ANTIBIOTIC FORMULARY AND PRESCRIBING ADVICE FOR ADULT PATIENTS

VERSION 9.1
EFFECTIVE 15 JUNE 2022

THIS DOCUMENT SUPERSEDES ALL LOCAL ANTIBIOTIC GUIDANCE FROM ANY SOURCE REGARDING ADULT PATIENTS DATED PRIOR TO THE ABOVE DATE

Northern Lincolnshire and Goole NHS Foundation Trust

United Lincolnshire Hospitals NHS Trust

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Amendment Record from Last Version (9.0)

Section 1
Minor changes.

Section 2
No changes.

Section 3
No changes.

Section 4

4.1 Urinary Tract Infections - No changes.

4.2 Upper Respiratory Tract Infections - No changes.

4.3 Lower Respiratory Tract Infections - No changes.

4.4 Soft Tissue Infections – No changes.

4.5 Central Nervous System – No changes.

4.6 Gastrointestinal Infections – section 4.6.11. Spontaneous Bacterial Peritonitis – dose of ciprofloxacin IV amended to 400mg.

4.7 Genital Tract – section 4.7.5. Maternal fever in labour (inc. Chorioamnionitis – frequency of co-amoxiclav and amoxicillin combination amended to 8 hourly.

4.8 Blood Stream Infections – No changes.

4.9 Ophthalmic infections - No changes.

4.10 Bone and joint Infections – section 4.10.4. Vertebral Osteomyelitis / discitis / epidural abscess. Dosing advice for ceftriaxone amended.

Section 5
No changes

Annex 1
Splenectomy & Splenic Dysfunction Patients - No changes.

Annex 2
Endophthalmitis - Intravitreal Reconstitution of antibiotics - No changes.

Annex 3
Management options for CDI patients that cannot swallow tablets - No changes

Annex 4
Renamed as ‘Guidelines for Administration of Antibiotic Line Lock Therapy, for Infected Central Venous Catheters’ - No changes.

Annex 5
Antifungals section refined to ‘Guideline for management of invasive candidiasis in non-neutropenic patients’ - No changes.

Annex 6
Varicella Zoster Immunoglobulin, Hepatitis B Immunoglobulin, Human Rabies Immunoglobulin and Rabies Vaccine - No changes.

Annex 7
Antimicrobial prescribing in extremes of body weight (Adults) - No changes.

Annex 8

Guidance on responding to chemical, biological, radiological and nuclear (CBRN) incidents - No changes.

1 Introduction

1.1 Aim

Antimicrobials are a very important part of the therapeutic regimen. They differ from all other drugs, however, in that the use of an antibiotic on one patient can affect many other patients through the selection of resistant organisms. To this end it is important that antibiotic use is controlled and profligate and unnecessary use, which selects for bacterial resistance, is avoided. The aim of this document is to encourage the appropriate use of this valuable resource.

The guidance in this document is designed to assist the prescriber during the early stages of management of an infection. It does not seek to be a comprehensive textbook of microbiology, and as such advice on diagnosis and non-antimicrobial management of infections is largely excluded. Please refer to specific clinical guidelines, the British National Formulary, CKS / NICE guidelines, and the Path Links laboratory handbook for advice on these aspects of treatment. For primary care prescribing, please refer to the CCG / PACEF community formulary, which has been authored in collaboration with the clinical Microbiologists involved in the development of this guidance. Likewise, the use of antibiotics in OPAT settings is covered by separate local documents. Once a formal microbiological diagnosis has been made, antibiotic choices should be tailored to cover the specific situation and should be guided by sensitivity results. Advice on prescribing for patients with renal impairment and with extremes of body weight can be found in the Annexes and on the Trust intranet. Where there is any need for advice, please contact the duty clinical Microbiologist or antimicrobial pharmacist via the acute hospital switchboards.

Guiding Principles For This Edition

The guidance has been based on national guidelines and best practice documents wherever possible, taking into consideration local epidemiology and practices. Consideration of the England Adaptation of the WHO AWaRe list has been emphasised, with Access list antimicrobial recommendations increased.

We have aimed to increase the heterogeneity in the choice of antibiotics, as a diversified guideline should lead to greater clinical freedom and reduce the selective pressure relating to individual classes of antibiotics. Restrictions on use of cephalosporins, quinolones and co-trimoxazole have been relaxed, in order to reduce the prescription of carbapenems and beta-lactam / beta-lactamase inhibitor combinations. The Gentamicin 5mg/kg regime has become well established since its introduction in the last version of this guideline. Vancomycin remains the preferred glycopeptide. The Microbiologists have concerns over antimicrobial resistance to teicoplanin, and have considered reports of anaphylactic reactions in the national literature (National audit projects, 2018), hence vancomycin is the preferred agent for treatment indications. Teicoplanin is recommended for surgical prophylaxis for pharmaceutical reasons, avoiding the need to set up an infusion a significant time in advance of the surgery. Teicoplanin can be an acceptable alternative to vancomycin where there are concerns over renal toxicity, and so it is offered as an alternative where appropriate.

Strictly speaking, antibiotics are compounds produced by micro-organisms to inhibit the growth of other micro-organisms. Chemically produced and modified compounds are more properly called antimicrobials. This difference is irrelevant in most clinical practice and thus the terms “Antibiotic” and “Antimicrobial” are used interchangeably throughout this document.

1.2 Personnel

This document is aimed at all staff involved in the delivery of antibiotics, including those prescribing, dispensing or administering antibiotics. It applies to all areas served by the Northern Lincolnshire & Goole NHS Foundation Trust (NLAG), United Lincolnshire Hospitals NHS Trust (ULHT), and Lincolnshire Community Health Services (LCHS).

1.3 Samples

Appropriate antibiotic use is best achieved when the target organism is known. To this end appropriate samples require to be collected **prior to the antibiotic being administered** *unless* immediate empirical treatment is indicated**.** The procedures for collecting appropriate microbiological samples, whilst relevant, are beyond the scope of this document. Full details of these procedures for collecting

appropriate microbiological samples can be found in the Path Links Laboratory Handbook available on the intranet.

When culture and sensitivity test results become available, any prior antimicrobial prescription should be reviewed and amended as indicated to ensure prescription of the most appropriate antibiotics. Any amendment must be documented in the medical notes to show that culture and sensitivity results have been acted upon.

1.4 Contact Information

Advice regarding the diagnosis, treatment, prevention and control of infection including the appropriate use of antibiotics can be obtained from the Duty Consultant Microbiologist at any time by ST3 grade doctors and above through the hospital switchboards.

Advice regarding the appropriate use of antibiotics can be obtained from the Duty Consultant Microbiologist, or Antimicrobial Pharmacists, contactable through switchboard for the relevant Trust.

2 Prescribing of Antimicrobials

This advice is intended to enable the responsibilities of prescribers to:

- Ensure all antimicrobial agents are **clinically indicated and essential**.
- Ensure any **allergy information** relating to antimicrobials is clearly recorded on the front of all the prescription charts, including the nature of the reaction.
- Ensure that prescriptions for antimicrobials are prescribed and administered at regular intervals.
- Ensure the **correct route** is prescribed.
- Ensure all antimicrobial prescriptions have a **specific indication documented** on the prescription chart AND in the medical records at the point of prescribing.
- Ensure all antimicrobial prescriptions have a **"review" or "stop" date** / length of course endorsed on the prescription chart at the point of prescribing. The duration should also be clear in the medical record.
- **Ensure all antimicrobials are reviewed at 48 to 72 hours** to focus therapy and either:
  - **Stop**
  - **De-escalate** from iv to oral therapy
  - **Change** to a narrow spectrum antibiotic
  - **Continue and review again** at 72 hours**.**
- Apply to all adult patients.
- Be used by medical, nursing and pharmacy staff.

Ref: Start Smart - Then Focus Antimicrobial Stewardship Toolkit for English Hospitals Updated March 2015 https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/417032/Start_Smart_Then_Focus_FINAL.PDF

2.1 General Points

Antimicrobials are only indicated when there is evidence of infection or when risk of infection is to be reduced through prophylaxis, such as during surgery. The mere presence of an organism is not an indication for antimicrobials, thus an organism, even MRSA, isolated from a wound that is healing well with no signs of infection does not necessarily require antimicrobial treatment. Antimicrobials are not indicated for conditions that are generally of viral origin.

For serious or life-threatening infections (e.g. red flag sepsis or septic shock, suspected bacterial meningitis, severe community acquired pneumonia) antibiotics should be prescribed and administered within one hour of presentation and, for less serious infections, within four hours.

All doses given in these guidelines, unless specifically indicated otherwise, assume normal renal and hepatic function. Doses may need to be adjusted if renal and hepatic function is impaired.

If a course of antimicrobials has not led to a cure, it should not be automatically repeated. Instead, the diagnosis needs to be reviewed and specialist advice sought where necessary.

Please exercise additional caution in prescribing antimicrobials in those at particular risk of *Clostridium difficile* disease, including elderly patients, those who have had previous *Clostridium difficile* disease, who are GDH-positive or those who are not able to take a normal diet, especially if nourished by TPN or NG/Peg feeding. In particular, cephalosporins, quinolones, clarithromycin and clindamycin should be avoided where less risk prone alternatives are safely available.

The WHO has produced a list of 'Access' antibiotics meaning that they should be used in preference over other antimicrobials. Tuberculosis drugs are excluded. This list has been adapted, further restricted and used by NHSI as a basis for antimicrobial stewardship national targets. Co-amoxiclav is included in the WHO access list, but excluded from the NHSI list. The antibiotics (IV and oral preparations) in the NHSI Access category are:

- phenoxymethylpenicillin
- nitrofurantoin
- metronidazole
- gentamicin
- flucloxacillin
- doxycycline
- co-trimoxazole
- amoxicillin
- ampicillin
- benzylpenicillin
- benzathine benzylpenicillin
- procaine benzylpenicillin
- fosfomycin (oral preparation only)
- fusidic acid (sodium fusidate)
- pivmecillinam
- tetracycline
- trimethoprim

2.2 Allergy Information (see also Section 3.3)

Any allergies to antimicrobials need to be clearly documented in the medical notes *and* on the prescription chart. It is important to establish the precise nature of the allergy, as decisions about restricting or using potentially life-saving treatments will be made on the basis of that information. Always use the generic name of the antimicrobial (brand name should only be an additional feature), as historic brands may no longer be familiar (e.g., Septrin being one of the brand names for Co-trimoxazole). Older patients will often refer to this by the brand name, when generic formulations were not common.

2.3 Indication

The specific indication for all orders of antibiotics on the drug chart ***must*** be included on each order. Please amend the indication once a formal diagnosis has been made, as simply stating 'sepsis' for example is too imprecise to be meaningful either in clinical discussions or during audit.

If there is not space in the specific box for this information on the prescription chart, the "Additional Instructions" or "Pharmacy" box must be used.

2.4 Timely Administration

The sooner patients with septic shock or red flag sepsis receive appropriate antibiotics, the lower the mortality risk. All patients should receive appropriate antibiotics within 1 hour of red flag sepsis recognition. (Obtain blood cultures BEFORE administration of antibiotics wherever possible).

- The initial dose should be prescribed on the "once only" section of the prescription chart.
- The exact times of prescribing and administration should be clearly documented.
- The prescriber should inform the staff member administering the antibiotic of the urgent need.
- Nurses should contact pharmacy as soon as possible if the required antibiotic is not stocked on the ward informing them of the urgency of the need.

For more information, please refer to the Sepsis Guidelines and Sepsis Care Bundle on the intranet.

It is good practice that the initial dose of any antimicrobial is prescribed on the "once only" section of the prescription chart, Care should be taken when prescribing the subsequent regular doses at the defined frequency to ensure this is taken in to account and avoid toxicity. Antimicrobials must be prescribed at a defined frequency, e.g. every 8 hours, to ensure antimicrobials are administered at regular intervals. Thus, dosing at 0600, 1400 and 2200 is acceptable but 0800, 1300, 1700 is NOT acceptable. Whilst there is an understandable tendency to adjust dosing times to fit with nursing medication rounds where possible, this should not be permitted to interfere with the above.

2.5 Course Duration and "Stop" or "Review" Date

All prescribers **must** document the intended duration on the prescription chart for **all** orders of antimicrobial agents. A "stop" / "review" date must be clearly indicated on the prescription chart at the point of prescribing any antimicrobial agent.

2.5.1 Oral Antimicrobial Therapy

The average length of an oral course is assumed to be 5 days unless otherwise stated in the guidelines.

For some patients it may be difficult to endorse a definite stop date until the patient's condition begins to improve. Antimicrobial agents in these cases should have a review date about twice a week (e.g. Consultant ward rounds and/or Fridays). As a minimum, oral prescriptions should be reviewed after 5 days and any reason for continuation must be documented on the prescribing chart and in the medical notes. There are some deeper-seated infections (for example osteomyelitis) for which a long course is appropriate. These should be prescribed in consultation with the Microbiologist and appropriate specialist.

2.5.2 IV Antimicrobial Therapy

In patients with a severe infection who initially require IV antimicrobial therapy, they can be switched to oral therapy **within 48 hours** in the majority of cases with a number of advantages:

- Reduction in the likelihood of hospital acquired IV access device associated infection.
- Reduce patient discomfort, improve mobility and possibly increase the potential for earlier hospital discharge.
- Save both medical and nursing time.
- Potentially reduce treatment costs.
- Reduce the risk of adverse incidents; risks of errors in preparation are significantly higher with parenteral drugs, compared with oral formulations.

The majority of IV antimicrobial agents will require a "review" rather than a "stop" date prior to being converted to oral.

For any intravenous antimicrobials that are continued beyond 48 hours duration, the reason for continuation must be documented on the prescribing chart and in the medical notes.

Intravenous antimicrobials that are re-prescribed beyond 48 hours should be reviewed daily unless being used for defined conditions necessitating long IV courses, for example endocarditis. The decision on continuation/completion of antimicrobial therapy must be documented in the medical notes.

2.5.3 Review of Antimicrobial Therapy

The “Start Smart – Then Focus” prescribing practice must be maintained, with daily review and documented evidence of an active review of all antibiotics after 48 hours. A day 3 prescribing decision should be documented within the notes, confirming or refining the indication for antibiotics, and focusing therapy in line with culture and sensitivity results, taking into account any additional clinical information. One of the following actions should be taken, and a stop (or review) date assigned to the action, with clear documentation of rationale:

- Stop
- De-escalate from iv to oral therapy
- Change to a narrow spectrum antibiotic based on precise diagnosis and microbiology results
- Continue and review again at 72 hours
- Escalate where necessary, preferably following microbiology advice
- Refer to Outpatient Parenteral Antibiotic Therapy (OPAT) for prolonged IV antibiotics courses

2.5.3.1 IV to Oral Switch Criteria

Suitability for the early switch from IV to oral therapy should be assessed by the attending clinician on a case-by-case basis. Please refer to the flowchart below for general guidance.

General inclusion criteria:

- Able to swallow and tolerate oral fluids
- Clinical improvement observed
- Infection markers showing trend towards normal:
  - Apyrexial for at least 24 hours
  - Heart rate ≤90bpm for previous 12hrs
  - White cell count (WCC) between 4 and 12x10^{9}L
- Not a deep-seated infection* (e.g. osteomyelitis, meningitis, infective endocarditis) – see exclusion criteria
- Suitable oral option available** – consult Pharmacy

"IV antibiotics are associated with patient discomfort, higher risk of introducing blood stream infections, increased costs of drugs and associated nursing care, and prolonged hospital stay."

