIN and TOBRAMYCIN- Multiple Daily Dosing
- AMIKACIN Once Daily Dosing

Vancomycin

- Intravenous Intermittent Infusion
- Intravenous Continuous Infusion

Daptomycin

Colistimethate (Colistin)
- Dosing
- Levels

Flucytosine
- Dosing
- Levels
- References

Posaconazole
- Levels
- References

Teicoplanin
- Regular dose (Skin and soft tissue infection)
  - Dosing
  - Levels
- High Dose (including BJI, *S. aureus* infections, endocarditis)
  - Dosing
  - Levels (Bone and Joint Infection, *S. aureus* Infection) NOT ENDOCARDITIS
  - Levels (Endocarditis)

Gentamicin Extended Interval (Once Daily) Dosing and Prescribing Guidelines

Exclusion criteria:

- Ascites
- Dialysis
- Myasthenia gravis
- Pregnancy
- Severe burns
- Cystic fibrosis
- Infective endocarditis
- Paediatrics (under 16 years)
- Prophylaxis

GENTAMICIN Dose Calculation using PICS

1. Select '**Gentamicin structured prescription'** in 'Prescription' tab

2. Confirm patient has neither infective endocarditis, ascites or severe burns and is not on dialysis.

3. PICS will propose a dose based on the patients weight (which is modified in obesity) and renal function

4. Select Yes to 'Additional One Off' to ensure treatment starts as soon as possible

5. Choose the timing of subsequent doses to be given every 24 hours.

For **emergency department** patients when the need for antibiotics is urgent and no weight or recent U&Es are available the gentamicin calculator will not function. Please prescribe Gentamicin as a one off dose based on the estimated weight:

- Weight below 70kg = 240mg STAT
- Weight 70kg and above = 360mg STAT

Manual GENTAMICIN dose calculation
maybe necessary if PICS has insufficient data to calculate dose

Timing of GENTAMICIN levels and recommended range

Interpretation of results and dose adjustment

Aminoglycoside Toxicities

Manual GENTAMICIN Dose Calculation

1. Determine patients weight and Cockcroft- Gault creatinine clearance via PICS

2. Prescribe the initial gentamicin dose based on renal function and weight:

Dosing in Stable Kidney Function (Stable C.G. GFR)			Dosing in Acute Kidney Injury (AKI)	
C.G. GFR (mL/min)	**Dosage Regimen**		**C.G. GFR is inaccurate in AKI**	**Dosage Regimen**
Greater than 40mL/ min	5mg /kg once daily		AKI secondary to sepsis (Baseline C.G.GFR is greater than 40ml/min)	5mg/ kg STAT
20-40mL/ min	3mg /kg once daily		Acute on CKD (Baseline C.G.GFR is less than 40ml/min)	3mg/ kg STAT
< 20mL/ min	Discuss with Infection Specialist before commencing 3mg/kg STAT		AKI not due to sepsis	**Avoid if possible** Discuss with Infection Specialist before commencing 3mg/kg STAT

For **emergency department** patients when the need for antibiotics is urgent and no weight or recent U&Es are available, prescribe Gentamicin as a one off dose based on the estimated weight:

- Weight below 70kg = 240mg STAT
- Weight 70kg and above = 360mg STAT

GENTAMICIN dose calculation using PICS

Timing of GENTAMICIN levels and recommended range

Interpretation of results and dose adjustment

Aminoglycoside Toxicities

How to Determine Patient's Weight for Aminoglycoside Dosing on PICS

1. Click on Observations tab

2. Click on Height/ Weight tab

3. If BMI is:

a. less than 30.00 kg/ m^2 use actual weight to calculate gentamicin dose

b. greater than or equal to 30.00 kg/ m^2 use ideal body weight https://www.mdcalc.com/calc/68/ideal-body-weight-adjusted-body-weight to calculate gentamicin dose

How to Determine Cockcroft-Gault Creatinine Clearance on PICS

1. Click on Misc Res tab

2. In ‘Discipline’ drop box, select ‘Clinical Chemistry’

3. Press ‘Apply’

4. Identify the most recent C.G. GFR

Timing of GENTAMICIN Levels and Recommended Range

Pre-dose levels should be taken 20-24 hours after the last dose of gentamicin.

Renal Function	Recommended Pre-Dose **Range**	First Level Due
C.G. GFR greater than or equal to 60mL/ min	Less than 1mg/ L	0-4 hours before 2nd dose. Result MUST be taken and checked prior to administering **third** dose
C.G less than 60mL/ min or **AKI**		0-4 hours before 2nd dose. Result MUST be taken and checked prior to administering **second** dose

GENTAMICIN dose calculation using PICS

Manual GENTAMICIN dose calculation
maybe necessary if PICS has insufficient data to calculate dose

Interpretation of results and dose adjustment

Aminoglycoside Toxicities

Interpretation of Results and Dose Adjustment

Gentamicin Level	Action	Future Monitoring
Less than 1mg/ L and renal function stable	Continue on current dosing regimen	Twice weekly pre-dose levels (more frequent if unstable C.G. GFR)
High levels (greater than 1mg/ L) Check to see if level is taken at appropriate time (0-4 hours pre-dose)		
1-1.5mg/ L and renal function stable	Delay next dose by 6 hours (a repeat level is not needed) then resume dosing at every 24 hours.	Take a level pre-dose and wait for level (target less than 1mg/ L) before giving each dose
1.5- 3.0mg/ L and renal function stable	Repeat levels 12 hourly until returned level is less than 1mg /L. Once level is less than 1mg/ L resume dosing at the same dose but every 48 hours.	Take a level pre-dose and wait for level (target less than 1mg/ L) before giving each dose
Greater than 3.0mg/ L and stable renal function	**Repeat level in 24 hours.** Discuss result with antimicrobial pharmacist or microbiology.	If gentamicin therapy continues, take a level pre-dose and wait for level (target less than 1mg/ L) before giving each dose.
Unstable renal function	Minimise aminoglycoside duration wherever possible. Discuss with microbiology for alternatives.	If gentamicin therapy continues, take a level pre-dose and wait for level (target less than 1mg/ L) before giving each dose.

GENTAMICIN dose calculation using PICS

Manual GENTAMICIN dose calculation
maybe necessary if PICS has insufficient data to calculate dose

Timing of GENTAMICIN levels and recommended range

Aminoglycoside Toxicities

Aminoglycoside Toxicities

Renal Toxicity

- Monitor creatinine daily. Seek advice if renal function is unstable (e.g. a change in creatinine of greater than 15-20%).
- If the patient's creatinine has risen by 20% or more consider stopping. If aminoglycoside is continued, creatinine and drug levels should be measured daily and the case discussed with pharmacy / Infection service.

Excretion is principally via the kidney and the half-life increases exponentially as the C.G. GFR decreases; therefore accumulation arises in CKD/AKI, resulting in toxicity

Ototoxicity

- Ototoxicity secondary to aminoglycosideis 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 greater than 10 days but may occur with more than 72 hours) and is secondary to drug accumulation within the inner ear.
- Stop treatment if ototoxicity is suspected and refer to Infection service for advice.

For patients requiring more than 10 days aminoglycoside 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.

GENTAMICIN Extended Interval (Once Daily) Dosing in Infective Endocarditis

GENTAMICIN Dose Calculation for Infective Endocarditis using PICS

1. Select '**Gentamicin structured prescription'** in 'Prescription' tab

2. Confirm patient has infective endocarditis and is not on dialysis.

3. PICS will propose a dose based on the patients weight (which is modified in obesity) and renal function

4. Select Yes to 'Additional One Off' to ensure treatment starts as soon as possible

5. Choose the timing of subsequent doses to be given every 24 hours.

For **emergency department** patients when the need for antibiotics is urgent and no weight or recent U&Es are available the gentamicin calculator will not function. Please prescribe Gentamicin as a one off dose based on the estimated weight:

- Weight below 70kg = 180 mg STAT
- Weight 70kg and above = 240 mg STAT

GENTAMICIN dose calculation in Infective Endocarditis using PICS

Manual GENTAMICIN dose calculation for Infective Endocarditis
maybe necessary if PICS has insufficient data to calculate dose

Timing of GENTAMICIN peak and trough levels and recommended ranges

Interpretation of results and dose adjustment

Aminoglycoside Toxicities

References

Manual GENTAMICIN in Infective Endocarditis Dose Calculation

1. Determine patients weight and Cockcroft- Gault creatinine clearance via PICS

2. Prescribe the initial gentamicin dose based on renal function and weight:

Gentamicin Dosing in Infective Endocarditis	
C.G. GFR (mL/min)	**Dosage Regimen**
Greater than 20mL/ min	3mg /kg once daily
Less than 20mL/ min	Discuss with Infection Specialist before commencing 3mg/kg STAT A second dose should not be given unless discussed with Infection Specialist.

Please discuss treatment options in patients with unstable renal function with the Infection Service.