Specific exclusion criteria:

- Oral route compromised:
  - Vomiting/ Nil by mouth
  - Unconscious
  - Mechanical swallowing disorder
  - Oral fluids not tolerated
- Absorption problems (e.g. diarrhoea, steatorrhoea, severe Crohn's disease)
- Continuing Red Flag sepsis – 2 or more from:
  - Temp >38ºC or <36ºC
  - Heartbeat >90bpm
  - Respiratory rate >20/min
  - Worsening WCC and/or CRP
- Febrile with neutropenia - neutrophils <1
- Specific indications
  - Deep abscess
  - Endocarditis
  - Exacerbation of Cystic fibrosis/ bronchiectasis
  - Hickman (central) line infection
  - Immunosuppression (e.g. chemo-related)
  - Infected implants/prosthetics
  - Legionella pneumonia
  - Mediastinitis
  - Meningitis/encephalitis
  - Osteomyelitis
  - Septic arthritis***
  - Severe or necrotising soft tissue infections such as group A streptococcal infection
  - *Staphylococcus aureus* or *Pseudomonas spp.* bacteraemia

Suitable for switch?

Yes

Make the switch to oral antibiotic (usually looking to complete a 5-7 day course):

- Refer to Path Links guidance on choices of antibiotic in de-escalation from IV to oral switch.
- Check contra-indications, drug-drug and drug-food interactions, potential adverse reactions.
- Check cultures and sensitivities.
- Indicate a stop/review date on drug chart.
- Remove IV cannula if not required.

No

Continue IV antibiotic:

- Document reason why IV antibiotic therapy needs to continue.
- Optimise the choice of antibiotic based on cultures and sensitivities.
- Continue to review the need for IV antibiotics every 24hrs.
- Monitor cannula site daily for any signs of infection.
- Seek Consultant Microbiologist or Antimicrobial Pharmacist advice if in doubt.

* Deep-seated infections may require an initial 2 weeks of IV therapy but seek microbiology advice.
** Certain multi-resistant organisms may require treatment with agents that are only available in an IV form (seek microbiology advice regarding length of treatment).
*** For treatment of septic arthritis, high-dose oral clindamycin may be appropriate once patient is stable – seek microbiology advice.

2.5.3.2 Recording the Route of Administration

When a course of antimicrobials is initiated, or switched from IV to oral, the route of administration must not only be entered onto the prescription chart, but must also be recorded in the medical notes.

2.6 Actions for Healthcare Professionals

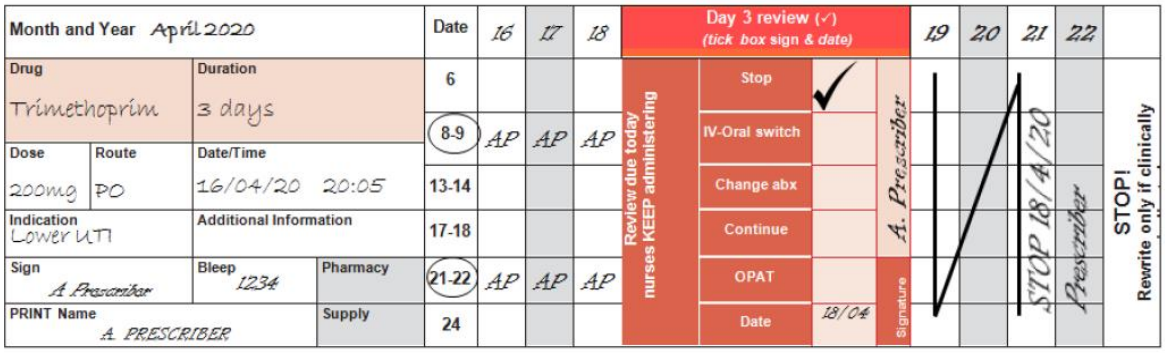
Please also refer to the Trust medicines management and antimicrobial prescribing policies.

2.6.1 Actions for Doctors

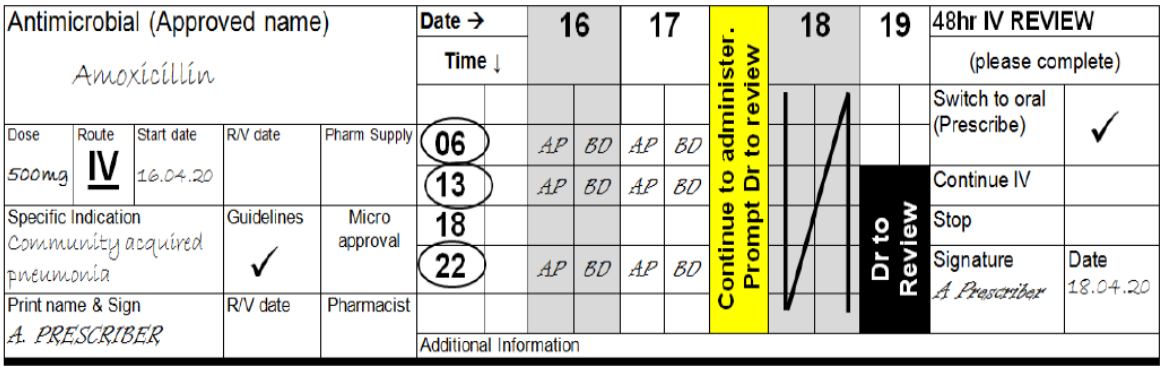
- Prior to prescribing any antibiotic **confirm the allergy status** of a patient, including the nature of the reaction. Ensure that the allergy box on the front of the prescription chart is completed.
- All prescriptions for antimicrobials should include an indication (enter in the Pharmacy/ 'Additional Instructions' box).
- **Write a "stop" date / intended course duration or a "review" date on the prescription chart for each antimicrobial agent prescribed.**
- The majority of IV antimicrobial therapy will require a "review" date rather than a "stop" date prior to being converted to oral.
- Review points should be targeted for lunchtime doses where possible and should avoid weekends unless the patient is due for daily Consultant review.
- Antimicrobial review should be clearly documented in the medical notes AND on the chart by completing and signing the review box where available. If there is not a review box, the 'Additional Instructions' or 'Pharmacy' box may be used. Endorse a new review date if to continue.
    - For some infections it may be difficult to endorse a definite review / stop date until the patient's clinical condition begins to improve. Antimicrobials in these circumstances should have review dates about twice a week (e.g. Consultant ward rounds and/or Fridays).
- Following an IV to oral switch a stop / course duration must be endorsed for each as either of the following:
    - "….. days more" i.e. …days of oral following iv therapy
    - "….. days in total" i.e. the total required duration of iv and po together
    - Or put a stop date (e.g. "stop 9/8/21")
- Antimicrobial agents should be stopped / reviewed earlier than the date shown if clinically indicated.

NOTE: When rewriting treatment sheets containing prescriptions for antibiotics, ensure that the ORIGINAL START DATE of any antibiotic, prescription which needs to be continued, is transferred onto the new prescription for that antibiotic, rather than the date the treatment sheet, is rewritten.

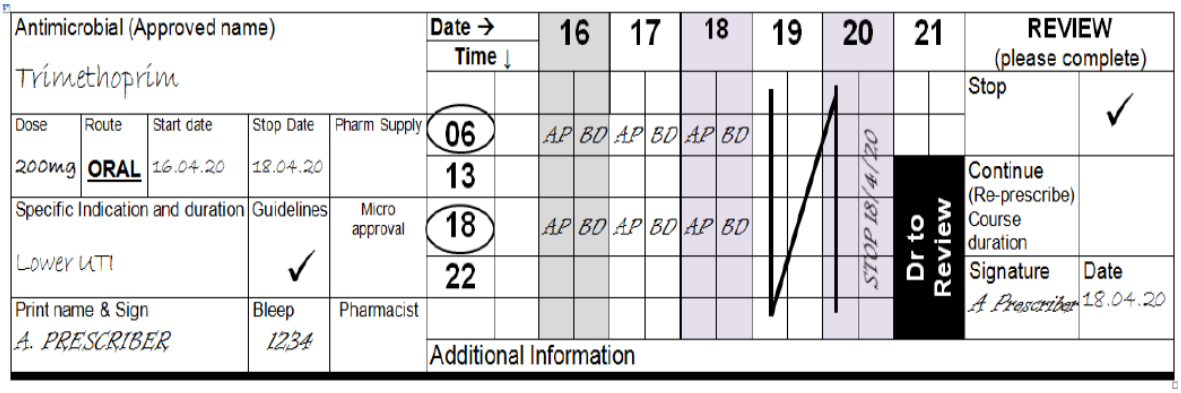
Example of a completed NLaG Antimicrobial Prescription, with stop date (mostly appropriate for oral therapy):



Example of a completed ULHT Prescription for IV Antimicrobials, with clear review decision



Example of a completed ULHT Prescription for oral Antimicrobials, with clear stop/review decision



2.6.2 Actions for Nurses

- Prior to administering any antibiotic **confirm the allergy status** of a patient, including the nature of the reaction. Ensure that the allergy box on the front of the prescription chart is completed by a prescriber or appropriate member of pharmacy.
- Request the Dr to write a “review” / “stop” date on the prescription chart for all antimicrobial agents where appropriate.
- Query all prescriptions continuing beyond the “review” / “stop” dates without a review being apparent.

- Whilst awaiting "review" continue to administer the antimicrobial, but encourage the appropriate prescriber to perform in a review as soon as possible.

- Where administering antibiotics as IV infusions, be mindful that the full dose is not administered if the infusion set is not flushed through. Please refer to local medicines management and IV administration policy.

- Ask the Dr to review a prescription if a number of doses have been missed during the prescribed course, especially if the patient is still unwell or at a weekend where regular review is unlikely.

2.6.3 Actions for Pharmacists

- Prior to checking and/or supplying any antibiotic **confirm the allergy status** of a patient, including the nature of the reaction. Ensure that the allergy box on the front of the prescription chart is completed.

- Ensure all prescriptions for restricted antibiotics adhere to the Antibiotic Formulary and Prescribing Advice. If on Microbiologist or Antimicrobial Pharmacist Advice, endorse prescription with the name of the person granting approval.

- Request an indication and "review" / "stop" date to be written on the prescription chart for all antimicrobial agents

- Provide support for nursing team with information on route and method of antimicrobial administration.

- Support the medical and nursing teams with information and advice on drugs requiring therapeutic dose monitoring.

- If the prescription is written in the presence of a Pharmacist, request an indication and "review" / "stop" date as part of the prescription writing process.

- Query all prescriptions continuing beyond the "review" / "stop" dates without a review being apparent.

- Ask the doctor to review a prescription if a number of doses have been missed during the prescribed course, especially if the patient is still unwell or at a weekend where regular review is unlikely.

If the above is not possible, write in the notes requesting for a "review" / "stop" date for the antimicrobial agent or annotate the prescription chart "review route". Review of dosage points should be targeted for lunchtime doses where possible and should avoid weekends unless the patient is due for daily Consultant review.

2.7 De-escalation of IV to Oral

Amoxicillin/co-amoxiclav: Amoxicillin has good oral bioavailability (unlike ampicillin); the switch from IV to oral amoxicillin should take place as soon as a patient's clinical condition improves. Similarly, for clavulanic acid, therefore co-amoxiclav de-escalation should be prompt. Standard IV and oral dose of amoxicillin are equal, 500mg – 1g every 8 hours. Standard IV dose of co-amoxiclav is 1.2g every 8 hours and oral 625mg every 8 hours.

Ciprofloxacin: Oral bioavailability of ciprofloxacin is approximately 70%. A standard dose of 200mg IV dose can be switched for a 250mg oral dose and the 400mg IV dose switched for a 500mg oral dose. Food delays the rate but not the extent of absorption. Do not give IV unless oral route is compromised, in which case switch to oral therapy as soon as patient is able to absorb.

Clarithromycin: Clarithromycin should be given orally if possible to help avoid adverse reactions associated with the rate of IV infusion. Clarithromycin is phlebitic and IV administration can be painful. Do not give IV unless oral route is compromised, in which case switch to oral therapy as soon as patient is able to absorb. Standard dose for both IV and oral is 500mg every 12 hours.

Clindamycin: Oral bioavailability of clindamycin is nearly complete. A standard dose for IV administration is 600mg every 6 hours, and 450mg orally every 6 hours. Food delays the rate but not the extent of absorption. Early switch to oral therapy is encouraged.

Flucloxacillin: Oral bioavailability of flucloxacillin is good. Dosing depends on the type and severity of infection, and include regimens of 1-2g IV every 6 hours, or 500mg-1g oral every 6 hours. Absorption of oral flucloxacillin is reduced in the presence of food. For optimal effect, doses should be administered half to one hour before meals.

Fluconazole: there is rapid absorption and widespread distribution after both oral and parenteral administration, with identical serum concentrations attained. Avoid IV unless oral route is compromised, in which case switch to oral therapy as soon as patient is able to absorb. Standard dose is typically 400mg once daily following the loading dose.

Levofloxacin: Rapid and almost complete absorption of levofloxacin occurs after oral administration producing an absolute bioavailability. Peak concentrations are reached within 1 hour post administration. Do not give IV unless oral route is compromised, in which case switch to oral therapy as soon as patient is able to absorb. Standard dose for both IV and oral is 500mg 12 or 24 hourly.

Linezolid: Linezolid has rapid and extensive absorption following oral dosing. The absolute bioavailability is complete (100%) and not significantly affected by food. Maximum plasma concentrations are reached within 2 hours of dosing and following oral administration steady state conditions are achieved by the 2nd day of dosing. Do not give IV unless oral route is compromised, in which case switch to oral therapy as soon as patient is able to absorb. Standard dose for both routes of administration is 600mg every 12 hours.

Metronidazole: Oral bioavailability is high and should be preferred. Effective blood concentrations are achieved within 5-12 hours. When the oral route and IV routes are not available, rectal route may be used although absorption is erratic hence this is the least favourable option. Typically, IV 500mg, or oral 400mg, doses are administered every 8 hours.

Moxifloxacin: Rapid and almost complete absorption of moxifloxacin occurs after oral administration with an absolute bioavailability. Peak concentrations are reached within 0.5 to 4 hours post administration. Do not give IV unless oral route is compromised, in which case switch to oral therapy as soon as patient is able to absorb. Standard dosing regimen for both IV and oral route of administration is 400mg daily.

Rifampicin: Oral bioavailability is near 100%. However, food delays the rate and extent of absorption so an oral dose should be taken at least 30 minutes before, or 2 hours after, food. Do not give IV unless oral route is compromised, in which case switch to oral therapy as soon as patient is able to absorb. Standard dose for both IV and oral is 600mg 12 hourly.

Vancomycin: Vancomycin does not have significant absorption following oral administration; consequently, the IV formulation must always be used to treat systemic infection. Oral vancomycin is effectively a local / topical treatment for *Clostridium difficile* disease only. Dosing regimen for IV route depends on body weight and desired serum concentration, and can be calculated as per information in section 3.4.2.1.

3 Notes on Specific Compounds

3.1 List of Antimicrobials

Freely available agents do not require Consultant Microbiologist approval.

All other agents will require the name of the Microbiologist consulted to be endorsed on the prescription unless prescribed for a permitted indication as per the table below.

Colour-coding, for the table below, is as follows: Green indicates the antimicrobial agent is freely available, Grey denotes which ones are restricted by indication, Black denotes high level restriction to microbiologist approval only, and Red indicates non formulary drug.

Agent (and route)	Permitted Indications
Aciclovir (iv/po)	Freely available
Amikacin (im/iv)	Intravitreal use permitted for endophthalmitis, as per guidelines **Microbiologist approval and monitoring plan required for iv treatment**
Amikacin liposomal/ inhalation	Treatment of cystic fibrosis. Not routinely commissioned by NHSE – **IFR approval required**
Amoxicillin (iv/po)	Freely available
Ampicillin (iv)	**Not on formulary and NOT stocked**
Anidulafungin (iv)	**Invasive candidiasis in non-neutropenic patients**
Anti-mycobacterial Agents	TB. Consultant Respiratory Physician input advised
Azithromycin (po)	Antibody deficiency syndromes Chlamydia conjunctivitis Epididymo-orchitis (part of 2nd line if STI suspected) Salmonella (non-typhoid species) Sexual Health use (for cover against chlamydia, gonorrhoea) Typhoid Whooping Cough/ Pertussis
Azithromycin (topical)	Chlamydia conjunctivitis
Azithromycin (iv)	**Not on formulary and NOT stocked**
Aztreonam (iv)	**Microbiologist approval required in all cases**
Benzylpenicillin (iv)	Freely available
Cefaclor (po)	**Not on formulary and NOT stocked**
Cefadroxil (po)	**Not on formulary and NOT stocked**
Cefalexin (po)	Acute Pyelonephritis, Complicated (upper) UTI pregnant women Catheter associated UTI pregnant women Lower UTI (Cystitis) pregnant women Recurrent UTI Pelvic Inflammatory Disease (non-STI) – part of oral stepdown option Pre-labour Rupture Of Membranes at term – part of oral stepdown option Puerperal Sepsis of pelvic origin – part of oral stepdown option
Cefixime (po)	Sexual Health use only. For 400mg oral stat dose in pelvic inflammatory disease where intramuscular injection is contraindicated or refused by patient.
Cefotaxime (iv)	Acute Prostatitis (Alternative) Brain Abscess, where no previous neurosurgery (1st line) Empirical treatment for splenectomy patients who are acutely unwell Epiglottitis (1st line) Meningitis of unknown aetiology (1st line) Pneumococcal/ Meningococcal/ Haemophilus meningitis (1st line) Salmonella – non-typhoid species (1st line)

Agent (and route)	Permitted Indications
Cefpodoxime (po)	**Not on formulary and NOT stocked**
Cefradine (iv/po)	**Not on formulary and NOT stocked**
Ceftaroline (iv)	**Microbiologist approval required in all cases**
Ceftazidime (iv)	COVID Pneumonia – Severe, Hospital Acquired - (Alternative) Cystic Fibrosis Hospital Acquired Pneumonia - Severe (Alternative) Intravitreal use permitted for endophthalmitis, as per guidelines Intravenous Line infections, Pseudomonas Malignant/Necrotising Otitis Externa (Alternative) Peritonitis (peritoneal dialysis-associated)
Ceftazidime/avibactam [Zavicefta] (iv)	**Microbiologist approval required in all cases**
Ceftobiprole (iv)	**Microbiologist approval required in all cases**
Ceftolozane	**Not on formulary and NOT stocked**
Ceftolozane/tazobactam [Zerbaxa] (iv)	**Microbiologist approval required in all cases**
Ceftriaxone (im/iv)	Brain Abscesses (part of 1st line) Cellulitis or Erysipelas (Non facial) (If ambulatory care is an option) Epididymo-orchitis, suspected STI (part of 1st line) Leg Ulcers, severely unwell (part of Alternative treatment) Meningitis of unknown aetiology origin (1st line) Pelvic Inflammatory Disease (part of 1st line) Pneumococcal/ Meningococcal/ Haemophilus meningitis (1st line) Sepsis syndrome – unknown origin (im where IV access not possible) Typhoid (1st line) Vertebral Osteomyelitis / discitis / epidural abscess (1st line if need gram -ve cover)
Cefuroxime (iv)	Acute Pyelonephritis Complicated (upper) UTI Aspiration pneumonia (alternative) Catheter associated upper UTI Community Acquired Pneumonia, Severe (Alternative) COVID Pneumonia, community acquired (part of alternative treatment) Empyema or Lung Abscess (part of alternative treatment) Facial Cellulitis or Erysipelas (part of alternative treatment) Human and Animal bites (part of Alternative treatment) Mastoiditis (Alternative) Maternal fever in labour, unknown organism, not red flag sepsis (alternative) Open-compound fractures (part of alternative treatment) Orbital (post-septal) cellulitis (part of 2nd line treatment) Pelvic Inflammatory Disease, STI not suspected (part of alternative treatment) Peri-orbital (pre-septal) cellulitis (part of 2nd line treatment) Pre-labour Rupture of Membranes at term (part of 1st line treatment) Puerperal Sepsis of pelvic origin – Endometritis (part of alternative treatment), Puerperal Sepsis of pelvic origin Endomyometritis (part of 1st line treatment) Sepsis (Amber Flag) of unknown origin (part of 2nd line treatment) Spontaneous Bacterial Peritonitis, severe (part of Alternative treatment) Suspected Intra-abdominal infection (part of Alternative treatment) Surgical prophylaxis as per guidelines
Cefuroxime axetil (po)	**Not on formulary and NOT stocked**
Cefuroxime (topical)	Eye drops, indicated for Keratitis, corneal ulcers (part of treatment) specialist advice only
Chloramphenicol (iv)	Meningitis of unknown aetiology origin (2nd line)

Agent (and route)	Permitted Indications
Chloramphenicol (po)	**Microbiologist approval required in all cases**
Chloramphenicol (topical)	Eye drops, freely available
Ciprofloxacin (iv/po)	IV use is only permitted without authorisation where ciprofloxacin use is indicated (as below) and the patient is unable to take ANY oral medication Acute Prostatitis (1st line) Cellulitis associated with fresh water immersion Malignant otitis externa (as part of combination) Prostate biopsy (trans rectal or trans perineal) Shigella Dysentery 1st Line Spontaneous Bacterial Peritonitis – as secondary prophylaxis Transrectal or Transperineal Prostate Biopsy Only if penicillin allergy: Acute Pyelonephritis, Complicated (upper) Urinary Tract Infection Campylobacter, Salmonella or Typhoid Infections Catheter associated Urinary Tract Infection Diabetic Foot Infection Hepatic abscess (pyogenic / bacterial) Human or Animal Bites, severe needing IV (as part of combination) Infective Endocarditis, if gentamicin unsuitable (as part of combination) Intra-abdominal Infections (as part of combination) Mastitis and Breast Abscesses Necrotising Fasciitis (as part of combination) Neutropenic sepsis (as part of combination) Peritonitis, including peritoneal dialysis-associated (as part of combination) Sepsis of unknown origin – Amber / Red flag (as part of combination) Spontaneous Bacterial Peritonitis – as primary prophylaxis Spontaneous Bacterial Peritonitis (as part of combination) Surgical site infections, Gastrointestinal or Genitourinary tract *Chelation interaction with bivalent ions will reduce absorption of dose, please time doses accordingly.* *Caution in patients with history of seizures, cardiac or musculoskeletal problems. Check drug-drug and drug-disease interactions first.*
Ciprofloxacin (topical)	Eye drops, indicated for conjunctivitis in persons who wear contact lenses (if 1st line option not available)
Clarithromycin (iv/po)	Freely available

Agent (and route)	Permitted Indications
Clindamycin (iv/po)	Hidradenitis suppurativa (as part of combination) – see local protocol Maternal fever in labour Necrotising fasciitis (as part of 1st line treatment regimen) **Penicillin allergy:** Diabetic Foot infection (as part of combination) Empyema or Lung Abscess (possibly as part of combination) Facial Cellulitis or Erysipelas Human and animal bites (as part of combination) Infected lacerations Mastitis and Breast abscesses Mastoiditis (as part of combination) Pelvic inflammatory disease, in-patient (as part of combination) Peri-orbital cellulitis Peritonsillar abscess (Quinsy) Pneumocystis (PCP) (as part of combination) Pre-labour Rupture of Membranes at term PROM Puerperal Sepsis of pelvic origin Septic Bursitis Surgical Prophylaxis, as per guidelines Surgical site infections, clean surgery not involving GI or GU tract
Co-amoxiclav (iv/po)	Freely available
Co-fluampicil [Magnapen]	**Not on the formulary and NOT stocked**
Colistin (iv)	**Microbiologist approval required in all cases**
Colistin (nebulised)	Respiratory Physician use only (reserved for Gram-negative infections resistant to first-line agents)
Co-trimoxazole (iv/po)	Acute exacerbation of COPD, if severely unwell or high risk of resistance. Acute prostatitis, oral stepdown Chronic bronchitis, if severely unwell or high risk of resistance. Hospital Acquired Pneumonia (including COVID related) Infected Leg ulcers *Pneumocystis* (PCP) prophylaxis and treatment Spontaneous Bacterial Peritonitis, mild Spontaneous Bacterial Peritonitis, secondary prophylaxis Whooping Cough/ Pertussis **Penicillin allergy:** Aspiration pneumonia Diabetic Foot infection Listeria meningitis Meningitis of unknown aetiology if age > 55 or immunocompromised
Dalbavancin (iv)	**Microbiologist approval required in all cases**
Daptomycin (iv)	**Microbiologist approval required in all cases**
Doxycycline (po)	Freely available *Chelation interaction with bivalent ions will reduce absorption of dose, please time doses accordingly.*
Ertapenem (iv)	**Microbiologist approval required in all cases**
Erythromycin (iv/po)	For pregnant patients, where macrolide required Pro-kinetic agent in Critical care Prophylaxis for splenectomy patients, where penicillin allergy Sexual Health (specialist use only)
Fidaxomicin (po)	*C. difficile* associated diarrhoea
Flucloxacillin (iv/po)	Freely available
Fosfomycin (iv)	**Microbiologist approval required in all cases**
Fosfomycin (po)	Lower UTI, non-pregnant women only

Agent (and route)	Permitted Indications
Fusidic Acid (iv/po)	**Microbiologist approval required in all cases**
Fusidic Acid (topical)	Freely available
Gentamicin (im/iv)	Freely available Drug dosing and monitoring information in Section 3.4.3.2.
Imipenem/cilastatin (iv)	**Microbiologist approval required in all cases**
Isavuconazole (iv/po)	**Microbiologist approval required in all cases**
Levofloxacin (iv/po)	Epididymo-orchitis, non STI related **Only if penicillin allergy:** Bronchiectasis Epiglottitis Epididymo-orchitis, likely STI Mastoiditis (as part of combination) Chronic bronchitis, if severely unwell or high risk of resistance. Acute exacerbation of COPD, if severely unwell or high risk of resistance Pneumonia (all types), where moderate or severe Empyema or Lung Abscess (as part of combination) Orbital (post-septal) cellulitis (as part of combination) *Chelation interaction with bivalent ions will reduce absorption of dose, please time doses accordingly.* *Caution in patients with history of seizures, cardiac or musculoskeletal problems. Check drug-drug and drug-disease interactions first.*
Levofloxacin (topical)	Eye drops, indicated for conjunctivitis in persons who wear contact lenses (if 1st line option not available) Corneal Ulcers - Keratitis
Linezolid (iv/po)	**Microbiologist approval required in all cases**
Meropenem (iv)	**Indications not listed below require Microbiologist approval.** Brain abscess, previous neurosurgery (as part of combination) * Infective endocarditis (native valve where there is risk factor for presence of multi-resistant Gram-negative organisms) * Maternal fever in labour (2nd line) * Necrotising fasciitis (as part of 1st line combination) Neutropenic sepsis (2nd line) Sepsis of Unknown Origin - Red Flag (2nd line) * Septic Shock (1st dose only) * ***These indications still require urgent discussion with a Consultant Microbiologist**
Methenamine	**Not on the formulary and NOT stocked**
Metronidazole (iv/po/pr)	Freely available
Minocycline	**Dermatology use only** **Rheumatology use where specifically approved on a case by case basis** *Chelation interaction with bivalent ions will reduce absorption of dose, please time doses accordingly.*
Moxifloxacin (iv/po)	**Microbiologist approval required in all cases** *Chelation interaction with bivalent ions will reduce absorption of dose, please time doses accordingly.* *Caution in patients with history of seizures, cardiac or musculoskeletal problems. Check drug-drug and drug-disease interactions first.*
Moxifloxacin (topical)	Eye drops, indicated for conjunctivitis in persons who wear contact lenses (if 1st line option not available)
Nalidixic Acid	**Not on the formulary and NOT stocked**

Agent (and route)	Permitted Indications
Neomycin (po)	Gut sterilisation/Colonic bacterial load reduction in hepatic failure
Netilmicin	**Not on the formulary and NOT stocked**
Nitrofurantoin (po)	Urinary Tract Infections, non-severe, lower UTI only
Norfloxacin	**Not on the formulary and NOT stocked** *Chelation interaction with bivalent ions will reduce absorption of dose, please time doses accordingly.* *Caution in patients with history of seizures, cardiac or musculoskeletal problems. Check drug-drug and drug-disease interactions first.*
Ofloxacin (po)	Epididymo-orchitis Ophthalmology (rarely) Pelvic Inflammatory Disease (part of 2nd line) Sexual Health use Urology (BCG bladder instillation) *Chelation interaction with bivalent ions will reduce absorption of dose, please time doses accordingly.* *Caution in patients with history of seizures, cardiac or musculoskeletal problems. Check drug-drug and drug-disease interactions first.*
Ofloxacin (topical)	Eye drops, indicated for conjunctivitis in persons who wear contact lenses (1st line) Chlamydia conjunctivitis
Oxytetracycline (po)	Dermatology use only *Chelation interaction with bivalent ions will reduce absorption of dose, please time doses accordingly.*
Phenoxymethylpenicillin [Penicillin V] (po)	Freely available
Piperacillin/tazobactam [Tazocin] (iv)	**Indications not listed below require Microbiologist approval.** Acute prostatitis, severe Bronchiectasis, severe Confirmed or suspected Pseudomonas Infection / Sepsis Hospital acquired COVID pneumonia, severe Hospital acquired pneumonia - Severe / Late onset (1st line) Leg Ulcers, severe infection (2nd line) Malignant otitis externa *(1st line)* Maternal fever in labour, unknown organism, red flag sepsis/septic shock Neutropenic sepsis (part of 1st line regimen) Sepsis - Red flag (1st line) Spontaneous Bacterial Peritonitis, severe (1st line)
Pivmecillinam (po)	Uncomplicated Urinary Tract Infection (2nd line)
Rifampicin (iv/po)	Hidradenitis suppurativa (as part of combination) – see local protocol Infective endocarditis, involving prosthesis (as part of combination) Meningitis where resistant Strep. Pneumoniae suspected (as part of combination) Tuberculosis – must have input of chest physician
Rifaximin (po)	For initiation by Consultant Gastroenterologist for hepatic encephalopathy prophylaxis only.
Spectinomycin	Sexual Health use only
Streptomycin (iv)	**Microbiologist approval required in all cases** except in TB
Sulfadiazine	Toxoplasmosis

Agent (and route)	Permitted Indications
Tedizolid (iv/po)	**Microbiologist approval required in all cases**
Teicoplanin (im/iv)	Any high risk MRSA (suspected or confirmed) infection Cellulitis, ambulatory care option (2nd line) Endocarditis prophylaxis if GI or GU tract surgery (as part of 2nd line combination) In place of Vancomycin if concerns around renal function Prosthetic Joint infection requiring revision Surgical Prophylaxis, as per guidelines Drug dosing and monitoring information in Section 3.4.2.2.
Telithromycin	**Not on the formulary and NOT stocked**
Temocillin (iv)	**Microbiologist approval required in all cases**
Ticarcillin/clavulanate [Timentin] (iv)	**Microbiologist approval required in all cases** Only made available during piperacillin/tazobactam shortage
Tigecycline (iv)	**Microbiologist approval required in all cases**
Tobramycin (iv)	Pseudomonas disease especially respiratory
Tobramycin (nebulised)	Respiratory Physician use only
Trimethoprim (po)	Freely available
Vancomycin (iv)	Freely available Drug dosing and monitoring information in Section 3.4.2.1.
Vancomycin (po)	*C. difficile* associated diarrhoea

3.2 Augmenting doses of Co-amoxiclav

There are times when the standard doses of co-amoxiclav are inadequate, and the duty microbiologist or antimicrobial pharmacists may advise enhanced dosing. Increasing the clavulanic acid component beyond 0.6g/day is NOT recommended. However, the amoxicillin component can safely be increased as far as 12g/day. The table below illustrates how to prescribe enhanced doses of co-amoxiclav.