For **emergency department** patients when the need for antibiotics is urgent and no weight or recent U&Es are available, prescribe Gentamicin as a one off dose based on the estimated weight:

- Weight below 70kg = 180mg STAT
- Weight 70kg and above = 240mg STAT

GENTAMICIN dose calculation in Infective Endocarditis using PICS

Manual GENTAMICIN dose calculation for Infective Endocarditis maybe necessary if PICS has insufficient data to calculate dose

Timing of GENTAMICIN peak and trough levels and recommended ranges

Interpretation of results and dose adjustment

Aminoglycoside Toxicities

References

Timing of GENTAMICIN Levels and Recommended Range in Infective Endocarditis

Both peak and trough levels should be taken for the monitoring of gentamicin in infective endocarditis.

1. Peak levels should be taken one hour after the gentamicin dose

2. Trough levels should be taken 20-24 hours after the last dose of gentamicin.

Renal Function	Recommended Pre-Dose **Range**	First Level Due
C.G. GFR greater than or equal to 40mL/ min	Less than 1mg/ L	0-4 hours before 2nd dose. Give the 2nd dose after taking level Result MUST be taken and checked prior to administering **third** dose
C.G GFR less than 40mL/ min or **AKI**		0-4 hours before 2nd dose. Result MUST be taken and checked prior to administering **second** dose

GENTAMICIN dose calculation in Infective Endocarditis using PICS

Manual GENTAMICIN dose calculation for Infective Endocarditis maybe necessary if PICS has insufficient data to calculate dose

Timing of GENTAMICIN peak and trough levels and recommended ranges

Interpretation of results and dose adjustment

Aminoglycoside Toxicities

References

Interpretation of Results and Gentamicin Dose Adjustment in Infective Endocarditis

Post Dose Levels

Target greater than 10mg / L

Post-dose levels can only be interpreted if there is assurance that samples were taken at 60 minutes post-dose (peak) **AND** an accurate pre-dose (trough) level has also been received.

If post-dose results fall outside target range please contact Infection Speciality or antimicrobial pharmacist

Pre-Dose Levels

Gentamicin Level	Action	Future Monitoring
Less than 1mg/ L and renal function stable	Continue on current dosing regimen	Twice weekly pre-dose levels (more frequent if unstable C.G. GFR)
High levels (greater than 1mg/ L) Check to see if level is taken at appropriate time (0-4 hours pre-dose)		
1-1.5mg / L and renal function stable	Delay next dose by 12 hours (a repeat level is not needed then resume dosing at every 36 hours.	Take a level before second 36 hourly dose. If level remains greater than 1mg/ L contact Infection Speciality or antimicrobial pharmacist for advice.
1.5- 3.0mg/ L and renal function stable	Omit further doses , Repeat levels 12 hourly until returned level is less than 1mg /L. Once level is less than 1mg/ L resume dosing at the same dose but every 48 hours.	Take a level before second 48 hourly dose.. If level remains > 1mg/ L contact Infection Speciality or antimicrobial pharmacist for advice.
Greater than 3.0mg/ L and stable renal function	**Repeat level in 24 hours.** Discuss result with antimicrobial pharmacist or microbiology.	If gentamicin therapy continues, take a level pre-dose and wait for level (target less than 1mg/ L) before giving each dose.
Unstable renal function	Minimise aminoglycoside duration wherever possible. Discuss with microbiology for alternatives.	If gentamicin therapy continues, take a level pre-dose and wait for level (target less than 1mg/ L) before giving each dose.

GENTAMICIN dose calculation in Infective Endocarditis using PICS

Manual GENTAMICIN dose calculation for Infective Endocarditis

maybe necessary if PICS has insufficient data to calculate dose

TOBRAMYCIN Extended Interval (Once Daily) Dosing and Prescribing Guidelines

Exclusion criteria:

- Ascites
- Dialysis
- Myasthenia gravis
- Pregnancy
- Severe burns
- Cystic fibrosis
- Infective endocarditis
- Paediatrics (under 16 years)
- Prophylaxis

TOBRAMYCIN dose calculation using PICS

Manual TOBRAMYCIN dose calculation
maybe necessary if PICS has insufficient data to calculate dose

Timing of TOBRAMYCIN levels and recommended range

Interpretation of results and dose adjustment

Aminoglycoside Toxicities

References

Tobramycin Dose Calculation using PICS

1. Select '**Tobramycin structured prescription'** in 'Prescription' tab

2. Confirm patient has neither infective endocarditis, ascites or severe burns and is not on dialysis.

3. PICS will propose a dose based on the patients weight (which is modified in obesity) and renal function

4. Select Yes to 'Additional One Off' to ensure treatment starts as soon as possible

5. Choose the timing of subsequent doses to be given every 24 hours.

Manual TOBRAMYCIN dose calculation
maybe necessary if PICS has insufficient data to calculate dose

Timing of TOBRAMYCIN levels and recommended range

Interpretation of results and dose adjustment

Aminoglycoside Toxicities

Manual TOBRAMYCIN Dose Calculation

1. Determine patients weight and Cockcroft- Gault creatinine clearance via PICS

2. Prescribe the initial tobramycin dose based on renal function and weight:

Dosing in Stable Kidney Function (Stable C.G. GFR)			Dosing in Acute Kidney Injury (AKI)	
C.G. GFR (mL/min)	**Dosage Regimen**		**C.G. GFR is inaccurate in AKI**	**Dosage Regimen**
Greater than 40mL/ min	5mg /kg once daily		AKI secondary to sepsis (Baseline C.G.GFR is greater than 40ml/min)	5mg/ kg STAT
20-40mL/ min	3mg /kg once daily		Acute on CKD (Baseline C.G.GFR is less than 40ml/min)	3mg/ kg STAT
< 20mL/ min	Discuss with Infection Specialist before commencing 3mg/kg STAT		AKI not due to sepsis	**Avoid if possible** Discuss with Infection Specialist before commencing 3mg/kg STAT

TOBRAMYCIN dose calculation using PICS

Timing of TOBRAMYCIN levels and recommended range

Interpretation of results and dose adjustment

Aminoglycoside Toxicities

Timing of TOBRAMYCIN Levels and Recommended Range

Pre-dose levels should be taken 20-24 hours after the last dose of tobramycin.

Renal Function	Recommended Pre-Dose **Range**	First Level Due
C.G. GFR greater than or equal to 60mL/ min	Less than 1mg/ L	0-4 hours before 2nd dose. Result MUST be taken and checked prior to administering **third** dose
C.G less than 60mL/ min or **AKI**		0-4 hours before 2nd dose. Result MUST be taken and checked prior to administering **second** dose

TOBRAMYCIN dose calculation using PICS

Manual TOBRAMYCIN dose calculation
maybe necessary if PICS has insufficient data to calculate dose

Interpretation of results and dose adjustment

Aminoglycoside Toxicities

Interpretation of Results and Dose Adjustment

Tobramycin Level	Action	Future Monitoring
Less than 1mg/ L and renal function stable	Continue on current dosing regimen	Twice weekly pre-dose levels (more frequent if unstable C.G. GFR)
High levels (greater than 1mg/ L) Check to see if level is taken at appropriate time (0-4 hours pre-dose)		
1-1.5mg/ L and renal function stable	Delay next dose by 6 hours (a repeat level is not needed) then resume dosing at every 24 hours.	Take a level pre-dose and wait for level (target less than 1mg/ L) before giving each dose
1.5- 3.0mg/ L and renal function stable	Repeat levels 12 hourly until returned level is less than 1mg /L. Once level is less than 1mg/ L resume dosing at the same dose but every 48 hours.	Take a level pre-dose and wait for level (target less than 1mg/ L) before giving each dose
Greater than 3.0mg/ L and stable renal function	**Repeat level in 24 hours.** Discuss result with antimicrobial pharmacist or microbiology.	If tobramycin therapy continues, take a level pre-dose and wait for level (target less than 1mg/ L) before giving each dose.
Unstable renal function	Minimise aminoglycoside duration wherever possible. Discuss with microbiology for alternatives.	If tobramycin therapy continues, take a level pre-dose and wait for level (target less than 1mg/ L) before giving each dose.

TOBRAMICIN dose calculation using PICS

Manual TOBRAMICIN dose calculation
maybe necessary if PICS has insufficient data to calculate dose

Timing of TOBRAMICIN levels and recommended range

Aminoglycoside Toxicities

Amikacin Extended Interval (Once Daily) Dosing and Prescribing Guidelines

Exclusion criteria:

- Ascites
- Dialysis
- Myasthenia gravis
- Pregnancy
- Severe burns
- Cystic fibrosis
- Infective endocarditis
- Paediatrics (under 16 years)
- Prophylaxis

AMIKACIN dose calculation using PICS

Manual AMIKACIN dose calculation
maybe necessary if PICS has insufficient data to calculate dose

Timing of AMIKACIN levels and recommended range

Interpretation of results and dose adjustment

Aminoglycoside Toxicities

References

Amikacin Dose Calculation using PICS

1. Select '**Amikacin structured prescription'** in 'Prescription' tab

2. Confirm patient has neither infective endocarditis, ascites or severe burns and is not on dialysis.

3. PICS will propose a dose based on the patients weight (which is modified in obesity) and renal function

4. Select Yes to 'Additional One Off' to ensure treatment starts as soon as possible

5. Choose the timing of subsequent doses to be given every 24 hours.

Manual AMIKACIN dose calculation
maybe necessary if PICS has insufficient data to calculate dose

Timing of AMIKACIN levels and recommended range

Interpretation of results and dose adjustment

Aminoglycoside Toxicities

Manual Amikacin Dose Calculation

1. Determine patients weight and Cockcroft- Gault creatinine clearance via PICS

2. Prescribe the initial amikacin dose based on renal function and weight:

Dosing in Stable Kidney Function (Stable C.G. GFR)			Dosing in Acute Kidney Injury (AKI)	
C.G. GFR (mL/min)	**Dosage Regimen**		**C.G. GFR is inaccurate in AKI**	**Dosage Regimen**
Greater than 40mL/ min	15mg /kg once daily		AKI secondary to sepsis (Baseline C.G.GFR is greater than 40ml/min)	15mg/ kg STAT
20-40mL/ min	7.5mg /kg once daily		Acute on CKD (Baseline C.G.GFR is less than 40ml/min)	7.5mg/ kg STAT
< 20mL/ min	Discuss with Infection Specialist before commencing 7.5mg/kg STAT		AKI not due to sepsis	**Avoid if possible** Discuss with Infection Specialist before commencing 7.5mg/kg STAT

AMIKACIN dose calculation using PICS

Timing of AMIKACIN levels and recommended range

Interpretation of results and dose adjustment

Aminoglycoside Toxicities

Timing of AMIKACIN Levels and Recommended Range

Pre-dose levels should be taken 20-24 hours after the last dose of amikcacin.

Renal Function	Recommended Pre-Dose **Range**	First Level Due
C.G. GFR greater than or equal to 60 mL/ min	Less than 5 mg/ L	0-4 hours before 2nd dose. Result MUST be taken and checked prior to administering **third** dose
C.G less than 60 mL/ min or **AKI**		0-4 hours before 2nd dose. Result MUST be taken and checked prior to administering **second** dose

AMIKACIN dose calculation using PICS

Manual AMIKACIN dose calculation
maybe necessary if PICS has insufficient data to calculate dose

Interpretation of results and dose adjustment

Aminoglycoside Toxicities

Interpretation of Results and Dose Adjustment

Amikacin Level	Action	Future Monitoring
Less than 5 mg/ L and renal function stable	Continue on current dosing regimen	Twice weekly pre-dose levels (more frequent if unstable C.G. GFR)
High levels (greater than 5mg/ L) Check to see if level is taken at appropriate time (0-4 hours pre-dose)		
5 - 7.5 mg/ L and renal function stable	Delay next dose by 6 hours (a repeat level is not needed) then resume dosing at every 24 hours.	Take a level pre-dose and wait for level (target less than 5mg/ L) before giving each dose
7.6 – 15 mg/ L and renal function stable	Repeat levels 12 hourly until returned level is less than 5mg /L. Once level is less than 5mg/ L resume dosing at the same dose but every 48 hours.	Take a level pre-dose and wait for level (target less than 5mg/ L) before giving each dose
Greater than 15 mg/ L and stable renal function	**Repeat level in 24 hours.** Discuss result with antimicrobial pharmacist or microbiology.	If amikacin therapy continues, take a level pre-dose and wait for level (target less than 5mg/ L) before giving each dose.
Unstable renal function	Minimise aminoglycoside duration wherever possible. Discuss with microbiology for alternatives.	If amikacin therapy continues, take a level pre-dose and wait for level (target less than 5mg/ L) before giving each dose.

AMIKACIN dose calculation using PICS

Manual AMIKACIN dose calculation
maybe necessary if PICS has insufficient data to calculate dose

Timing of AMIKACIN levels and recommended range

Aminoglycoside Toxicities

References

1. Chelsea and Westminster Hospital NHS Foundation Trust. ADULT Gentamicin Extended Interval (Once Daily) Dosing Guidelines. Review Date: February 2024.

2. Sandwell and West Birmingham Hospitals NHS Trust. Adult Antimicrobial Guide: Gentamicin Treatment Protocol. Accessed via MicroGuide on 3.1.23

3. Oxford University Hospital NHS Foundation Trust. Adult Antimicrobial Guide: Gentamicin. Accessed via MicroGuide on 3.1.23

4. Lincolnshire STP Hospital Adult Antimicrobial Guides. Extended Interval Dosing of Gentamicin. Accessed via MicroGuide on 3.1.23.

Intravenous Gentamicin and Tobramycin – Multiple Daily Dosing

INCLUSIONS AND EXCLUSIONS

To be used only where once daily dosing is excluded e.g. ascites or severe burns

Manual Gentamicin and Tobramycin Dose Calculation for Multiple Daily Dosing

1. Determine patients weight and Cockcroft- Gault creatinine clearance via PICS

2. Prescribe the initial aminoglycoside dose based on renal function and weight:

Dosing in Stable Kidney Function (Stable C.G. GFR)	
C.G. GFR (mL/min)	**Dosage Regimen**
Greater than 30mL/ min	1 mg /kg (up to 80mg) tds (three times daily)
Less than 30mL/ min	1 mg /kg (up to 80mg) bd (twice daily)

MONITORING

- 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 may change depending on indication:

Indication	Timely of level	Target level
All conditions	Pre-dose (trough level taken immediately prior to drug administration)	less than 2mg/L
	Post-dose (peak level taken one hour after drug administration)	5 - 10 mg/L

- Repeat levels at 2-to-3-day intervals, depending on length of therapy
- If the aminoglycoside level is 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.**

Aminoglycoside Toxicities

Intravenous Vancomycin- Intermittent Infusion

- 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
- **This guideline must not to be used to treat** *Clostridioides difficile* **infection**

VANCOMYCIN Dose Calculation using PICS

1. Select '**Vancomycin structured prescription'** in 'Prescription' tab

2. PICS will propose a dose based on the patient's weight (which is modified in obesity) and renal function

3. Select Yes to 'Additional One Off' to ensure treatment starts as soon as possible.

4. Choose the timing of subsequent doses to be given every 8-24 hours.

Manual Vancomycin Dose Calculation

1. Determine patients weight and Cockcroft- Gault creatinine clearance via PICS

2. Prescribe the initial vancomycin dose based on age, renal function and weight:

3. **For patients under 65 years of age, prescribe an initial weight-based loading dose:**

Actual Body Weight/ kg	Loading Dose
Less than 40	750 mg
40-59	1000 mg
60-90	1500 mg
More than 90 kg	2000 mg

4. For all patients prescribe the maintenance dose schedule based on CG GFR.

Row	CG GFR/ ml/min	Maintenance Dose
1	Less than 20	500mg every 48 hours
2	20-29	500mg daily
3	30-39	750mg daily
4	40-54	500mg every 12 hours
5	55-74	750mg every 12 hours
6	75-89	1000mg every 12 hours
7	90-110	1250mg every 12 hours
8	Greater than 110*	1500mg every 12 hours

* If difficult to achieve adequate trough levels with twice daily dosing, consider dosing at 1000mg every eight hours

Timing of VANCOMYCIN Levels and Recommended Range

- Take a trough sample (pre-dose) prior to the third vancomycin dose or at 36 hours after commencing

- Take level and **THEN** give dose

- It is not necessary to wait for the result before giving the third dose.

Interpretation of Vancomycin Results and Dose Adjustment

Two target vancomycin levels are frequently used at UHB:

- Regular range:10-15 mg/ L
- Escalated range15-20 mg/ L: Used in the management of MRSA bacteraemia, deep seated infection such as endocarditis, meningitis and osteomyelitis

Trouble Shooting Levels Outside Recommended Range

1. Check time last dose was administered, and time sample taken.

2. If level is completely unexpected contact Infection Speciality or Antimicrobial Pharmacist for advice

3. If the returned vancomycin level is below the target range, increase dose by moving down one row in the table below.

4. If the returned vancomycin level is above the target range, decrease dose by moving up one row in the table below.

5. Repeat levels in 48 hours

Row	Maintenance Dose
1	500mg every 48 hours
2	500mg daily
3	750mg daily
4	500mg every 12 hours
5	750mg every 12 hours
6	1000mg every 12 hours
7	1250mg every 12 hours
8	1500mg every 12 hours
9	1500mg every 8 hours

Intravenous Vancomycin- Continuous Infusion

(Critical care only)

Practice points:

- **Adults (16yrs and over) for the treatment of infection only.**
- **This guideline must not to be used to treat** *Clostridioides difficile* **infection**

Monitoring:

- Daily monitoring of vancomycin levels at 06.00 every day.
- Daily monitoring of urea and electrolytes.

Steps for Dosing of Vancomycin

1. Prescribe and Administer a Weight Based Loading Dose

Actual Body Weight/ kg	Loading Dose
Less than 40	750 mg
40-59	1000 mg
60-90	1500 mg
More than 90 kg	2000 mg

2. Prescribe the Maintenance Dose Infusion

Use the C.G GFR value to calculate the administration rate.