Dose Ladder For Co-amoxiclav

Dose	Route	Frequency	Comments
375mg co-amoxiclav	Oral	Every 8 hours	Dose is below usual adult recommended dose where normal renal function and body mass. If liquid formulation required prescribe co-amoxiclav 375mg dispersible tablets (250mg amoxicillin equivalent)
625mg co-amoxiclav	Oral	Every 8 hours	Normal oral dose where normal renal function and body mass. If liquid formulation required prescribe 10ml co-amoxiclav 250/62 in 5ml suspension (500mg amoxicillin equivalent) MAXIMUM oral daily dose of clavulanate
600mg co-amoxiclav	Intravenous	Every 8 hours	Dose is below recommended dose and usually reserved for use in renal impairment – consider 1.2g instead.
1.2g co-amoxiclav	Intravenous	Every 8 hours	Normal parenteral dose MAXIMUM IV daily dose of clavulanate (3g amoxicillin /day equivalent)
When Increased Doses Are Required (discuss with Microbiologist / antimicrobial pharmacist)			
625mg co-amoxiclav PLUS 500mg amoxicillin	Oral	Every 8 hours	MAXIMUM oral daily dose of clavulanate (3g amoxicillin/day equivalent)
1.2g co-amoxiclav PLUS 1g amoxicillin	Intravenous	Every 8 hours	MAXIMUM IV daily dose of clavulanate (6g amoxicillin/day equivalent) May advise further increasing Amoxicillin element to every 6 hours (8g amoxicillin/day equivalent)
1.2g co-amoxiclav PLUS 2g amoxicillin	Intravenous	Every 8 hours	MAXIMUM IV daily dose of clavulanate (9g amoxicillin/day equivalent) May advise further increasing Amoxicillin element to every 6 hours (12g amoxicillin/day equivalent)

3.3 Note on Penicillin Allergy

"Penicillin allergy" appears to be very common in hospitalised patients, being listed in the known drug allergies in up to half of inpatients. In practice genuine penicillin allergy is significantly rarer.
Before any patient is labelled penicillin allergic, confirm that the allergy is genuine.

Symptom	Interpretation
Nausea, vomiting, abdominal pain:	Frequently accompany oral antibiotics use. These are not usually allergies.
Maculopapular rash developing several days in a course of antibiotics	May be a non-allergic rash, particularly common with amoxicillin given during EBV infection. However, any features of Stevens-Johnson syndrome should result in immediate discontinuation of the drug and prohibition of use in the future.
Immediate onset angioedema, rhinitis, dyspnoea, wheeze, hypotension etc.	Type 1 hypersensitivity. These symptoms are very suspicious of IgE mediate allergy. Do not use any beta-lactam if a beta-lactam was the provoking drug. Do NOT use a "test dose" to "find out" unless under specialist immunology supervision. Seek alternatives to beta-lactam based antibiotics. If no alternative, discuss risk assessment of cephalosporin or carbapenem use with Consultant Microbiologist.
"My mum told me I was allergic to penicillin, I don't know why"	Each case will need individual assessment. Discuss with a Microbiologist.

Please note:

- Penicillin allergy is NOT usually inherited. Testing is NOT indicated even if a relative has true penicillin allergy.
- Skin testing for penicillin is the 'gold standard' but reagents for this have stopped being manufactured and this service cannot be offered by the Immunology Department at the present time.
- A detailed history including timing and type of reaction is essential in assessing patients with possible drug allergy.

It is often valuable to check previous drug administration sheets and surgical sheets to determine whether or not the patient has received a penicillin, cephalosporin, or carbapenem agent in the past without adverse effect.

PENICILLIN ALLERGY CAN KILL

Antibiotic prescribing in a penicillin allergic patient

- If patient only has a mild rash with a penicillin or a rash that appears >72 hours after administration, they may be able to safely tolerate another beta-lactam antibiotic (including cephalosporins, carbapenems and aztreonam) but proceed with caution.
- Patients with a severe penicillin allergy (anaphylaxis, urticaria or rash immediately after penicillin administration) SHOULD NOT receive a penicillin or any other beta-lactam antibiotic

CONTRA-INDICATED*

PENICILLIN ANTIBIOTICS

- Amoxicillin
- Benzylpenicillin (Penicillin G)
- Co-amoxiclav (Augmentin®)
- Co-fluampicil (Magnapen®)
- Flucloxacillin
- Phenoxymethylpenicillin (Penicillin V)
- Piperacillin/tazobactam (Tazocin®)
- Pivmecillinam
- Temocillin
- Ticarcillin/clavulanic acid (Timentin®)

Use with CAUTION* if mild allergy. AVOID if severe penicillin allergy

BETA-LACTAM ANTIBIOTICS

- Aztreonam
- Cefaclor
- Cefadroxil
- Cefalexin
- Cefixime
- Cefotaxime
- Cefpodoxime
- Cefradine
- Ceftaroline
- Ceftazidime (combined in Zavicefta®)
- Ceftobiprole
- Ceftolozane (combined in Zerbaxa®)
- Ceftriaxone
- Cefuroxime
- Ertapenem
- Imipenem
- Meropenem

CONSIDERED SAFE

- Amikacin
- Azithromycin
- Chloramphenicol
- Ciprofloxacin
- Clarithromycin
- Clindamycin
- Colistimethate (Colistin®)
- Cotrimoxazole (Septrin®)
- Dalbavancin
- Daptomycin
- Doxycycline
- Erythromycin
- Fidaxomicin
- Fosfomycin
- Fusidic acid
- Gentamicin
- Levofloxacin
- Linezolid
- Methenamine
- Metronidazole
- Minocycline
- Moxifloxacin
- Neomycin
- Netilmicin
- Nitrofurantoin
- Norfloxacin
- Ofloxacin
- Oxytetracycline
- Rifampicin
- Rifaximin
- Spectinomycin
- Streptomycin
- Sulfadiazine
- Tedizolid
- Teicoplanin
- Tobramycin
- Trimethoprim
- Vancomycin

*Please seek expert microbiology advice in cases of **severe** infections

3.3.1 Inadvertent administration of a beta-lactam based antibiotic to a patient with a history of adverse reactions to penicillin, with no apparent reaction.

Administration of a penicillin-based antibiotic to a patient with a previously recorded adverse reaction **is a serious clinical error**, and all efforts to avoid it must be made. However, it is acknowledged that this error does occasionally occur, and the result can yield useful information which may be of benefit to the patient.

First there must be duty of candour – discuss the situation with the patient and apologise for the error. Involve the Consultant in charge of the patient's care as soon as practical. Complete an incident report form (IR1) via Datix.

Nature of previous reaction	Mechanism	Action to be taken
Anaphylaxis, angioedema, acute urticaria	Type 1 hypersensitivity	Inadvertent test of hypersensitivity. If no reaction at first dose, risk of reaction to subsequent doses is no greater than for the rest of the population. Reassure patient and re-label notes as not Type 1 hypersensitivity.
Stevens-Johnson syndrome, erythema multiforme, severe mouth ulcers, toxic epidermal necrolysis (TEN)	Delayed hypersensitivity, drug acts as a hapten	Stop the antibiotic immediately and discuss with a Microbiologist or Antimicrobial Pharmacist. Careful history regarding timing of antibiotics in previous reaction needed – it may have been the underlying infection that caused the reaction.
Rash after amoxicillin for sore throat	Amoxicillin / EBV effect	Reassure. If symptoms recur, reclassify as delayed onset rash.
Delayed onset rash	T-cell mediated	If single dose only, switch to an alternative agent. If 2 or more doses, watch and manage symptoms if they occur. If no reaction, reassure and re-label.
Drug fever / serum sickness-like reaction	Immune complex / type III	Review need for antibiotics. Discuss alternatives with a Microbiologist or Antimicrobial Pharmacist
Nausea, vomiting or diarrhoea	GI intolerance	Reassure patient. If symptoms recur, review need for antibiotics. Discuss alternatives with a Microbiologist or Antimicrobial Pharmacist if necessary.
Clostridium difficile colitis or previous GDH positivity	Imbalance of GI flora	Review need for antibiotics. Discuss alternatives with a Microbiologist or Antimicrobial Pharmacist
Thrush	Super-infection with *Candida* spp.	Should resolve on stopping antibiotics. Manage symptoms according to the antibiotic formulary.
HIV disease-related drug reaction	CD4 <200	Seek specialist advice.
Unknown	Unknown	If no reaction, continue antibiotic and watch for symptoms. If they occur, manage accordingly. If not, reassure and re-label.

If the patient is found not to be allergic to the agent administered, communicate the finding to the rest of the medical and nursing team, re-label the medical records and drug chart, explain to and reassure the patient, and inform the GP.

3.4 Therapeutic Drug Monitoring

Antibiotic Assays

Vancomycin and gentamicin assays are performed by Path Links Blood Sciences laboratories.

The need and mechanisms for testing serum concentration of other antimicrobial agents must be discussed with the Consultant Microbiologist **prior** to sending any samples as they are sent to reference laboratories. Please contact the pharmacy department for advice about interpretation of results, frequency of testing, dosing adjustments, etc.

These are all measured from serum samples, which should be collected in a plain tube (i.e. clotted blood).

3.4.1 Creatinine Clearance (Cockcroft-Gault)

In a dynamic situation, the eGFR as displayed on WebV is not adequate for the calculation of creatinine clearance for TDM purposes. The Cockcroft-Gault Creatinine Clearance estimates using the different formulas listed in the sections below must be used instead.

3.4.2 Glycopeptides

3.4.2.1 Vancomycin

Vancomycin is used intravenously to treat serious gram-positive infections, including those caused by methicillin-resistant *Staphylococcus aureus* (MRSA). This section covers the use of intravenous vancomycin prescribed as an intermittent (pulsed) infusion in adult patients*. The advised dosing regimen uses actual body weight to calculate the loading dose, and a combination of creatinine clearance and serum vancomycin concentration to calculate maintenance doses.

*For information on how to give vancomycin as an **intracolonic infusion** (a consideration for management of C. difficile infection only) please refer to Annex 3.
For prescribing advice on vancomycin **for patients treated in Renal Units** please follow local protocol (not covered in this guideline).

Vancomycin Loading Dose (Based on actual body weight, independent of renal function/age)

Table 1

Actual Body Weight	Dose
< 40 kg	750mg in 250ml sodium chloride 0.9% over 1.5 hours
40 - 59 kg	1g in 250ml sodium chloride 0.9% over 2 hours
60 - 90 kg	1.5g in 500ml sodium chloride 0.9% over 3 hours
> 90 kg	2g in 500ml sodium chloride 0.9% over 4 hours

Note: Glucose 5% may be used in patients with sodium restriction.
Volumes advised are for peripheral administration. More concentrated solutions (10mg/ml) must only be given via a central line

Vancomycin Maintenance Dose (Based on renal function)

First, calculate creatinine clearance (mL/minute):

$$\text{Men:}\quad \frac{1.23 \times (140 - \text{age}) \times \text{Actual Body Weight* in kg}}{\text{Serum creatinine (micromol/L)}}$$

$$\text{Women:}\quad \frac{1.04 \times (140 - \text{age}) \times \text{Actual Body Weight* in kg}}{\text{Serum creatinine (micromol/L)}}$$

*Use Actual Body Weight (ABW) or Maximum Body Weight (MBW), whichever is lower, for the Cockcroft-Gault equation above.

** In patients with a low serum creatinine (<60micromol/L), use value of 60 micromol/L for calculation.

Maximum Body Weight Table

Maximum Body Weight Table			
Height (ft inches)	**Height (cm)**	**MBW (kg) Male**	**MBW (kg) Female**
4' 8"	142	49	43
4' 9"	145	52	47
4' 10"	147	54	49
4' 11"	150	58	52
5' 0"	152	60	55
5' 1"	155	62	58
5' 2"	158	66	60
5' 3"	160	68	62
5' 4"	163	71	66
5' 5"	165	74	68
5' 6"	168	77	71
5' 7"	170	79	74
5' 8"	173	82	77
5' 9"	175	85	79
5' 10"	178	88	82
5' 11"	180	90	85
6' 0"	183	94	88
6' 1"	185	96	90
6' 2"	188	98	94
6' 3"	191	101	97
6' 4"	193	104	99
6' 5"	195	107	101
6' 6"	198	109	105
6' 7"	201	113	108
6' 8"	203	115	110

Initial Maintenance Dose

Table 2

Calculated Creatinine Clearance (ml/min)	Maintenance Dose	Time after Loading to start maintenance dose (hours)	Recommended volume of fluid for each dose	Duration of infusion for each dose	Time of 1st vancomycin pre-dose level**
> 110ml/min	1.5g BD	12	500ml	3 hours	Before 4th dose
90 - 110 ml/min	1.25g BD	12	250ml	2.5 hours	Before 4th dose
75 - 89 ml/min	1g BD	12	250ml	2 hours	Before 4th dose
55 – 74 ml/min	750mg BD	12	250ml	1.5 hours	Before 4th dose
40 – 54 ml/min	500mg BD	12	100ml	1 hour	Before 4th dose
30 – 39 ml/min	750mg OD	24	250ml	1.5 hours	Before 4th dose
20 – 29 ml/min	500mg OD	24	100ml	1 hour	Before 4th dose
10 – 19 ml/min	500mg every 48 hours	48	100ml	1 hour	Before 2nd dose
Oliguric, anuric, or < 10ml/min	Check levels 48 hours after loading dose. Re-dose with 1g once level <15mg/L	Only re-dose once levels <15mg/L	250ml	2 hours	48 hours after dose

** The loading dose counts as the 1st dose.

Administration:
Vancomycin administration must be done slowly at a rate of not more than 10mg per minute, in order to prevent infusion-related toxicities, pain or muscle spasm.

Monitoring:
Pre-dose ('trough') serum vancomycin concentrations are the most accurate and practical method of monitoring efficacy.

Samples should be collected **immediately pre-dose** in a plain tube (i.e. clotted blood). The **next dose should still be given** prior to obtaining the result. Samples for antibiotic assays must NEVER be taken via the intravenous line through which the drug is administered because otherwise the result will be spuriously high.

The **time and date when levels are to be taken must be clearly annotated** on the administration section of the prescription and on the level request form.

Renal function (urine output via a fluid balance chart and at least twice weekly U&Es) should be monitored for patients receiving more than a single dose of vancomycin. Any significant renal dysfunction should lead to repeat U&E's and a pre-dose vancomycin level just before the next dose is due.

Target ranges:
Minimum serum vancomycin trough concentrations should always be maintained above 10mg/L to sustain efficacy and avoid development of resistance.

Currently, the recommended target pre-dose ('trough') concentration should be in the range 10-15mg/L for minor infections and 15-20mg/L for MRSA bacteraemias, and serious deep seated infections. Monitoring of peak serum concentration is not required.

It should be noted that it may take up to 5 dosing intervals to achieve steady state levels. When interpreting levels ensure that the 1st pre-dose levels has not been taken too early and that the level you are interpreting is a true pre-dose level and taken at the correct time.