Row	C.G GFR (ml/minute)	Maintenance Infusion Rate (mL / hr)
	Less than 20 (not on RRT)	**USE INTERMITTENT VANCOMYCIN GUIDELINE**
	Less than 20 (on RRT)	**10**
1	20 – 29	5
2	30 – 39	8
3	40 – 54	10
4	55 - 74	16
5	75 - 89	21
6	90 – 109	26
7	110 - 129	31
8	130 - 149	36
9	Greater than 150	41

Preparation of Vancomycin Maintenance Dose Infusion

- Start the continuous infusion immediately on completing the loading dose.
- **DILUTE 1000mg of vancomycin in 250ml of NaCl 0.9% or Dextrose 5% - DO NOT ADJUST CONCENTRATION**
- Infusion bags are only stable for 24hours. Discard any remaining infusion after 24 hours.

Vancomycin Levels

- **TAKE LEVELS DAILY AT 06:00**
- Record in PICS and on the sample request form the exact time the sample was collected and that the patient is on a continuous infusion.

Target Vancomycin Level

TARGET CONCENTRATION RANGE: 20 – 25 mg /L

Table 1: Action to be Taken on receiving Vancomycin Level

Returned Vancomycin Level	Action
Less than 20mg/ L	Increase rate by moving down **one** row in table 2 below.
Less than 12mg /L	Increase rate by moving down **two** rows in table 2 below.
Greater than 25mg /L	Decrease rate by moving up one row in table 2 below.
Greater than 30mg /L	Stop infusion and recheck level after 6 hours. Stop until level is below 25mg/L. Then discuss with ICU consultant and ITU/Antimicrobial Pharmacist about restarting at a reduced rate.

- Repeat levels every 24 hours

Table 2: Suggested Infusion Rates

Row	Maintenance Infusion Rate (mL / hr)
1	5
2	8
3	10
4	16
5	21
6	26
7	31
8	36
9	41
10	46

Vancomycin References

intravenous-vancomycin-use-in-adults-intermittent-pulsed-infusion-v01.pdf (sapg.scot) – Review date: June 2025. Accessed 30/11/23

intravenous-vancomycin-use-in-adults-continuous-infusion-v01.pdf (sapg.scot) Review date June 2025. Accessed 30/11/23.

Daptomycin

Practice points:

- Daptomycin is a redistricted antibiotic and requires approval by infection specialist 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

- Some indications require higher dosing then what is licensed in the BNF. This will be on advice of infection specialist only. Check microbiology tab on PICS.
- Dose: **8mg/kg ONCE daily** (or if rare circumstances **10mg/kg ONCE daily**)
- Round doses to nearest 50mg to add administration
- **Note:** Higher risk of side-effects with larger doses. Ensure patients renal function, CK and observations are monitored regularly and reviewed during treatment course.

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 (creatinine clearance less than 80ml/min, haemodialysis and CAPD)
    - Medication known to be associated with myopathy (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 – Doses 8mg/kg and over
    - Patients with severe renal impairment (C.G. GFR less than 30ml/min)
    - 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. 48hours 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

- Specific product characteristics for Cubicin (Daptomycin) – 22/03/2019
- 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
- Bhavnani SM et al. Daptomycin exposure and the probability of elevations in the creatine phosphokinase level: data from a randomized trial of patients with bacteremia and endocarditis. CID. 2010 Jun 15;50(12):1568-74. – Accessed 18/06/2019
- Reiber et al. Therapeutic Drug Monitoring of Daptomycin: A Retrospective Monocentric Analysis. Ther Drug Monit. 2015; 37 :634-40. – Accessed 18/06/2019

Colistimethate Sodium (Colistin)

(Intravenous administration)

Practice points:

- Monitor renal function at baseline and every 48 hours

Colistin Dosing

Loading dose

- Use actual body weight in patients with a BMI is less than 30 kg m^2
- Use ideal body weight in patients with a BMI greater than 30 kg m_2

- A loading dose of up to 12 MU may be used in critically ill patients
- The loading dose is unaffected by renal impairment.

Body Weight / kg	Loading Dose
40-50 kg	7 MU
51-60 kg	8 MU
>60 kg	9 MU

Maintenance dose

First maintenance dose to be given 8 hours after loading dose completed

Creatinine Clearance (mL /min)	Dose and Frequency	Starting Time After Loading Dose
< 10	1.75 MU every 12 hours	24 hours
10 - 29	2.5 MU every 12 hours	24 hours
30 - 49	3 MU every 12 hours	24 hours
Greater than 50	3 MU every 8 hours	12 hours

Monitoring Colistin Levels

Levels

- Take pre-dose level at day 7
- The 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 Infection service 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.

Colistin Reference

- Antimicrobial Reference Laboratory North Bristol NHS Trust– Guideline ranges for TDM 2023-2024
- Renal drug database (Colistimethate sodium (Colistin) – Accessed 09/10/2023

SAPG: High Dose Colistimethate Sodium (Colistin) in Adults- Consensus Guidance. Available at: High Dose Colistin.pdf (scot.nhs.uk) Accessed: 16/10/2023

Flucytosine

Practice points:

- Ensure CG GFR is obtained from PICS or using Cockcroft and Gault equation
- Monitor full blood count at least weekly to detect myelosuppression

Flucytosine Dosing: Oral and Intravenous

C.G. GFR (mL/min)	Dosage Regimen
Greater than 40	50- 150 mg/ kg/ **day** in divided doses every 6 hours
20-40	25mg/ kg/ **dose** every 12 hours
10-19	25mg/ kg/ **dose** every 24 hours
Less than 10	25mg/ kg/ **dose** every 48 hours

Flucytosine Levels

- Both pre- and post-dose levels are required 72 hours after the following:
    - Starting therapy
    - Changing dose regimen
    - Stopping Ambisome
    - Change in renal function

- Repat levels at least every seven days

Continue therapy at same dosing schedule and ensure no doses are missed

Target Pre-dose (Trough) Level

- Sample taken immediately prior to drug administration

- **Target pre-dose level: 20-50 mg/L**

- If pre-dose levels are found to be less than 20mg/L, increase dose by 50%

Target Post-dose (Peak) Level

- Sample taken 30 minutes after intravenous dose or 2 hours after oral dose

  Target post dose level: 50-100 mg/L

- If post-dose levels are found to be over 100mg/L reduce dose by 50%

Flucytosine Reference

- Antimicrobial Reference Laboratory – Guideline ranges for TDM 2023-2024
- Renal drug database (Flucytosine) – Accessed 09/10/2023
- Ashbee HR, Barnes RA, Johnson EM, Richardson MD, Gorton R & Hope WW (2014). Therapeutic drug monitoring (TDM) of antifungal agents: guidelines from the British Society for Medical Mycology. J Antimicrob Chemother. **69**:1162-76.
- Standard Medication Usage Guide: Available at: https://med.stanford.edu/content/dam/sm/bugsanddrugs/documents/antimicrobial-dosing-protocols/SHC-SMUG-Flucytosine.pdf Accessed: 17.10.23

Posaconazole

Practice points:

- Posaconazole levels may be required in the following cases:
  - Treatment of infection
  - Patients receiving liquid for prophylaxis or treatment

- In patients with moderate or severe renal impairment (CG GFR less than 50 mL/min), accumulation of the intravenous vehicle, Betadex Sulfobutyl Ether Sodium (SBECD), is expected to occur. Avoid unless benefit outweighs the risk.

Monitoring Posaconazole Levels

- Aim to take first pre-dose levels approximately 5 days after starting therapy.

- Results usually take approx. 48hours to be reported.

- Continue therapy at same dosing schedule and ensure no doses are missed

Target Pre-dose (Trough) Level

- Sample taken immediately prior to drug administration

- **Therapeutic Target pre-dose level: 1.0 – 3.75 mg/ L**

- **Prophylactic Target pre-dose level: 0.7 – 3.75 mg/ L**

- If pre-dose levels are found to be low 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

References

- Antimicrobial Reference Laboratory – Guideline ranges for TDM 2023

Teicoplanin: Regular Dose (Skin and soft tissue infections)

Practice points:

- Levels are not required in patients receiving surgical prophylaxis

- **Treatment duration:** 7 - 14 days.
- Switch to oral to complete course as soon as appropriate.

Teicoplanin Regular Dose: Loading dose

Actual body weight (kg)	Dose
Less than or equal to 55kg	300mg every 12 hours for 3 doses (0, 12, 24hrs)
56 - 85kg	400mg every 12 hours for 3 doses (0, 12, 24hrs)
Greater than 85kg	600mg every 12 hours for 3 doses (0, 12, 24hrs)

Teicoplanin Regular Dose: Maintenance dose

Actual body weight (kg)	Renal Function (CG GFR)		
	Greater than 80ml/min	**30-80ml/min**	**Less than 30ml/min**
Less than or equal to 55kg	300mg ONCE daily	300mg daily until day 4 then reduce to 150mg ONCE daily	300mg daily until day 4 then reduce to 400mg every 72hours
56 - 85kg	400mg ONCE daily	400mg daily until day 4 then reduce to 200mg ONCE daily	400mg daily until day 4 then reduce to 400mg every 72hours
Greater than 85kg	600mg ONCE daily	600mg daily until day 4 then reduce to 300mg ONCE daily	600mg daily until day 4 then reduce to 600mg every 72hours

Monitoring Teicoplanin Levels (Skin and soft tissue infections)

- Take first pre-dose levels 5 days after starting therapy.
- Results usually take approx. 48hours to be reported.
- Continue therapy at same dosing schedule and ensure no doses are missed
- **Target 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

TEICOPLANIN DOSE ADJUSTMENT TABLE	
Level (mg/ L)	**Action**
Less than 15 mg/L	Contact antimicrobial pharmacist / pharmacy for dosing advice
15 – 30 mg/L	Continue at present dosing regimen. Continue to monitor regularly
31 – 60 mg/L	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.
Greater than 60 mg/L	Stop treatment immediately and retest level Contact antimicrobial pharmacist / pharmacy for dosing advice

Reference

- Antimicrobial Reference Laboratory – Guideline ranges for TDM 2023

Teicoplanin HIGH DOSE (Bone and joint infections / Deep seated infections/ Endocarditis)

Practice points:

- Levels are not required in patients receiving surgical prophylaxis

- The guidelines below are tailored for patients with:
  - Bone and joint infections
  - Deep seated infections such as endocarditis or severe *Staphylococcus. aureus* infection

- Treatment duration: variable, depending on indication
- Switch to oral to complete course as soon as appropriate.

Teicoplanin High Dose Loading dose

- No adjustment to loading dose required in renal impairment

Actual body weight (kg)	Dose
Less than or equal to 55kg	600mg every 12 hours for 3 doses (0, 12, 24hrs)
55- 85kg	800mg every 12 hours for 3 doses (0, 12, 24hrs)
Greater than 85kg	1000mg every 12 hours for 3 doses (0, 12, 24hrs)

Teicoplanin High Dose Maintenance dose

Actual body weight (kg)	Renal function		
	Normal C.GGFR greater than 80ml/min	Mild – moderate renal impairment C.GGFR 30-80ml/min	Severe renal impairment C.GGFR less than 30ml/min
Less than or equal to 55kg	600mg ONCE daily	600mg daily until day 4 then reduce to 300mg ONCE daily	600mg daily until day 4 then reduce to 300mg every 72hours
55 - 85kg	800mg ONCE daily	800mg daily until day 4 then reduce to 400mg ONCE daily	800mg daily until day 4 then reduce to 800mg every 72hours
Greater than 85kg	1000mg ONCE daily	1000mg daily until day 4 then reduce to 500mg ONCE daily	1000mg daily until day 4 then reduce to 1000mg every 72hours

Monitoring Teicoplanin Levels: Bone and Joint Infections and *S. aureus* Infection (not endocarditis)

- Take first pre-dose levels 5 days after starting therapy.
- Results usually take approx. 48hours to be reported.
- Continue therapy at same dosing schedule and ensure no doses are missed
- **Target 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

Level (mg/L)	Action
Less than 20 mg/L	Contact antimicrobial pharmacist / pharmacy for dosing advice on increasing the dose
20 – 40 mg/L	Continue at present dosing regimen. Continue to monitor regularly
41 – 60 mg/L	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.
Greater than 60 mg/L	Stop treatment immediately and retest level Contact antimicrobial pharmacist / pharmacy for dosing advice

Monitoring Teicoplanin Levels: Endocarditis

- Take first pre-dose levels 5 days after starting therapy.
- Results usually take approx. 48hours to be reported.
- Continue therapy at same dosing schedule and ensure no doses are missed
- **Target 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

Level (mg/L)	Action
Less than 30 mg/L	Contact antimicrobial pharmacist / pharmacy for dosing advice
30 – 40 mg/L	Continue at present dosing regimen. Continue to monitor regularly
41 – 60 mg/L	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.
Greater than 60 mg/L	Stop treatment immediately and retest level Contact antimicrobial pharmacist / pharmacy for dosing advice

Voriconazole

Practice points:

- Oral bioavailability is 96%.
- Avoid intravenous preparation in renal failure due to accumulation of intravenous vehicle (SBECD).
- 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.

Voriconazole Dosing

Intravenous:
Voriconazole IV 6mg/kg every 12 hours for 12 hours than 4mg/kg every 12 hours.

Monitoring Voriconazole Levels

- Take first pre-dose level at 3-5 days of starting or changing dose regimen.
- Results usually take approx. 48-72hours to be reported
- Continue therapy at same dosing schedule and ensure no doses are missed.

Therapeutic & Prophylactic Use Target Pre-dose (Trough) Level

- Sample taken immediately prior to drug administration.
- **Therapeutic & Prophylactic Target Pre-dose level: 1.5 – 5.5 mg/ L**
- In disseminated or ‘bulky infections’ a pre-dose level more than 2.0-5.5 mg/ L is preferable
- For management of high or low levels contact Infection Service or pharmacy for advice on dose modification.

INTRAVENOUS GANCICLOVIR DOSING GUIDELINE

Indication: treatment of Cytomegalovirus (CMV) disease in immunocompromised patients

Contact Consultant Virologists for advice prior to starting therapy (contact via switchboard)

1. **Renal function and weight**
    - Check patient's C.G. GFR
    - Do NOT use eGFR under flowchart.

2. **Dosing**
    - Actual body weight is used to calculate the dosing at 5mg / kg 12 hourly.
    - Adjustment required for renal impairment.
    - Monitor full blood count for bone marrow suppression

3. **Administration**
    - The Trust has pre-made bags of IV Ganciclovir kept in the emergency drug cupboard
    - The strengths of pre-filled bags stocked in emergency drug cupboard fridge used for initial treatment are:
        - **150mg** in 100ml of sodium chloride 0.9%
        - **250mg** in 100ml of sodium chloride 0.9%
    - Bags can be mixed and matched and part doses given to match dose required.
    - Give dose intravenously over 60mins.
    - Do not mix with any other medicines or infusions.

4. **Further ordering and supply**
    - Ward Pharmacist to order regular doses from pharmacy production unit.

5. **Monitoring**
    - Daily check of renal function
    - For patients not responding to treatment please discuss with virology to consider antiviral levels being taken and resistance testing to be undertaken. Contact virology via switchboard.

6. **References**

    - https://www.medicines.org.uk/emc/product/10242/smpc#gref - Accessed 18/11/2019
    - Renal drug database – Accessed 18/11/2019

Part G: Appendices

Appendix 1: ADDITIONAL REFERENCES

.

Antimicrobial Stewardship: “Start Smart – Then focus”. Guidance for Antimicrobial Stewardship in Hospitals (England). Department of Health, Advisory Committee on Antimicrobial Resistance and Healthcare Associated Infection (ARHAI). 13th September 2011

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.

Antimicrobial prescribing. A summary of practice. Saving Lives: reducing infection, delivering clean and safe care. DOH 2007.

British National Formulary (BNF). September 2022.

Summary of Product Characteristics. http://www.medicines.org.uk

UKHSA, Immunisation Against Disease: ‘The Green Book’, 2020. Available at: https://www.gov.uk/government/collections/immunisation-against-infectious-disease-the-green-book Accessed: 20.1.22

Appendix 2: OPAT Referral Inclusion and Exclusion Criteria

Inclusions

- Patient is aged 16 or above.
- Patient is medically stable : apyrexial, observations stable, inflammatory markers improving, source control achieved, routine bloods stable, feeling well.
- Patient is deemed suitable for home intravenous antibiotic therapy by OPAT CNS/Clinician.
- Patient requires intravenous antibiotics/antifungals.
- Antibiotic plan has been agreed with ID/microbiology.
- Patient has had first dose of antibiotic without any adverse effects.
- Patient has given verbal informed consent for receiving intravenous antibiotics at home.
- Patient has a contact telephone number.
- Patient has a GP in Birmingham, Solihull or South Staffs **OR** out of area where OPAT can be facilitated (reviewed on a case-by-case basis).
- Community team have capacity to take patient on regimen required.

Exclusion

- Patient has no fixed abode.
- Concerns about intravenous drug use.
- Patient is on vancomycin or gentamicin-cannot be facilitated due to antibiotic levels required every 3rd dose.
- Patient is confused and unable to maintain vascular access device.