Maintenance Dose Adjustment using Pre-Dose Steady State Vancomycin Levels
(excluding patients with CrCL <10ml/min, anuric or oliguric – see table 2 for advice on re-dosing)

Table 3

Pre-dose ('trough') level	How to adjust the maintenance dose given in Table 2	Time to take subsequent vancomycin level**
< 5mg/L	Increase the dose by two dosing levels (2 rows) from current dosing schedule (e.g. If current dose is 500mg BD, move UP Table 2 by two rows to increase dose to 1g BD)	Before 4th dose
5-10mg/L	Increase dose by one dosing level	Before 4th dose
10-15mg/L	Aiming for 10 - 15mg/L – Continue at current dose	After 3 - 4 days
	Aiming for 15 - 20mg/L – Increase by one dosing level	Before 4th dose
15-20mg/L	Aiming for 10 - 15mg/L – Decrease by one dosing level without omitting any doses (i.e. move DOWN Table 2 by one row)*	Before 4th dose
	Aiming for 15 - 20mg/L – Continue at this dose	After 3 - 4 days
20-25mg/L	Decrease by one dosing level without omitting any doses*	Before 4th dose
> 25mg/L	Omit next dose. Decrease by two dosing levels*	Before 4th dose
> 30mg/L	Omit any further doses. Re-check renal function (i.e. U&E's) and urine output and seek advice from microbiology / pharmacy.	

* If current regimen is 500mg every 48 hours – seek advice from microbiology / pharmacy
** may need to take pre-dose levels more frequently for patient with weight < 40 kg or >120 kg, or >90, or poor/unstable renal function. Contact pharmacy for advice.

Where trough level is still not reaching range despite highest dosing recommendation, please contact an antimicrobial pharmacist for advice.

Refs:

Thompson et al Development and evaluation of vancomycin dosage guidelines designed to achieve new target concentrations, Journal of Antimicrobial Chemotherapy (2009) 63, 1050-1057.

Scottish Medicines Consortium: Scottish Antimicrobial Prescribing Group. Intravenous Vancomycin Use in Adults Intermittent (Pulsed) Infusion. January 2019. (Accessed September 2021).

National Injectable Medicines Guide (Medusa) – vancomycin monograph (Accessed September 2021)

3.4.2.2 Teicoplanin

Teicoplanin is used intravenously to treat serious gram-positive infections, including those caused by methicillin-resistant *Staphylococcus aureus* (MRSA). This section covers the use of intravenous teicoplanin for treatment of infections, rather than prophylaxis.
Use actual body weight to calculate the dosing regimen, with trough (pre-dose) level monitoring guiding dosing adjustments.
Pharmacist input should be sought for support in guiding dosing and monitoring, and advising on management of levels that are outside of desired range. For dosing guidance for patients with extreme body weight, please refer to Annex 7 of this document, or discuss with an antimicrobial pharmacist.

ADULTS & ELDERLY PATIENTS WITH NORMAL RENAL FUNCTION[1]

Indications	Loading Dose Regimen	Targeted trough concentrations[2] at Day 3 to 5	Maintenance Dose	Targeted trough concentrations[2] during maintenance
• **Complicated skin and soft tissue infections** • **Pneumonia** • **Complicated urinary tract infections**	400mg IV (this equates to approximately 6mg/kg body weight) every 12 hours for 3 administrations*	15 - 30mg/L	6mg/kg body weight IV OD*	>15mg/L once a week
• **Bone & joint infections**	800mg IV (this equates to approximately 12mg/kg body weight) every 12 hours for 3 to 5 administrations*	20 - 40mg/L	12mg/kg body weight IV OD*	>20mg/L once a week
• **Infective endocarditis**	800mg IV (this equates to approximately 12mg/kg body weight) every 12 hours for 3 to 5 administrations*	30 - 40mg/L	12mg/kg body weight IV OD*	>30mg/L

[1] In patients with impaired renal function dose adjustment is not required until the 4th day of treatment, at which time dosing should be adjusted. Seek advice from Pharmacy or refer to local renal dosing guidelines for advice.
[2] Measured by Fluorescence polarization immunoassay (FPIA).
* Maximum recommended dose: 1200mg. In patients who are >100 kg, discuss dosing with Pharmacy. Specific advice on drug regime can be obtained from Antimicrobial Pharmacists during working hours.

Note: The testing is performed out of county. Samples are sent off **MONDAY TO FRIDAY** between **9am - 5pm**. If looking to send samples over the weekend or bank holidays, please discuss with microbiology first.

Administration:
Teicoplanin should be administered by the intravenous route. The intravenous injection may be administered either as a bolus over 3 to 5 minutes or as a 30-minute infusion. Where administering as an infusion, flush the infusion set through to ensure total dose administration.
*If IV route is unavailable, please discuss alternative route or agents with an Antimicrobial Pharmacist.

Monitoring:
Teicoplanin trough serum concentrations should be monitored at steady state after completion of the loading dose regimen. This is to ensure that a minimum concentration has been reached for effective cover, and is within safe range.
Pre-dose levels should be taken weekly when prolonged treatment is envisaged or prescribed (e.g. endocarditis, osteomyelitis etc.), to ensure concentrations remains safe, stable, and provide effective cover. The samples should be collected in a plain tube (i.e. clotted blood).
Trough levels (pre-dose) in excess of 20 mg/L are recommended. Avoid levels >40mg/L, levels above 60mg/L are considered toxic. As usual, levels out of range should be scrutinised carefully to ensure correct timing of sample collection and ascertain details of dosing leading up to the level being taken.

Duration of treatment:
The duration of treatment should be decided based on microbiology advice and clinical response. For infective endocarditis a minimum of 21 days is usually considered appropriate. Treatment should not exceed 4 months.

Surgical prophylaxis:
Where a glycopeptide is advised for surgical prophylaxis, Teicoplanin is the preferred agent due to several practical issues with vancomycin. Teicoplanin dosing is simpler as there are fewer dose bands for body weight, less risk when using in renal impairment, and can be administered as a slow IV bolus over 3-5 minutes. Past experiences with the use of vancomycin highlighted significant challenges in ensuring its administration within the 1-hour timeframe, prior to surgical incision.
Dosing table for surgical prophylaxis is given below and based on Actual Body Weight:

Prophylactic Teicoplanin Dosage	
Body Weight	**Dose**
<40kg	200mg
40 – 80kg	400mg
>80kg	800mg

Combination therapy:
Teicoplanin has a similar spectrum of activity to Vancomycin, hence is used against a number of Gram positive bacterial infections, including some that are resistant to vancomycin. It is not suitable for use as a single agent for the empirical treatment of some types of infections unless the pathogen is already documented and known to be susceptible, or there is a high suspicion that the most likely pathogen(s) would be suitable for treatment with teicoplanin.

Renal impairment:
Teicoplanin is considered safer in renal impairment than vancomycin, with careful dosing adjustment, although this is not required until the fourth day of treatment. At this point, a trough level should be taken immediately before the next dose, with dosing adjusted whilst awaiting results. Please consult local guidelines or a pharmacist for individually tailored advice.

Teicoplanin is **NOT** removed by haemodialysis and only slowly by peritoneal dialysis.

3.4.3 Aminoglycosides

The aminoglycoside antibiotics are potent intravenous antibiotics that can be toxic if misused. The following guidance covers the use of Gentamicin, Tobramycin and Amikacin.

The preferred method of administering Gentamicin regularly is once daily. If once daily dosing is contraindicated, or for synergistic use in endocarditis, multiple daily dosing of Gentamicin is recommended.

For the other aminoglycosides; **Tobramycin** is particularly useful for treating chronic respiratory infections caused by *Pseudomonas aeruginosa* and conventional multiple daily dosing is recommended. **Amikacin** is slightly more complex. With no local facility for testing of serum levels at present, turnaround times for results render this option unsuitable, as trough levels are required daily in order to ensure safety. Hence, these guidelines and Path Links microbiologists do not recommend using Amikacin.

3.4.3.1 Single Dosing Of Gentamicin

The most common use of gentamicin is as a single large dose administered in the acutely ill.

The appropriate dose to use, in almost every case of such circumstances is the 5 mg/kg dose. Use actual body weight, unless adjustment is required due to obesity (on basis of the same calculations as used for extended interval dosing see 3.4.3.2 under STEP 2). For patients with renal impairment, lower doses of 3 mg/kg or 2 mg/kg, depending on creatinine clearance, may be used in discussion with Pharmacy or Microbiology as per the table below:

Renal Function	Single IV Gentamicin Dose
CrCL > 40 mL/min	5 mg/kg (Max dose 400 mg)
CrCL 20 – 39 mL/min	3 mg/kg (Max dose 240 mg)
CrCL < 20 mL/min	2 mg/kg (Max dose 160 mg)

If only a single dose is planned, levels DO NOT need to be measured.

If a single dose is envisaged but subsequent doses are later deemed necessary, a trough level must be checked. The level should be around 20 hours post-dose as per section 3.4.3.2.

3.4.3.2 Protocol for Extended Interval Dosing of Gentamicin (Adults)

Gentamicin is most effective when high peak concentrations are achieved, while nephrotoxicity has been linked to inadequate clearance of the drug between doses (Matzke et al, 1983; Raveh et al, 2002).

The extended interval regimen accounts for both of these effects and is suitable in all cases except the following, where a conventional, multiple daily dosing regimen should be used instead.

To ensure safe and effective dosing of extended interval gentamicin, follow the steps below:

STEP 1: IS THE PATIENT SUITABLE?

DO NOT USE THIS REGIMEN FOR:

- Endocarditis
- Urology surgery prophylaxis

Do NOT use this regimen for any of the following, EXCEPT on the advice of a Consultant Microbiologist:

- Any patient who has
  - Significant ascites
  - Limb amputation(s)
  - Cystic fibrosis
  - Major burns
  - Renal transplant
  - Renal impairment – creatinine clearance <60mL/min
- Pregnant women
- Children < 16 years
- On any form of haemodialysis or haemofiltration

Do not use this regimen for longer than 5 days without discussing with a Consultant Microbiologist.

STEP 2: CHECK WEIGHT AND ADJUST IF OVERWEIGHT

For all non-obese patients, the patient's actual body weight can be used for dosing without adjustment.

Adults with a BMI greater than 30 kg/m^2, or Actual Body Weight (ABW) being more than 20% of calculated Ideal Body Weight (IBW), are defined as obese. BMI is rarely used for dosing, but gives an indication on of the patient's stature. BMI should however be used with caution as may give an inaccurate picture in some patient groups. For example: highly muscular adults; adults of Asian, black African or African-Caribbean descent; or in elderly patients.

Gentamicin is hydrophilic and does not distribute well into adipose tissue therefore **dose adjustment is required in obese patients** to avoid over-dosing – if relevant use the adjusted body weight (AjBW)

calculator on the ULHT intranet (https://gentamicincalculator.ulh.nhs.uk/Login.aspx?ReturnUrl=%2f), or refer to the table for estimation of ideal body weight (IBW) and use the equation below.

Adjusted Body Weight (AjBW) = IBW + 0.4(actual weight - IBW)

Female IBW = 45 + (0.91 x (ht. in cm – 152.4))
Male IBW = 50 + (0.91 x (ht. in cm – 152.4))

If patient is < 5 feet (< 150cm) tall, use IBW = 45kg (females) or 50kg (males)

IBW table:

Height (feet)		5	5'1"	5'2"	5'3"	5'4"	5'5"	5'6"	5'7"	5'8"
Height (cm)		152	155	157	160	163	165	168	170	173
IBW (kg)	**Female**	45.5	47.8	50.1	52.4	54.7	57	59.3	63.9	61.6
	Male	50	52.3	54.6	56.9	59.2	61.5	63.8	68.4	66.1

Height (feet)		5'9"	5'10	5'11	6'	6'1"	6'2"	6'3"	6'4"
Height (cm)		175	178	180	183	185	188	190	193
IBW (kg)	**Female**	66.2	68.5	70.8	73.1	75.4	77.7	80.0	82.3
	Male	70.7	73	75.3	77.6	79.9	82.2	84.5	86.8

STEP 3: CHECK CREATININE CLEARANCE

Automated eGFR calculation is an unreliable estimate of creatinine clearance (CrCL) in extremes of weight and age; therefore, CrCL should be calculated using the Cockcroft-Gault equation:

Creatinine clearance (mL/minute):

Men:

$$\frac{1.23 \times (140 - \text{age}) \times \text{Ideal Body Weight in kg}}{\text{Serum creatinine (micromol/L)}}$$

Women:

$$\frac{1.04 \times (140 - \text{age}) \times \text{Ideal Body Weight in kg}}{\text{Serum creatinine (micromol/L)}}$$

STEP 4: CALCULATE THE STARTING DOSE AND INTERVAL

Refer to the table below for dosing. If creatinine clearance is <60 mL/min, please discuss with Microbiology as to whether regular gentamicin is the most appropriate option.

Weight → CrCL (mL/min) ↓	**<40kg**	**40 – 49.9kg**	**50 – 59.9kg**	**60 – 69.9kg**	**70 – 80kg**	**>80kg**
<20	Single dose 2mg/kg (max 160mg) only. Do not give further doses without discussion with Microbiology or Pharmacy.					
21 - 39 (~3mg/kg)	80mg 48 hourly	120mg 48 hourly	160mg 48 hourly	180mg 48 hourly	220mg 48 hourly	240mg 48 hourly
40 – 59 (~5mg/kg)	180mg 48 hourly	220mg 48 hourly	280mg 48 hourly	320mg 48 hourly	360mg 48 hourly	400mg 48 hourly
>60 (~5mg/kg)	180mg 24 hourly	220mg 24 hourly	280mg 24 hourly	320mg 24 hourly	360mg 24 hourly	400mg 24 hourly

- Prescribe on the gentamicin prescription that can be obtained from central store. Do not prescribe the extended interval regimen on regular prescription.
- Plan doses for late morning (10am to 12pm) to allow time for pre-dose levels to be taken and reviewed if prescribing a dose as 'level and wait'.

- Dilute the antibiotic dose in 100mL sodium chloride 0.9% and give by intravenous infusion over 1 hour.

- Record on the gentamicin prescription chart the **exact start time** of the infusion.

STEP 5: MONITORING LEVELS AND DOSE ADJUSTMENT

- Pre-dose levels are needed to check the gentamicin is being adequately cleared (target level <1 mg/L) between doses.

- Collect one pre-dose blood sample (ideally 10mL) 2-4 hours before the dose is due in a plain tube (i.e. clotted blood). Doses should be planned so the sample can be taken in the morning.

- Do not take the blood sample from the IV line used for aminoglycoside administration.

- Document on the microbiology request form the EXACT time and date the previous dose was given and the EXACT time and date the sample was taken in addition to the patient details and mark as 'pre-dose for once daily gentamicin'.

- The specimen bottle must show the:
  - Patient's name
  - NHS Number
  - Date of birth
  - Ward
  - Date and time the sample was taken

- U&Es should also be checked daily while on regular gentamicin therapy.

- If the level is missed but the dose has not yet been administered, immediately take blood and send for an urgent level. If the dose is designated as 'level and wait' due to previous high levels or renal impairment, this can be delayed until the result of the urgent level is available.

Monitoring advice table

Re-check gentamicin levels and adjust dosing as per the tables below. If renal function is normal (CrCL > 60 mL/min) mark the dose as 'level and give'. If dosing in renal impairment 'level and wait' should ALWAYS be used for every dose.