APPENDIX 3: Antimicrobials Administration via Enteral Tubes (NG, PEG, NJ, PEJ)

Drug Name	Form	Instructions	Feed Directions	Additional Information
Aciclovir	*Dispersible tablets	Disperse tablet in at least 50mL of water.	A prolonged break in feeding is not required before or after administration	Absorbed in the upper GI tract. Reduced absorption may be experienced when administered via tubes terminating in the jejunum. Use doses at the higher end of the range for NJ/PEJ administration and monitor for sub-optimal effect. Flush the enteral feeding tube with 10mL of water (30mL if aciclovir is the last medicine to be administered at this time)
	Oral suspension	Extremely viscous liquid. Suspension often contains mannitol or sorbitol. Tablets are preferred option.		
Amoxicillin	Oral syrup/ suspension	Dilute with an equal volume of water prior to administration and flush well.	A prolonged break in feeding is not required before or after administration	Absorbed in the duodenum and upper jejunum
Ciprofloxacin	*Tablets	Disperse in water for injections. Flush tube after each dose with 65mL of water for injections.	Withhold feed for two hours before AND after administration.	Absorbed in the duodenum. Reduced absorption may be experienced when administered via tubes terminating in the jejunum. Consider alternative route or antimicrobial in patients with NJ/PEJ tubes.
	Suspension	**DO NOT USE** Suspension can block feeding tube.		
Clarithromycin	*Tablets	Crush and disperse in water. Flush well following administration	A prolonged break in feeding is not required before or after administration	Absorbed throughout GI tract
	Suspension	Dilute with an equal volume of water immediately prior to administration and flush well.		
Clindamycin	*Capsules	Open capsules and disperse in water	A prolonged break in feeding is not required before or after administration	Capsule contents have a very unpleasant taste.
Co-amoxiclav	Oral suspension	Dilute with an equal volume of water prior to administration and flush well.	A prolonged break in feeding is not required before or after administration	Co-amoxiclav is absorbed in the upper small intestine. Not suitable for NJ/PEJ administration
Co-trimoxazole	*Suspension	Dilute with 2-3 times volume of water immediately prior to administration. Shake well.	A prolonged break in feeding is not required before or after administration	Each 5ml contains less than 100 micrograms of alcohol.
	Tablets	**DO NOT USE** Crushed tablets can block feeding tube.		

Doxycycline	*Dispersible tablets	Disperse in water immediately prior to administration and flush well.	Withhold feed for two hours before AND one hour after administration.	Prescribe at the higher end of the standard dosage range
	Capsules	**DO NOT USE** Capsule contents are irritant.		
Erythromycin	Oral suspension (erythromycin ethylsuccinate)	Suspension can be given undiluted. Dose of erythromycin ethylsuccinate (as suspension) needs to be approximately double that of erythromycin stearate (as tablets)	A prolonged break in feeding is not required before or after administration	Absorption may be reduced when administered via NJ/ PEJ tube. For use as in infection management consider alternative route or antimicrobial.
	Capsules (erythromycin stearate)	**DO NOT USE** Contain enteral coated granules.		
	Tablets (erythromycin stearate)	**DO NOT USE** Film-coated, not suitable for		
Fidaxomicin	Tablets	Crush and disperse in water. Flush well following administration	A prolonged break in feeding is not required before or after administration	The tablets are film-coated, so crush well to avoid tube blockage, and flush well post-dose to ensure that the entire dose is administered.
Flucloxacillin	Oral suspension	Suspension can be given undiluted	Withhold feed for 60 minutes before AND 30-60 minutes after administration.	Due to four times dosing and feed interaction, an alternative antimicrobial should be considered.
Fluconazole	Oral suspension	Suspension can be given undiluted	Withhold feed for one hour before AND after administration.	Doses at the higher end of the range must be used for NJ/PEJ administration.
	Capsules	Open capsules and disperse in water		
Levofloxacin	**Not suitable for administration via feeding tubes. Consider alternative route or antimicrobial.**			
Linezolid	*Tablets	Crush thoroughly and disperse in water. Flush well following administration	A prolonged break in feeding is not required before or after administration	Absorbed in the duodenum. Consider alternative route or antimicrobial in patients with NJ/PEJ tubes.
	Oral Suspension	Suspension can be given undiluted. Suspension often contains mannitol or sorbitol.		
Moxifloxacin	Tablets	Crush and disperse in water. Flush well following administration	A prolonged break in feeding is not required before or after administration	Although there are concerns about feed interactions with quinolones, these have not been demonstrated with moxifloxacin.
Metronidazole	*Tablets	Crush and disperse in water. Flush well following administration	A prolonged break in feeding is not required before or after administration	Suspension contains benzoate salt which needs to be broken down by gastric enzymes to enable absorption. Suspension must not be used for NJ/PEJ administration.
	Oral suspension	Suspension can be given undiluted	**Suspension Only:** Withhold feed for two hours before AND one hour after administration.	

Nitrofurantoin	*Oral suspension	Dilute with an equal volume of water prior to administration and flush well.	A prolonged break in feeding is not required before or after administration	**Irritant** Do not crush tablets. Avoid inhalation.
	Immediate release capsules	Open capsules and disperse in water		
	Tablets	Disperse in water. Flush well following administration		
	Prolonged release capsules	**DO NOT USE** Not suitable for administration via tube		
Oseltamivir	Capsules	Open capsules and disperse in water	A prolonged break in feeding is not required before or after administration	Contents of capsule can be opened and mixed with chocolate syrup, honey, sugar dissolved in water, dessert toppings, sweetened condensed milk, apple sauce or yoghurt
	Oral Suspension	Suspension can be given undiluted		
Oxytetracycline	Tablets Capsules	Open capsules or crush tablets and disperse in water	Withhold feed for two hours before AND one hour after administration.	Consider using doxycycline.
Phenoxymethylpenicillin (Penicillin V)	*Oral suspension	Suspension can be given undiluted	Withhold feed for two hours before AND one hour after administration.	Doses at the higher end of the range must be used for tube administration.
	Tablets	**DO NOT USE** Due to risk of inhalation by sensitive individuals		
Rifampicin	*Oral syrup	Dilute with an equal volume of water prior to administration and flush well.	Withhold feed for two hours before AND one hour after administration.	Absorbed in the stomach and duodenum. Doses at the higher end of the range must be used for NJ/PEJ administration.
	Capsules	**DO NOT USE** Due to risk of inhalation by sensitive individuals		
Vancomycin	Injection	Solution can be given undiluted	A prolonged break in feeding is not required before or after administration	Give injection orally. Dilute 500mg vial with 10ml Water For Injection. Withdraw 2.5ml (125mg) from the reconstituted vial and mix in 30ml of water. Store remaining reconstituted vial in the fridge. Discard vial after 24 hours.
	Capsules	**DO NOT USE** Not suitable for administration via tube		
Voriconazole	Oral suspension	Suspension can be given undiluted	Withhold feed for two hours before AND one hour after administration.	Take levels following 3-5 days of therapy.
	*Tablets	Crush tablets and disperse in water		

References:

1. NEWT Guidelines. Available at: www.newtguidelines.com. Accessed: 7.12.21
2. Handbook of Drug Administration via Enteral Feeding Tubes. Available at: https://about.medicinescomplete.com/ Accessed: 7.12.21

3. Drug Administration via Enteral Feeding Tubes. Available at: https://www.nhsgrampian.org/globalassets/foidocument/foi-public-documents1---all-documents/Guide_EnteralTubeA.pdf. Accessed: 7.12.21
4. Dose Conversions of Erythromycin Salts, New Zealand Pharmacy Network. Available at: https://nzpharmacy.wordpress.com/2009/02/09/dose-conversions-of-erythromycin-salts/. Accessed: 7.12.21.

APPENDIX 4: HOW TO DETMINE C.G.GFR ON PICS

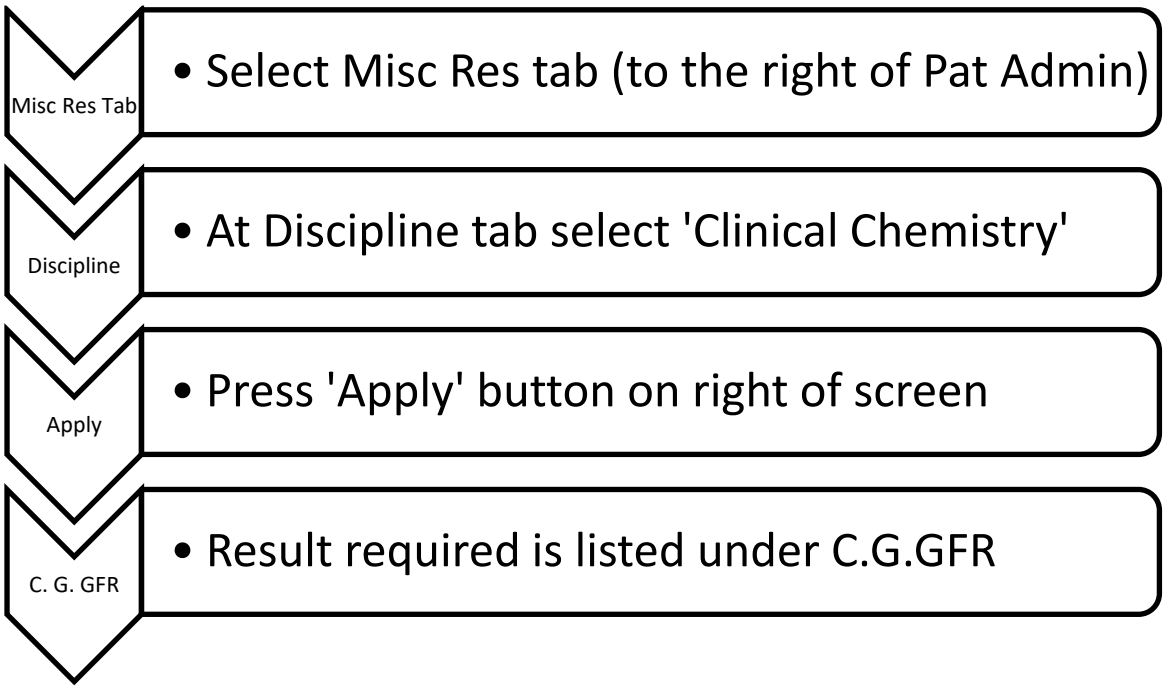
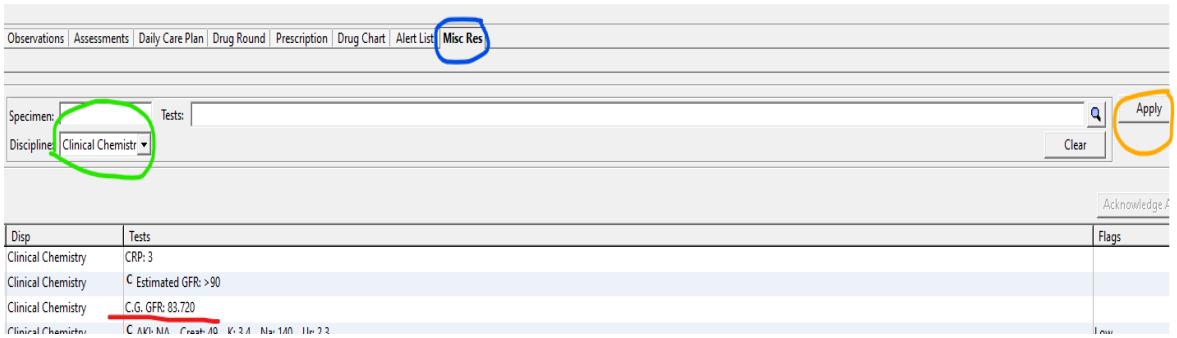


Figure: PICS Screenshot



APPENDIX 5: HOW TO DETERMINE C.G.GFR ON MICROGUIDE

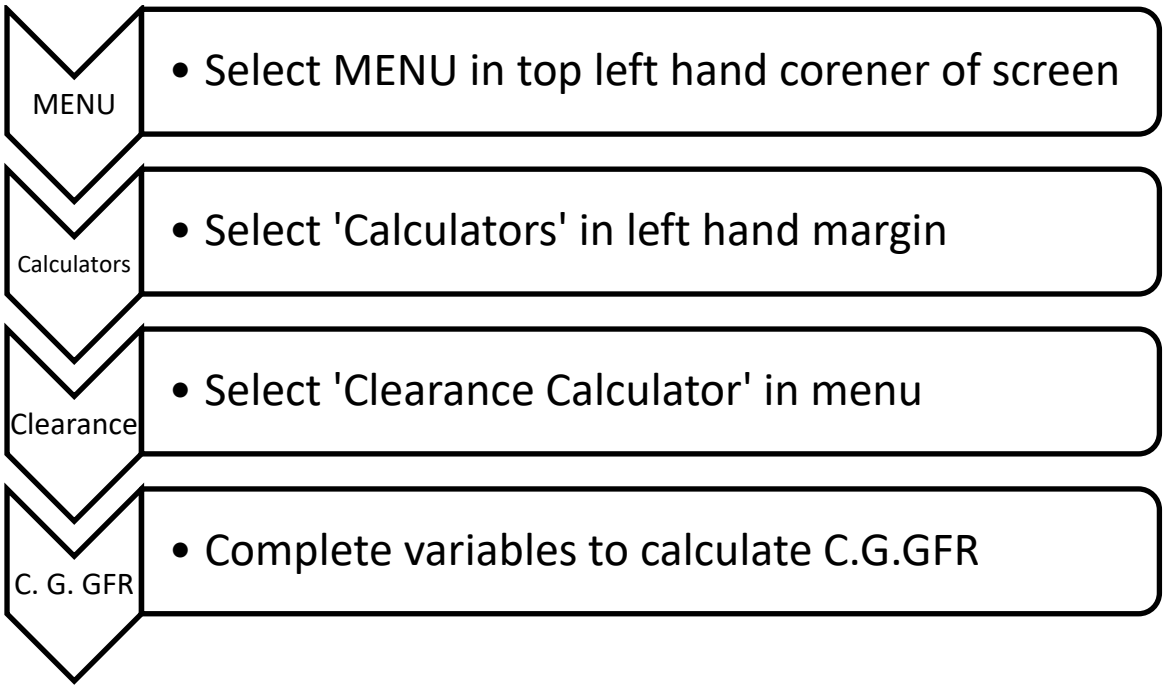
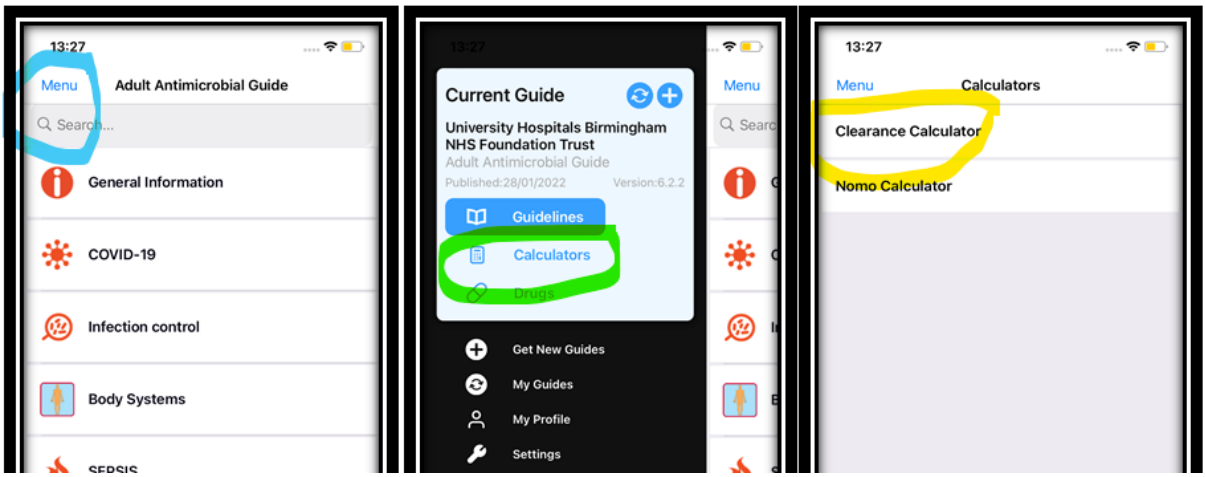


Figure: MicroGuide Screenshot



APPENDIX 6: CALCULATION TO DETERMINE C.G GFR ON NON-PICS WARDS OR AREAS

Cockcroft- Gault Equation:

$$\text{C.G GFR (mL/min)} = \frac{\text{constant} \times [140 - \text{Age (years)}] \times \text{weight (kg)}}{\text{Serum creatinine (micromol/L)}}$$

Constant in males = 1.23
Constant in females = 1.04

Use IBW (kg) if patient is obese (BMI greater than or equal to 30 kg/ m^2)

Note:
In patients with low creatinine (i.e. less than 60micromol/L), use 60 micromol/L in the above equation

APPENDIX 7: CALCULATION OF IDEAL BODY WEIGHT

Ideal Body Weight (IBW) formula

Males	**IBW = 50.0 + 0.91 x (Height [cm] - 152.4)**
Females	IBW = 45.5 + 0.91 x (Height [cm] - 152.4)

APPENDIX 8: CALCULATION OF ADJUSTED BODY WEIGHT

Adjusted Body Weight (ABW) = IBW + 0.4(TBW- IBW)

TBW = Total Body Weight

IBW = Ideal Body Weight

APPENDIX 9: INTERPRETATION OF LABORATORY REPORTS

As part of the accreditation process for the microbiology laboratory, we have updated the way that we report antibiotic sensitivities for bacteria recovered from clinical specimens.

Sensitivities are reported qualitatively in three forms:
"S" – sensitive. This antibiotic has proven sensitive *in vitro*. The antibiotic may be used to treat the infection at standard dosing. The penetration of the drug and dose adjustment for patient's weight and renal function should be considered before prescribing.

"I" – sensitive, increased exposure. The antibiotic is less sensitive *in vitro*. The antibiotic may be used to treat the infection by adjusting the dose regimen or by adjusting its concentration at the site of infection. This can be achieved by higher doses or more frequent administration.

"R" – resistant. The antibiotic is resistant *in vitro*. There is a high likelihood of therapeutic failure even when there is increased exposure.

Increasing dose adjustment should be within the dosing regimens listed in the BNF or within the SPC. Ward pharmacists will be available to advise on dose escalation and adjustment. The table below summarises the antibiotics that may be reported as "I" and describes the doses for each:

Antibiotic	**Escalated Adult Dose**		**Relevant Pathogen**
	IV	**PO**	
Amoxicillin	1g TDS	1g TDS	*Haemophilus* spp.
Ceftazidime	2g TDS	[redacted]	*Pseudomonas aeruginosa*
Ciprofloxacin	400mg TDS	750mg BD	*Pseudomonas aeruginosa*
Co-amoxiclav	Co-amoxiclav 1.2g TDS plus amoxicillin 1g TDS	Co-amoxiclav 625mg TDS plus amoxicillin 500mg TDS	*Haemophilus* spp.
Co-trimoxazole	1.44g BD	1.44g BD	*Stenotrophomonas maltophillia*
Piperacillin-Tazobactam	4.5g QDS	[redacted]	*Pseudomonas aeruginosa*

Renal Dosing:

Contact pharmacy or microbiology for dosing advice in patients with renal impairment.