Renal Function (Starting regime)	**Monitoring**	**Level interpretation (After checking level was timed correctly)**
CrCL > 60 mL/min (~5mg/kg 24 hourly)	Take trough level 2-4 hours BEFORE 2nd dose is due. Give 2nd dose without waiting for level.	If <1 mg/L, continue to dose at current interval. Recheck levels twice weekly (level and give) and monitor U+E. If >1 mg/L, increase the interval by 24 hours (e.g. from 24 hourly to 48 hourly) and repeat a pre-dose level before the next dose is due. **Only give the next dose when level <1 mg/L.**
CrCL 40 – 59 mL/min (~5mg/kg 48 hourly)	Take trough level 2-4 hours BEFORE 2nd dose is due. **DO NOT** give 2nd dose until level is in range.	If <1 mg/L, continue to dose at current interval. Recheck levels before each dose (level and wait) and monitor U+E. If >1 mg/L, increase the interval by 24 hours (e.g. from 48 hourly to 72 hourly) and repeat a pre-dose level before the next dose is due. **Only give the next dose when level <1 mg/L.**

Renal Function (Starting regime)	**Monitoring**	**Level interpretation (After checking level was timed correctly)**
CrCL 20 – 39 mL/min (~3mg/kg 48 hourly)	Take trough level 2-4 hours BEFORE 2nd dose is due. **DO NOT** give 2nd dose until level is in range.	If <1 mg/L, continue to dose at current interval. Recheck levels before each dose (level and wait) and monitor U+E. If >1 mg/L, consider discontinuing regular gentamicin. If continuing, increase the interval by 24 hours (e.g. from 48 hourly to 72 hourly) and repeat a pre-dose level before the next dose is due. **Only give the next dose when level <1 mg/L.**
CrCL < 20 mL/min (~2mg/kg single dose)	DO NOT re-dose unless advised by Microbiology	Repeat doses can be given with the advice of Microbiology if a trough level <1 mg/L has been obtained and renal function is stable.

3.4.3.3 Aminoglycoside dosing for Endocarditis

In these conditions, the drug is used for synergy and MUST be given with a cell-wall active agent (i.e. a beta-lactam or a glycopeptide).

Use Ideal Body Weight (IBW) for calculation of Creatinine Clearance and dose, unless the patient is underweight (in which case use their actual body weight).

Ideal Body Weight (IBW) tables:

Height (feet)		5	5'1"	5'2"	5'3"	5'4"	5'5"	5'6"	5'7"	5'8"
Height (cm)		152	155	157	160	163	165	168	170	173
IBW (kg)	**Female**	45.5	47.8	50.1	52.4	54.7	57	59.3	63.9	61.6
	Male	50	52.3	54.6	56.9	59.2	61.5	63.8	68.4	66.1

Height (feet)		5'9"	5'10	5'11	6'	6'1"	6'2"	6'3"	6'4"
Height (cm)		175	178	180	183	185	188	190	193
IBW (kg)	**Female**	66.2	68.5	70.8	73.1	75.4	77.7	80.0	82.3
	Male	70.7	73	75.3	77.6	79.9	82.2	84.5	86.8

Automated eGFR calculation is an unreliable estimate of creatinine clearance (CrCL) in extremes of weight and age; therefore, CrCL should be calculated using the Cockcroft-Gault equation:

Creatinine clearance (mL/minute):

Men: $\frac{1.23 \times (140 - \text{age}) \times \text{Ideal Body Weight in kg}}{\text{Serum creatinine (micromol/L)}}$

Women: $\frac{1.04 \times (140 - \text{age}) \times \text{Ideal Body Weight in kg}}{\text{Serum creatinine (micromol/L)}}$

1. **For normal renal function (GFR >60 mL/min)** give 1mg/kg bodyweight given every 12 hours. Maximum 80mg per dose. For obese patients remember to use IBW for calculation of renal function and calculation of dose.

2. **For impaired renal function (GFR <60 mL/min)** use the doses from the table below, round off to the nearest 10mg.

Creatinine clearance (GFR) mL/min	Dose and frequency of administration
30 – 60	1 mg/kg IBW (Max 80mg) every 12 hours
10 – 30	1 mg/kg IBW (Max 80mg) every 24 hours
<10	1 mg/kg IBW (Max 80mg) 48 hours

ADMINISTRATION

Each dose can be administered as an undiluted intravenous injection over 2-3 minutes.

MONITORING LEVELS

1. In patients with normal renal function, measure serum levels after 3-5 doses.
2. Patients with renal impairment may require more frequent monitoring.
3. Blood samples for levels must not be taken from the site of administration.
4. Samples should be collected in a plain tube (i.e. clotted blood).
5. Pre-dose levels should be taken immediately before the dose is administered (but NOT before the FIRST dose).
6. Post-dose levels should be taken 1 hour after the dose is finished.

PRE – DOSE (TROUGH) LEVELS

1. The target range is < 1mg/L to minimise toxicity. Remember that apparently high levels may be due to mistiming of samples.
2. If the level is within target then continue the regimen and continue to monitor twice weekly - so long as renal function is stable.
3. If the pre-dose is >1.0mg/L (and renal function unchanged) **decrease the frequency** e.g. from every 12 hours to every 24 hours.
4. If the pre-dose level is > 2mg/L withhold therapy and discuss with microbiology.

POST – DOSE (PEAK) LEVELS

1. The target peak level is in the range is 3-5mg/L.
2. If the post dose level is below the target range the level is sub-therapeutic and the total daily dose **must be increased** by 40mg**.**

3.4.4 Co-trimoxazole

High dose co-trimoxazole therapy e.g. for pneumocystis (PCP) treatment may occasionally be required. Unlike standard dose therapy, levels may need monitoring. Serum samples should be collected in a plain tube (i.e. clotted blood), immediately pre-dose and 1-hour post dose if IV (or 2-hours post dose if oral, on day 5, day 10, day 15 and day 21.

Pre-dose sulphamethoxazole levels should be <100mg/L
Post-dose sulphamethoxazole levels should be between 120 and 150 mg/L

Pre-dose trimethoprim levels should be 5 to 7mg/L
Post-dose trimethoprim levels should be >10mg/L but <20mg/L

Note: The testing is performed by an external reference laboratory. As such **TESTING IS ONLY POSSIBLE ON A MONDAY TO THURSDAY** and samples **MUST REACH THE LABOARATORY** by 1530hrs.

3.4.5 Colomycin

Colomycin (also known as **Colistimethate Sodium** or **Colistin**) is a bactericidal polymyxin antibiotic.

It acts like a detergent by interacting with phospholipids in the bacterial cell membrane leading to disruption of the membrane and cell death. It is active against gram-negative organisms including *Pseudomonas aeruginosa* and *Klebsiella pneumoniae*.

Colomycin can be given by **inhalation of nebulised solution** and **intravenously**.

It is contra-indicated in myasthenia gravis as it can worsen muscle weakness.

Nebulised Colomycin is used to delay ***Pseudomonas aeruginosa*** progressing to chronic colonisation and for the prevention of clinical deterioration or recurrent exacerbations in patients who are already chronically colonised. It is licensed for use in the management of chronic pulmonary infections due to *Pseudomonas aeruginosa* in patients with cystic fibrosis.
The use of inhaled nebulised Colomycin for the treatment of infection in patients with non-cystic fibrosis bronchiectasis is an unlicensed indication, but can be used when clinically indicated (see British Thoracic Society (BTS) guidance for more details).

Important points to note –

- Nebulised Colomycin can cause bronchospasm as a side effect. Give first dose in hospital so patient can be observed for any adverse effect .
- When nebulising Colomycin, a filter/valve set should be used to prevent the drug being inhaled by others in the area as it is exhaled by the patient. It is advisable to nebulise Colomycin in a room with the door shut and window open.
- Please refer to local Trust guidelines for more information.

Intravenous Colomycin is used in serious infections due to selected aerobic gram-negative bacteria in patients with limited treatment options. Due to significant toxicity risks, this option is avoided as far as possible and only used where there are no other suitable agents. Microbiologist approval is required for use in all cases.

Important points to note –

- Side effects include neurotoxicity and nephrotoxicity, and they are dose-related.
- If given intravenously pre-dose levels should be in the range of 2-4mg/L. There is no need to monitor post dose levels on standard dosing regimens.

3.4.6 Other Antibiotics Requiring Monitoring

Some other antimicrobials also require levels monitoring and some require monitoring of other markers. The following table is by no means an exhaustive list. Patients receiving anti-tuberculous agents should be monitored in line with local TB management protocols and the BNF.

The testing of antimicrobial serum concentrations is performed by an external reference laboratory. Please discuss with microbiology laboratory before sending samples to ascertain any restrictions in when samples can be sent, and what type of sample bottle to use (usually collected in a plain tube (i.e. clotted blood) bottle)

Compound	Monitor
Rifampicin	Hepatic function weekly
Daptomycin	Creatinine kinase initial baseline and weekly thereafter.
Linezolid	Blood pressure for first 24 hours Platelet & white blood cell count weekly Visual acuity if treating for >14 days.
Chloramphenicol	Levels may require monitoring Trough levels should be <15mg/L Peak levels should be 15-25mg/L

For therapeutic monitoring ranges and frequencies of antimicrobial agents (with exception of aminoglycosides and glycopeptides, please refer to the latest antibiotic assay guideline ranges published by the Bristol based Antimicrobial Reference Laboratory (ARL) service.
https://www.nbt.nhs.uk/sites/default/files/Antibiotic%20Guideline%20Ranges%202020.pdf

4 Regimens for Treatment of Common Infections

Empirical (Blind) Antimicrobial Chemotherapy

The initiation of antimicrobial chemotherapy should normally be withheld until appropriate specimens are collected and a microbiological diagnosis is made unless:

- the patient's defences are compromised
- a life-threatening infection is clinically evident or suspected
- appropriate laboratory investigations cannot be rapidly performed

In such cases antimicrobial chemotherapy should commence immediately after the collection of the diagnostic specimens.

4.1 Urinary Tract Infections

4.1.1 Lower Urinary Tract Infection (Cystitis)

Lower Urinary Tract Infection (Cystitis)[1]	First Line Choices[2]	Alternatives where first line choices contraindicated (e.g. allergy), not tolerated or not effective[2]
Do not base decisions about testing for, or treatment of, a UTI on positive urine dip alone. Urine dip is unhelpful in older or catheterised patients. Negative urine dip rules out urinary tract infection. Do not send urine for culture in asymptomatic patients with positive urine dip, unless antenatal. Older patients- only sample if 2 or more possible signs of infection, for example dysuria, pyrexia or new incontinence. Three or more typical symptoms of UTI (e.g. dysuria, urgency, frequency, polyuria, suprapubic tenderness, haematuria) needed to justify empirical antibiotic treatment in non-pregnant women. Pregnancy is a significant risk factor for pyelonephritis, so where positive urine dip, send urine cultures. Positive culture result should lead to treatment, even if asymptomatic. If doubt, repeat culture and discuss with Microbiologist.		
Non-pregnant women	**Nitrofurantoin**[3] oral 100mg modified release every 12 hours (OR normal release 50mg every 6 hours) **Trimethoprim** oral 200mg every 12 hours (only use if low risk of resistance[4]) **DURATION: 3 days**	**Pivmecillinam** oral 400mg stat then 200mg every 8 hours DO NOT use in penicillin allergic patients **Amoxicillin** oral 500mg every 8 hours (only if culture results available and susceptible). DO NOT use in penicillin allergic patients **Fosfomycin**[5] oral 3g single dose **DURATION: 3 days**

Lower Urinary Tract Infection (Cystitis)[1]	First Line Choices[2]	Alternatives where first line choices contraindicated (e.g. allergy), not tolerated or not effective[2]
Pregnant women	**Nitrofurantoin**[3,6] oral 100mg modified release every 12 hours (OR normal release 50mg every 6 hours) **Cefalexin** 500mg po every 12 hours[7] CAUTION in penicillin allergic patients **DURATION: 7 days**	**Amoxicillin** oral 500mg every 8 hours (only if culture results available and susceptible) DO NOT use in penicillin allergic patients **DURATION: 7 days**
Men	**Nitrofurantoin**[3,8] oral modified release 100mg po every 12 hours (or immediate release 50mg po every 6 hours) **Trimethoprim** oral 200mg every 12 hours (only use if low risk of resistance[4]) **DURATION: 7 days**	Consider alternative diagnosis (for example; acute pyelonephritis, prostatitis)

Notes

1. NICE Guideline NG109: Urinary tract infection (lower): antimicrobial prescribing. October 2018 https://www.nice.org.uk/guidance/ng109
2. Check any previous urine culture and susceptibility results and antibiotic prescribing and choose antibiotics accordingly. Where a person is receiving prophylactic antibiotics, treatment should be with a different antibiotic, not a higher dose of the same antibiotic.
3. Do not use in patients with eGFR <45 mL/minute, acute porphyria, G6PD deficiency, or fever. Some manufacturers support use with extreme caution in cases where eGFR is 30–44 mL/minute as a short-course only (3 to 7 days), to treat uncomplicated lower urinary-tract infection caused by suspected or proven multidrug resistant bacteria and only if potential benefit outweighs risk. Discuss such cases with an Antimicrobial Pharmacist or Microbiologist first. https://bnf.nice.org.uk/drug/nitrofurantoin.html#renalImpairment
4. A lower risk of resistance may be more likely if not used in the past 3 months, previous urine culture suggests susceptibility (but this was not used). A higher risk of resistance may be more likely with recent use.
5. Do not use Fosfomycin if CrCl <10ml/min
6. Avoid nitrofurantoin near term (over 36 weeks in pregnancy) as theoretical risk of haemolytic anaemia in the foetus or new born infant due to immature erythrocyte enzyme systems.
7. Using lower frequency and total daily dose in pregnant women with simple cystitis only.
8. Nitrofurantoin is not recommended for men with suspected prostate involvement because it is unlikely to reach therapeutic levels in the prostate.

4.1.2 Acute Pyelonephritis, Complicated (upper) Urinary Tract Infection

Acute Pyelonephritis, Complicated (upper) Urinary Tract Infection[1,2]	First Line Choices[3]	Alternatives where first line choices contraindicated (e.g. allergy), not tolerated or not effective[3]
If admission not needed, send MSU for culture and susceptibility testing, and start antibiotics. If no improvement within 24 hours, seek advice from Consultant Microbiologist. Consider need for single dose of gentamicin[10] IV, if signs of systemic sepsis		
Non-pregnant women Men	**Co-amoxiclav**[4] IV 1.2g every 8 hours DO NOT use in penicillin allergic patients **Cefuroxime**[5] IV 1.5g every 8 hours CAUTION in penicillin allergic patients **DURATION**[6]**: 7 days**	**Ciprofloxacin**[7,8,9] oral 500mg every 12 hours **Gentamicin**[10] IV **DURATION: 7 days**

Acute Pyelonephritis, Complicated (upper) Urinary Tract Infection[1,2]	First Line Choices[3]	Alternatives where first line choices contraindicated (e.g. allergy), not tolerated or not effective[3]
Pregnant women IF SEVERE beta lactam allergy, discuss options with Microbiologist on call	**Cefalexin** 500mg po every 8 hours CAUTION in penicillin allergic patients **DURATION: 7-10 days**	**Cefuroxime**[5] IV 1.5g every 8 hours CAUTION in penicillin allergic patients **DURATION: 7-10 days**

Notes
1. Includes sepsis related to urine infection
2. NICE Guideline NG111: Pyelonephritis (acute): antimicrobial prescribing. October 2018 https://www.nice.org.uk/guidance/ng111
3. Check any previous urine culture and susceptibility results and antibiotic prescribing and choose antibiotics accordingly. Where a child or young person is receiving prophylactic antibiotics, treatment should be with a different antibiotic, not a higher dose of the same antibiotic.
4. May extend Co-amoxiclav course duration to 10 days where clinically appropriate.
5. Oral switch option is Cefalexin oral 500mg every 8 hours.
6. If no improvement within 24 hours, seek advice from consultant microbiologist. Review IV to oral at 48 to 72 hours.
7. Chelation interaction with bivalent ions reduces dose absorption, time doses accordingly.
8. Caution in patients with history of seizures, cardiac or musculoskeletal problems. Check drug-drug and drug-disease interactions first.
9. Can use IV but has very good oral bioavailability, so use (or switched to) oral as soon as absorption of medication is felt to be reliable.
10. Gentamicin drug dosing and monitoring information in Section 3.4.3.2.