APPENDIX 10: IV to Oral Switch Guidelines

Available in MicroGuide as a Decision Support Tool

IV to Oral switch check questions and supporting notes (Answer all questions with yes/no)		
1	Is the patient still clinically unstable? Translation - Do they have TWO or more of the following (regardless of indication)? • Pyrexial within the last 24 hours • Heart rate unstable and >90 beats per minute • Respiratory rate unstable and >20 breath per minute • Blood pressure unstable • White cell count and CRP high and not yet trending towards normal If **Yes**, continue IV antibiotics seeking microbiology or antimicrobial team input if not improving. If **No**, move on to next question	
2	Is the patient <u>febrile</u> with associated neutropenia / immunosuppression? (please circle) Neutrophil count < 1.0 or significant immunosuppression anticipated due to recent chemotherapy/medications/medical conditions. If **Yes**, continue IV antibiotics until afebrile for 24hours. If **No**, move on to next question	
3	Is the patient being treated for any of the following? (please circle) • Endocarditis • Osteomyelitis • Cholecystitis • Septic arthritis • Meningitis/Encephalitis/Intracranial abscess • Severe infections during chemotherapy-related neutropenia • Severe necrotising soft tissue infections • Staphylococcus aureus bacteraemia • Cavitating pneumonia/Empyema • Exacerbation of Cystic fibrosis/Bronchiectasis • Inadequately drained abscesses • Liver abscess • Infected implants/prosthesis • Mediastinitis If **Yes**, continue IV antibiotics with a clear stop or review date. If **No**, move on to next question	
4	Is the enteral route compromised? Includes PO/ NG/ NJ being compromised • vomiting or mechanical swallowing disorders • nil by mouth (consider likely timeframe) • mental capacity issues • reduced gut absorption e.g. severe diarrhoea or steatorrhoea • post-surgery patients not tolerating > 1L of oral fluids, or nil oral intake If **Yes**, continue IV antibiotics until next review. If **No**, move on to next question	
5	Are there any clear limitations to oral switch? • Penicillin allergy • Contraindications to oral options • Multi-resistant organisms • Toxicity (risks outweigh the benefits)	

<table>
<tr><td></td><td>If Yes, this may (or may not) create a compelling reason to remain on IV antibiotics.
If No, move on to next question.</td><td></td></tr>
<tr><td>6</td><td>Any other compelling and clear reason to remain on IV antibiotics?
This must be a legitimate reason. Examples of reasons considered NOT to be valid include: Senior doctors preference, awaiting senior review, patient prefers IV antibiotics

If Yes, STATE reason clearly

If No, then the IV route is inappropriate.</td><td></td></tr>
<tr><td></td><td>Outcome: Are IV antibiotics appropriate? Yes or No

Prompts:
<table><tr><th>YES</th><th>NO</th></tr><tr><td colspan="2">☐ Ask ward team to request bloods & check cultures
(if no recent bloods for inflammatory markers)</td></tr><tr><td colspan="2">☐ Stop/review date set on the drug chart</td></tr><tr><td>☐ If appropriate, discuss with ward team regarding OPAT referral</td><td>☐ Discuss with ward team regarding IV to oral sw</td></tr></table></td><td></td></tr>
</table>

APPENDIX 11: CHANGES TO PREVIOUS VERSIONS

Version	Approval Dates	Changes to Previous Version
6.2	February 2021	
6.2.1	October 2021	Page 6: restore hyperlink for 'Closed Fracture Fixation' Page 8: re-number appendices in 'Contents Pages. Page 9: update contacts for comments or guideline changes Page 44: restore hyperlinks for 'CAP' and 'HAP'. Remove redundant bullet points. Page 99: remove ceftriaxone as management for 'Sepsis of unknown origin' in cephalosporin allergy. Amend to gentamicin and vancomycin in line with penicillin allergy. Page 181: amend amikacin trough level on graph to Less than 5mg /L, in-line with text. Page 250: Addition of 'Changes to Previous Version'
6.2.2	December 2021	Page 48-52: Influenza update in line with national policy Page 238: Oseltamivir dose modification in renal impairment Amendment of units for BMI throughout document.
6.2.3	January 2022	Page 10: Remove 'What's New in this version' (replaced by this table) Page 35: Post-splenectomy prophylaxis vaccination. Guidance and reference update to Green Book on Vaccination, 2020. Page 41, 72, 73: Revert from moxifloxacin to levofloxacin for CAP, orbital cellulitis and epiglottitis. (Previous change due to supply problems). Page 183: Amended typographical errors which referred to gentamicin in amikacin guideline
6.3	October 2022	Page 22: Update protected antimicrobials table Page 31: Added updated C. diff guidelines Page 59: Add 'Post Neurosurgical Empyema and Brain Abscess' Page 71: Remove treatment guidelines for E-O to avoid confusion with instead add link Umbrella Guideline. **Page 90: Update human and animal bite treatment and prophylaxis in line with NICE guidelines. Duration of therapy changed, prophylaxis for 3 days, treatment for 5 days.** Page 101: Inclusion of MSSA/ MRSA management in body of guidelines. Page 156: Add reference for arthroplasty prophylaxis. Page 200: Part E: Move Prophylaxis of Contacts. Page 206: Continuous vancomycin infusion update for clarity. Page 207: Update voriconazole references Page 210: Remove dosing guideline information from daptomycin monograph. Page 212: Remove dosing guideline information from colistin monograph. Page 212: Modify amikacin working for RRT Page 214: Remove dosing guideline information from flucytosine monograph. Page 216: Remove dosing guideline information from posaconazole monograph. 220: Remove dosing guideline information from voriconazole monograph. Page 231: Remove renal dosing guideline information from ganciclovir Page 212-249: Remove renal dosing appendix Page 249: Appendix 2: OPAT referral criteria Page 251: Appendix 3: Administration of antimicrobials via enteral tubes Page 288: Appendix 4: How to determine C.G.GFR on PICS Page 289: Appendix 5: How to determine C.G.GFR on Microguide Page 290: Appendix 6: How to calculate determine C.G.GFR. Page 291: Appendix 7: Gentamicin dose calculation on PICS Page 292: Appendix 8: Ideal body weight calculation Page 293: Appendix 9: Adjusted body weight calculation • Make formatting consistent throughout document by use of Headings 1-5 and Arial-11. • Make consistent throughout guideline document the use of Cockcroft-Gault calculation (C.G.GFR) for determination of renal function. • Amend and update typographical errors throughout. • Insertion of footer on every page stating last date of document review and last date of section/page review.

		• Make piperacillin-tazobactam consistent throughout document • Updated references where appropriate.
6.4	March 2023	- Correct spellings throughout - Page 16: remove reductant information on IVOS - Page 23 add pivmecillinam to unrestricted. - Page 23: Add cidofovir to antivirals list - Page 29: Update management of *Salmonella* - Page 49: Remove serum for atypical pneumonia - Page 54: Mild/ moderate HAP management first line to co-trimoxazole - Page 56: Audiometry for nebulised aminoglycosides - Page 65: Add to meningitis 'Please phone laboratory to inform them that a sample has been sent - Page 85: Add *Pseudomonas* for bacterial conjunctivitis - Page 90: Add benzylpenicillin for pts with acute pharyngitis who are unable to swallow. - Page 112: Modify wording to 'Varicella' guidance - Page 121: Febrile neutropenia in penicillin tolerant patients changed to piperacillin-tazobactam and gentamicin. - Page 139- teicoplain dosing in CABG/ TAVI - Page 205-219: Aminoglycoside monitoring update and review - Page 242: Update ganciclovir preparations and process - Page 243: Remove Intravenous fosfomycin- all information available in SPC. - Page 246: Remove gentamicin dose calculator - Page 250- Add oseltamivir to appendix 3 - Page 259: Add APPENDIX 9: INTERPRETATION OF LABORATORY REPORTS - Page 262- Add APPENDIX 10: IV to Oral switch guidelines - Page 261: Change control becomes appendix 11.
6.4.1	May 2023	Page 44: Change 'Intravenous Gentamicin- multiple daily dosing' to 'Gentamicin Extended Interval (Once Daily) Dosing in Infective Endocarditis' Page 46: Change 'Intravenous Gentamicin- multiple daily dosing' to 'Gentamicin Extended Interval (Once Daily) Dosing in Infective Endocarditis' Page 44-46: Update of endocarditis reference Pg 118: Include hyperlink for For Patients with Physiological Decompensation (Septic shock) in sepsis of unknown orgin section Pg 226: amend gentamicin to amikacin
7.0	July 2024	Removal of Concerto red trianhle throughout document. Page 64: additional of zanamivir IV dosing Addition of chapter on Thoracic surgery Uptake of the following chapters: - Gastro-intestinal system - Cardiovascular system - Genitourinary system - Antifungal therapy - Cardio- cardiothoracic surgery