4.1.3 Catheter associated Urinary Tract Infection

Catheter associated Urinary Tract Infection[1]	First Line Choices[2]	Alternatives where first line choices contraindicated (e.g. allergy), not tolerated or not effective[2]
Urine dip is not useful here. In catheterised patients, antibiotic therapy is unlikely to eradicate asymptomatic bacteriuria[3]. Short-term urinary catheters must be removed as soon as possible. Do not use prophylactic antibiotics for routine catheter changes unless there is a clear history of catheter-change associated UTI or trauma[4] Patients with a long-term catheter should be treated only if symptomatic (unless pregnant), and/or with significant ascending infection. Long-term antimicrobial prophylaxis is usually ineffective and promotes resistance so should NOT be used. Discuss alternative approaches with Consultant Microbiologist.		
Non-pregnant women or Men **No upper UTI symptoms**	**Nitrofurantoin**[5,6] oral modified release 100mg po every 12 hours (or immediate release 50mg po every 6 hours). **Trimethoprim** oral 200mg every 12 hours (only use if low risk of resistance[7]) **DURATION: 7 days**	**Amoxicillin** oral 500mg every 8 hours (only if culture results available and susceptible). DO NOT use in penicillin allergic patients **Pivmecillinam** oral 400mg stat then 200mg every 8 hours DO NOT use in penicillin allergic patients **DURATION: 7 days**
Non-pregnant women or Men **Upper UTI symptoms**	**Co-amoxiclav**[8] IV 1.2g every 8 hours DO NOT use in penicillin allergic patients **Cefuroxime**[9] IV 1.5g every 8 hours CAUTION in penicillin allergic patients **DURATION: 7 days**	**Ciprofloxacin**[10,11,12] oral 500mg every 12 hours **Gentamicin**[13] IV **DURATION: 7 days**
Pregnant women IF SEVERE beta lactam allergy, discuss options with microbiologist on call	**Cefalexin** 500mg po every 8 hours CAUTION in penicillin allergic patients **DURATION: 7-10 days**	**Cefuroxime**[9] IV 1.5g every 8 hours CAUTION in penicillin allergic patients **DURATION: 7-10 days**

Notes

1. NICE Guideline NG113: Urinary tract infection (catheter-associated): antimicrobial prescribing. November 2018 https://www.nice.org.uk/guidance/ng113
2. Check any previous urine culture and susceptibility results and antibiotic prescribing and choose antibiotics accordingly. Where a person is receiving prophylactic antibiotics, treatment should be with a different antibiotic, not a higher dose of the same antibiotic.
3. NICE Quality Standard QS90 Urinary tract infections in adults. June 2015 https://www.nice.org.uk/guidance/qs90/chapter/Quality-statement-2-Diagnosing-urinary-tract-infections-in-adults-with-catheters
4. In such cases recommendation is Gentamicin 80mg IV STAT dose. If a catheter or meatal/suprapubic catheter exit site is known to be colonised with Staphylococcus aureus (including MRSA) contact microbiologist on call for advice.
5. Do not use in patients with eGFR <45 mL/minute, acute porphyria, and G6PD deficiency. Some manufacturers support use with extreme caution in cases where eGFR is 30–44 mL/minute as a short-course only (3 to 7 days), to treat uncomplicated lower urinary-tract infection caused by suspected or proven multidrug resistant bacteria and only if potential benefit outweighs risk.
6. Nitrofurantoin is not recommended for men with suspected prostate involvement because it is unlikely to reach therapeutic levels in the prostate.
7. A lower risk of resistance may be more likely if not used in the past 3 months, previous urine culture suggests susceptibility (but this was not used). A higher risk of resistance may be more likely with recent use.
8. May extend course duration to 10 days where clinically appropriate.
9. Oral switch option is Cefalexin oral 500mg every 8 hours.
10. Chelation interaction with bivalent ions reduces dose absorption, time doses accordingly.
11. Caution in patients with history of seizures, cardiac or musculoskeletal problems. Check drug-drug and drug-disease interactions first.
12. Can use IV but has very good oral bioavailability, so use (or switched to) oral as soon as absorption of medication is felt to be reliable.
13. Gentamicin drug dosing and monitoring information in Section 3.4.3.2.

4.1.4 Recurrent Urinary Tract Infection

Recurrent Urinary Tract Infection[1,2]	First Line Choices[3,4]	Alternatives where first line choices contraindicated (eg allergy), not tolerated or not effective[3,4]
The urinary tract is the most common source of infection leading to Gram-negative bloodstream infections (GNBSIs), most commonly Escherichia coli, for which there is increased resistance to trimethoprim. Most cases are community onset. Risk is greater among older patients, and those with history of repeated UTIs (in the period leading up to the BSI), significant dehydration, and poor incontinence care. Only a small proportion of infections were related to urinary catheterisation. Correct management of UTIs has significant impact in reducing GNBSIs.		
On specialist advice only and choice of agent MUST be guided by culture and sensitivities.	**Nitrofurantoin**[5,6,7,8] oral 100mg single dose when exposed to a trigger, **OR** 50-100 mg at night **Trimethoprim**[9] oral 200mg single dose when exposed to a trigger, **OR** 100 mg at night **DURATION: 3 months then seek review with specialist**	**Cefalexin** oral 500 mg single dose when exposed to a trigger, **OR** 125mg at night CAUTION in penicillin allergic patients **Amoxicillin**[10] oral 500mg single dose when exposed to a trigger, **OR** 250mg at night DO NOT use in penicillin allergic patients **DURATION: 3 months then seek review with specialist**
Non-pregnant women[11] with recurrent LOWER UTI	Consider vaginal oestrogen for postmenopausal women if appropriate, and review within 12 months[12,13].	If no improvement, consider[13] single dose antibiotic prophylaxis for exposure to an identifiable trigger, before going for a daily regimen. Refer or seek specialist advice if underlying cause unknown or cancer suspected

Recurrent Urinary Tract Infection[1,2]	First Line Choices[3,4]	Alternatives where first line choices contraindicated (eg allergy), not tolerated or not effective[3,4]
Non-pregnant women[11] with recurrent UPPER UTI	Refer or seek specialist advice to understand and address cause where possible.	Consider[13] a daily antibiotic prophylaxis regime rather than 'single doses when exposed to triggers'. DO NOT use nitrofurantoin.
Men with recurrent UPPER or LOWER UTI	Refer or seek specialist advice to understand and address cause where possible. Consider[13] alternative diagnosis (e.g., prostatitis, cancer)	Consider[13] a daily antibiotic prophylaxis regime, rather than 'single doses when exposed to triggers'. DO NOT use nitrofurantoin if recurrent UPPER UTI, or if prostatic involvement[8].
Pregnant women with recurrent UPPER or LOWER UTI	Refer or seek specialist advice to understand and address cause where possible.	DO NOT use nitrofurantoin or trimethoprim unless advised by a microbiologist or antimicrobial pharmacist, see notes below. Choose from the alternative options given in right hand column above.

Notes

1. NICE Guideline NG112: Urinary tract infection (recurrent): antimicrobial prescribing. October 2018 https://www.nice.org.uk/guidance/ng112
2. Preventing healthcare associated Gram-negative (focus on E. coli) BSIs: an improvement resource by UKHSA and NHS Improvement. May 2018 https://improvement.nhs.uk/documents/984/Gram-negative_IPCresource_pack.pdf
3. Antibiotics - ensure any current UTI is treated and take account of severity and frequency of symptoms, risk of complications and long-term antibiotic use, previous urine culture and susceptibility results, previous antibiotic use, local antimicrobial resistance, and preferences for treatment
4. Check any previous urine culture and susceptibility results and antibiotic prescribing and choose antibiotics accordingly. Where a person is receiving prophylactic antibiotics, treatment should be with a different antibiotic, not a higher dose of the same antibiotic. Similarly, use a different antibiotic for prophylaxis if recently treated an acute UTI.
5. Advice is to use normal release tablets or capsules, not modified release.
6. Do not use nitrofurantoin in patients with eGFR <45 mL/minute, acute porphyria, or G6PD deficiency. Some manufacturers support use with extreme caution in cases where eGFR is 30–44 mL/minute as a short-course only (3 to 7 days), to treat uncomplicated lower urinary-tract infection caused by suspected or proven multidrug resistant bacteria and only if potential benefit outweighs risk. Must discuss with an Antimicrobial Pharmacist or Microbiologist first.
7. Avoid nitrofurantoin near term (over 36 weeks in pregnancy) as theoretical risk of haemolytic anaemia in the foetus or new born infant due to immature erythrocyte enzyme systems.
8. Nitrofurantoin is not recommended for men with suspected prostate involvement because it is unlikely to reach therapeutic levels in the prostate.
9. Trimethoprim should be avoided in pregnancy. Total contraindication in first trimester.
10. Amoxicillin is not licensed for preventing UTIs, so use for this indication would be off‑label.
11. Non-pregnant women may wish to try D-mannose or cranberry products but should be advised of sugar content and that evidence of benefit is uncertain. Not suitable in pregnancy.
12. Vaginal oestrogen - take account of severity and frequency of symptoms, risk of complications, benefits for other symptoms (vaginal dryness), possible adverse effects (breast tenderness and vaginal bleeding), unknown long-term endometrial safety and preferences for treatment
13. NICE uses 'offer' when there is more certainty of benefit and 'consider' when evidence of benefit is less clear.

4.1.5 Acute Prostatitis

Acute Prostatitis[1,2]	First Line Choices[3]	Alternatives where first line choices contraindicated (e.g. allergy), not tolerated or not effective
Discuss with urology. Send MSU for culture and start antibiotics. If possible also send prostatic secretions for culture.		
Signs of sepsis Also take blood cultures	**Ciprofloxacin**[4,5] IV 400mg every 12 hours IF patient critically unwell, add **Gentamicin**[6] IV STAT **DURATION**[5,8]**:** review IV to oral switch by 72 hours	**Piperacillin/Tazobactam** IV 4.5g every 8 hours DO NOT use in penicillin allergic patients **Cefotaxime** IV 1g every 12 hours CAUTION in penicillin allergic patients IF patient critically unwell, add **Gentamicin**[6] IV STAT **DURATION**[7,8]**:** review IV to oral switch by 72 hours
No signs of sepsis	**Ciprofloxacin**[4,9] oral 500mg every 12 hours **DURATION**[8]**: review at 14 days**	**Trimethoprim** oral 200mg every 12 hours (only use if low risk of resistance[10]) **DURATION**[8]**: review at 14 days**

Notes

1. BMJ Best practice: Acute Prostatitis. Last reviewed October 2020 Acute prostatitis - Symptoms, diagnosis and treatment | BMJ Best Practice
2. NICE Clinical knowledge summary: Prostatitis – acute. August 2021 https://cks.nice.org.uk/topics/prostatitis-acute/
3. Acute prostatitis is the most frequent urological diagnosis in men <50 years old. *Escherichia coli* - the most common causative pathogen. Quinolones are first agents of choice as good penetration to the area. Second choice of Trimethoprim is subject to increasing resistance.
4. Caution in patients with history of seizures, cardiac or musculoskeletal problems. Check drug-drug and drug-disease interactions first.
5. Ciprofloxacin has very good oral bioavailability, so switch to oral as soon as absorption of medication is felt to be reliable. If improving, consider IV to oral switch. Review again at 14 days.
6. Gentamicin drug dosing and monitoring information in Section 3.4.3.2.
7. Step down to oral co-trimoxazole 960mg BD, review again at 14 days.
8. Either stop treatment at 14 days, or continue for a further 14 days (total 28 days) based on assessment of symptoms, clinical examination and blood tests. A 28-day course may prevent chronic prostatitis. In recurrent or chronic prostatitis discuss treatment with Consultant Microbiologist
9. Chelation interaction with bivalent ions reduces dose absorption, time doses accordingly.
10. A lower risk of resistance may be more likely if not used in the past 3 months, previous urine culture suggests susceptibility (but this was not used). A higher risk of resistance may be more likely with recent use.

4.2 Upper Respiratory Tract Infections - Ear Nose and Throat Infections

4.2.1 Common cold

Common cold[1]
Reassure common cold is self-limiting with symptoms typically resolving after 7 days. It is usually caused by viruses, symptomatic relief and rest are appropriate. Antibiotics are not needed as they are likely to make no difference to the symptoms and may have side effects.
Notes 1. NICE Guideline CG69: Respiratory tract infections (self-limiting): prescribing antibiotics https://www.nice.org.uk/guidance/cg69

4.2.2 Influenza

Influenza[1]
• Annual vaccination is the most effective way of preventing influenza and should be offered to all "at risk"[1] patients in accordance with national guidelines. • For otherwise healthy adults, the use of zanamivir or oseltamivir is not recommended. • Zanamivir or oseltamivir are recommended when influenza is circulating in the community, for the treatment of "at-risk" adults presenting with symptoms of influenza-like illness (ILI) who can commence treatment within **48 hours** of the start of symptoms[1] • For dosing and duration advice, please refer to the most current UKHSA guidance on the use of antiviral agents for the treatment and prophylaxis of influenza[1]
Notes 1. UKHSA guidance – Influenza: treatment and prophylaxis using anti-viral agents. Last updated Oct 2019 https://www.gov.uk/government/publications/influenza-treatment-and-prophylaxis-using-anti-viral-agents

4.2.3 Otitis externa, Uncomplicated

Otitis externa, Uncomplicated[1,2,3]	**First Line Choices**	**Alternatives where first line choices contraindicated (e.g. allergy), not tolerated or not effective**
Otitis externa refers to inflammation of the external ear canal which in some cases may involve oedema. It is primarily caused by bacterial infection. It is important to consider whether the otitis externa may be secondary to otorrhoea from otitis media.		

Otitis externa, Uncomplicated[1,2,3]	First Line Choices	Alternatives where first line choices contraindicated (e.g. allergy), not tolerated or not effective
	AURAL TOILET. Also note, in the presence of infection do not use steroids alone. Keep dry.	
A systemic antibacterial may be considered in addition to antimicrobial ear drops, if the infection is spreading outside the ear canal, or the patient is systemically unwell[4].	**Flucloxacillin** oral 500mg every 4 hours DO NOT use in penicillin allergic patients **DURATION: 7 days**	**Clarithromycin** oral 500mg every 12 hours **DURATION: 7 days**
Notes 1. BNF: Treatment Summary: Ear. https://bnf.nice.org.uk/treatment-summary/ear.html 2. NICE Clinical knowledge summary: Otitis Externa. February 2018 https://cks.nice.org.uk/topics/otitis-externa/ 3. UKHSA/NICE: Managing common infections: guidance for primary care. November 2020. https://www.gov.uk/government/publications/managing-common-infections-guidance-for-primary-care 4. Referral should be considered if there is extensive swelling of the auditory canal or high risk of malignant otitis externa.		

4.2.4 Malignant/ Necrotising Otitis Externa

Malignant/ Necrotising Otitis Externa	First Line Choices[1]	Alternatives where first line choices contraindicated (e.g. allergy), not tolerated or not effective[1]
Malignant Otitis Externa is an aggressive infection that predominantly affects people who are immunocompromised, diabetic, or the elderly. Otitis externa spreads into the bone surrounding the ear canal (the mastoid and temporal bones). It is also known as necrotising otitis externa.		
Investigations: • Ear swab for culture • CT/ MRI scan Refer to ENT ALL cases must be discussed with Microbiologist	**Piperacillin/Tazobactam** IV 4.5g every 8 hours **and Ciprofloxacin** oral 750mg every 12 hours[2,3] DO NOT use in penicillin allergic patients **DURATION: 6 weeks[4]**	**Ceftazidime*** IV 2g every 8 hours **and Ciprofloxacin** oral 750mg every 12 hours[2,3] *CAUTION in penicillin allergic patients IF SEVERE beta lactam allergy, discuss options with Microbiologist on call **DURATION: 6 weeks[4]**
Notes 1. ENT UK guideline on Necrotising Otitis Externa Necrotising otitis externa.pdf (entuk.org) 2. Caution in patients with history of seizures, cardiac or musculoskeletal problems. Check drug-drug and drug-disease interactions first. 3. Chelation interaction with bivalent ions reduces dose absorption, time doses accordingly. 4. Systemic antibiotics can be terminated after minimum 6 weeks treatment and improved otalgia and biochemical markers, (+/- improvement on imaging). Any intention to continue beyond 6 weeks should be discussed with microbiology.		

4.2.5 Otitis Media

Otitis Media	First Line Choices	Alternatives where first line choices contraindicated (e.g. allergy), not tolerated or not effective
Acute[1] Refer to ENT if: • Severe systemic infection • Complications like mastoiditis	Acute otitis media can be caused by viruses or bacteria. It lasts for about a week, and most patients get better in 3 days without antibiotics. **Treat with Analgesics/ anti-inflammatories only** **DURATION: Anticipated duration 3 days to 1 week- thereafter treat as per guidance on chronic otitis media**	
Chronic[2,3] Refer to ENT for assessment	**Amoxicillin** oral 500mg every 8 hours DO NOT use in penicillin allergic patients **DURATION: 5 days**	**Clarithromycin** oral 500mg every 12 hours **DURATION: 5 days**
Notes 1. NICE Guidance NG91: Otitis media (acute): antimicrobial prescribing https://www.nice.org.uk/guidance/ng91 2. NICE CKS Guidance: Otitis media – chronic suppurative https://cks.nice.org.uk/topics/otitis-media-chronic-suppurative 3. Chronic suppurative otitis media is the chronic inflammation of the middle ear and mastoid cavity, which presents with recurrent ear discharges through a tympanic perforation.		

4.2.6 Mastoiditis

Mastoiditis	First Line Choices	Alternatives where first line choices contraindicated (e.g. allergy), not tolerated or not effective
Normally confirmed by CT or MRI scan. Severe complication of Otitis Media can rarely spread and cause meningitis or cerebral abscess. Oral switch is recommended once patient is stabilised.		
Must refer to ENT for assessment, and antimicrobial treatment discussed with microbiology.	**Co-amoxiclav** IV 1.2g every 8 hours DO NOT use in penicillin allergic patients **DURATION**[1]**: 14 days**	**Cefuroxime*** IV 1.5g every 8 hours **and Metronidazole** IV 500mg every 8 hours[2] *CAUTION in penicillin allergic patients **Levofloxacin**[3,4] IV 500mg every 12 hours **and Clindamycin** IV 600mg every 6 hours **DURATION**[1]**: 14 days**
Notes 1. Includes oral switch once patient is stabilised. 2. Oral stepdown to Cefalexin 500mg every 8 hours and Metronidazole 400mg every 8 hours 3. Caution in patients with history of seizures, cardiac or musculoskeletal problems. Check drug-drug and drug-disease interactions first. 4. Chelation interaction with bivalent ions reduces dose absorption, time doses accordingly.		

4.2.7 Acute Sore Throat (including pharyngitis and tonsillitis)

Acute Sore Throat[1] (including pharyngitis and tonsillitis)	First Line Choices	Alternatives where first line choices contraindicated (e.g. allergy), not tolerated or not effective
Patients with 3 of 5 centor criteria (history of fever, purulent tonsils, cervical adenopathy, absence of cough) or history of otitis media may benefit more from antibiotics. Acute sore throat (including pharyngitis and tonsillitis) is self-limiting and often triggered by a viral infection of the upper respiratory tract. Symptoms can last around one week, but most people will get better within this time without antibiotics, regardless of cause (bacterial or viral).		
Antibacterial therapy is required only in patients who are systemically very unwell, have symptoms and signs of a more serious illness or condition or are at a high-risk of complications.	**Phenoxymethylpenicillin** oral 500mg every 6 hours[2] DO NOT use in penicillin allergic patients **DURATION: 5-10 days**[2]	**Clarithromycin**[3] oral 500mg every 12 hours Failed therapy and confirmed EBV negative: **Co-amoxiclav** oral 625mg every 8 hours[4] DO NOT use in penicillin allergic patients **DURATION: 5 days**
Notes 1. NICE Guideline NG84: Sore throat (acute): antimicrobial prescribing. January 2018. https://www.nice.org.uk/guidance/ng84 2. Five days of Phenoxymethylpenicillin may be enough for symptomatic cure; but a 10-day course may increase the chance of microbiological cure. 3. Erythromycin is preferred in women who are pregnant. 4. Epstein-Barr virus infection can also present this way and is a contraindication to Amoxicillin containing products like Co-amoxiclav.		

4.2.8 Peritonsillar Abscess (Quinsy)

Peritonsillar Abscess (Quinsy)	First Line Choices	Alternatives where first line choices contraindicated (e.g. allergy), not tolerated or not effective
Needle aspiration or incision and drainage must be considered. Cover for oral anaerobic organisms is required.	**Benzylpenicillin** IV 1.2g every 4 hours **and Metronidazole** IV 500mg every 8 hours[1,2] DO NOT use in penicillin allergic patients **DURATION: 7-10 days in total**[3]	**Clindamycin** IV 600mg every 6 hours[2] **DURATION: 7-10 days in total**[3]
Notes 1. Oral switch to Amoxicillin 500mg every 8 hours and Metronidazole 400mg every 8 hours. 2. Review IV to oral at 48 to 72 hours. 3. If Group A Streptococcus is implicated, treat for 10 days.		

4.2.9 Epiglottitis

Epiglottitis[1]	First Line Choices	Alternatives where first line choices contraindicated (e.g. allergy), not tolerated or not effective
Epiglottitis is a cellulitis of the supraglottis with the potential to cause airway compromise, and should be treated as a surgical emergency until the airway is secured.		
Once the airway has been secured and antibiotics have been initiated, the condition usually resolves rapidly.	**Cefotaxime** IV 2g every 8 hours[2] CAUTION in penicillin allergic patients (Switch to **Co-amoxiclav** oral 625mg 8 hourly once stable) DO NOT use in penicillin allergic patients **DURATION: 7 days in total**	**Levofloxacin** IV 500mg every 12 hours[3,4]**, and** discuss with consultant Microbiologist urgently

Notes
1. BMJ Best practice: Epiglottitis Last reviewed February 2020. https://bestpractice.bmj.com/topics/en-gb/452
2. Review IV to oral at 48 to 72 hours
3. Caution in patients with history of seizures, cardiac or musculoskeletal problems. Check drug-drug and drug-disease interactions first.
4. Chelation interaction with bivalent ions reduces dose absorption, time doses accordingly.

4.2.10 Sinusitis

Sinusitis[1]	First Line Choices	Alternatives where first line choices contraindicated (e.g. allergy), not tolerated or not effective
Usually lasts 2-3 weeks, most cases will resolve without antibiotics. Treatment is indicated if symptoms worsen rapidly or significantly, systemically very unwell or high risk of complications. Symptom relief for fever and pain is advised. Steroid nasal spray can be considered.		
Where patient is not systemically unwell but needs antibiotics	**Phenoxymethylpenicillin** oral 500mg every 6 hours DO NOT use in penicillin allergic patients **DURATION: 5 days**	**Doxycycline**[2] oral 200mg on day 1, then 100mg once daily DO NOT use doxycycline in pregnancy **Clarithromycin**[3] 500 mg oral 500mg every 12 hours **DURATION: 5 days**
If systemically unwell or worsening symptoms despite more than 48 hours on the choices above.	**Co-amoxiclav** oral 625mg every 8 hours DO NOT use in penicillin allergic patients **DURATION: 5 days**	If patient is penicillin allergic, or not improving on Co-amoxiclav, seek Microbiologist advice

Notes
1. NICE Guideline NG79: Sinusitis (acute): antimicrobial prescribing. October 2017. https://www.nice.org.uk/guidance/ng79
2. Chelation interaction with bivalent ions will reduce absorption of dose, time doses accordingly.
3. Erythromycin is preferred in women who are pregnant.

4.2.11 Whooping Cough/ Pertussis

Whooping Cough/ Pertussis[1,2]	First Line Choices[3]	Alternatives where first line choices contraindicated (e.g. allergy), not tolerated or not effective
Incubation period is around 7 days, and the person is infectious for 3 weeks after the onset of symptoms.		
Prescribe antibiotic for all suspected or confirmed cases with onset of cough within the previous 21 days.	**Clarithromycin** oral 500mg every 12 hours[3,4] **for 7 days** **Azithromycin** oral 500mg once daily[5] **for 3 days**	If unable to tolerate a macrolide, or contraindicated **Co-trimoxazole** oral 960mg every 12 hours[3] **for 7 days**

Notes
1. NICE Clinical knowledge summary: Whooping Cough. June 2018. https://cks.nice.org.uk/whooping-cough#!topicSummary
2. UKHSA Guidelines for the Public Health management of Pertussis in England. May 2018. 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
3. Give oral antibiotics first line if the person can take oral medicines. If severe, treat with intravenous antibiotics.
4. Erythromycin is preferred in women who are pregnant.
5. Azithromycin course length is shorter as this drug has a longer half-life.

4.3 Lower Respiratory Tract Infections Incl. COPD, Pneumonia, TB

4.3.1 Bronchitis, Acute

Bronchitis, Acute[1,2]
Usually lasts up to 3 or 4 weeks. **Do not** routinely offer an antibiotic to treat an acute cough, unless patient is at higher risk of complications, systemically unwell or symptoms worsening rapidly. Refer to treatment recommendations for chronic bronchitis and infective exacerbations of COPD for such cases. Encourage adequate fluid intake, and prescribe paracetamol or ibuprofen if appropriate, for symptomatic relief. Unless the patient has pre-existing COPD, the use of bronchodilators, corticosteroids or mucolytics is not recommended.
Notes 1. NICE Guideline NG120 Cough (acute): antimicrobial prescribing https://www.nice.org.uk/guidance/NG120 2. Acute Bronchitis – NICE https://cks.nice.org.uk/topics/chest-infections-adult/management/acute-bronchitis/

4.3.2 Bronchitis, Chronic and COPD, Acute Exacerbations

Bronchitis, Chronic and COPD, Acute Exacerbations[1]	**First Line Choices[2]**	**Alternatives where first line choices contraindicated (e.g. allergy), not tolerated or not effective**
A range of factors (including viral infections and smoking) can trigger an exacerbation. Many exacerbations (including some severe exacerbations) are not caused by bacterial infections so will not respond to antibiotics.		
Consider an antibiotic for people with an acute exacerbation of COPD, but only after taking into account the severity of symptoms, particularly changes in sputum colour/volume/thickness, the need for hospital admission, previous exacerbations, the risk of developing complications, previous sputum culture results and antibiotic courses. If *Pseudomonas aeruginosa* has been isolated, discuss case with Microbiologist or respiratory physician, as early aggressive eradication of new colonisation is likely to be beneficial (see BTS bronchiectasis guidelines)[3]		
Give oral antibiotics first line if the person can take oral medicines, and the severity of their exacerbation does not require intravenous antibiotics.	**Doxycycline[4,5]** oral 200mg on day 1, then 100mg once daily DO NOT use doxycycline in pregnancy **Amoxicillin[6]** oral 500mg every 8 hours DO NOT use in penicillin allergic patients	**If severely unwell or higher risk of resistance (guided by susceptibilities where available)** **Co-amoxiclav** oral 625mg (or iv 1.2g) every 8 hours DO NOT use in penicillin allergic patients

Bronchitis, Chronic and COPD, Acute Exacerbations[1]	First Line Choices[2]	Alternatives where first line choices contraindicated (e.g. allergy), not tolerated or not effective
	Clarithromycin oral 500mg every 12 hours **DURATION[2]: 5 days**	**Levofloxacin**[4,7] oral 500mg every 24 hours (If unable to take orally, use IV 500mg every 12 hours) **Co-trimoxazole** oral 960mg (or IV 1.44g) every 12 hours **DURATION[2]: 5 days**

Notes
1. NICE Guideline NG114: Chronic obstructive pulmonary disease (acute exacerbation): antimicrobial prescribing https://www.nice.org.uk/guidance/ng114/chapter/Recommendations
2. For all antibiotics, if no improvement after 2-3 days check sputum culture results and consider switching to 2nd or 3rd line agent.
3. British Thoracic Society: Bronchiectasis in Adults. December 2018 https://www.brit-thoracic.org.uk/quality-improvement/guidelines/bronchiectasis-in-adults/
4. Chelation interaction with bivalent ions reduces dose absorption, time doses accordingly.
5. Higher doses may be used if severe infection Doxycycline 200mg oral once daily
6. Higher doses may be used if severe infection Amoxicillin 1g oral every 8 hours.
7. Caution in patients with history of seizures, cardiac or musculoskeletal problems. Check drug-drug and drug-disease interactions first.

4.3.3 Community Acquired Pneumonia, Mild

Community Acquired Pneumonia[1] Mild (CURB Score 0-1)	First Line Choices[3]	Alternatives where first line choices contraindicated (e.g. allergy), not tolerated or not effective
Clinical or X-ray evidence of lobar consolidation is required. **CURB-65** Score - 1 for each of the following (British Thoracic Society) • Acute unexplained **C**onfusion (mental test score <8, or disorientation in time/place/person) • **U**rea > 7mmol/l • **R**espiratory rate ≥30/min • **B**lood pressure – systolic <90 mmHg and/or diastolic ≤60 mmHg • Age 65 years or over **THE CURB-65 SCORE IS NOT A SUBSTITUTE FOR GOOD CLINICAL JUDGEMENT**		
Perform additional investigations as appropriate[2].	**Amoxicillin**[3,4] oral 500mg-1g every 8 hours DO NOT use in penicillin allergic patients **DURATION: 5 days[6]**	**Doxycycline**[5] oral 200mg on day 1, then 100mg once daily DO NOT use doxycycline in pregnancy **Clarithromycin**[4] oral 500mg every 12 hours **DURATION: 5 days[6]**

Notes
1. NICE Guideline NG138: Pneumonia (community-acquired): antimicrobial prescribing https://www.nice.org.uk/guidance/ng138
2. Specimens: fresh sputum and blood for culture; blood for serology, throat swabs for viral and 'atypical' bacterial PCR should be collected at onset of disease, and two weeks later.
3. The first line choice does not cover atypical pathogens. Most of these are self-limiting infections but should be considered in cases of treatment failure.
4. Can be given IV, but review and switch to oral as soon as possible.
5. Chelation interaction with bivalent ions reduces dose absorption, time doses accordingly.
6. Stop antibiotic treatment after 5 days unless microbiological results suggest a longer course is needed or the person is not clinically stable (fever in past 48 hours or more than 1 sign of clinical instability [systolic blood pressure < 90mmHg, heart rate >100/min, respiratory rate <24/min, arterial oxygen saturation <90% or PaO_2 under 60 mmHg in room air]).

4.3.4 Community Acquired Pneumonia, Moderate

Community Acquired Pneumonia[1] Moderate (CURB Score 2)	First Line Choices[3]	Alternatives where first line choices contraindicated (e.g. allergy), not tolerated or not effective[3]
Clinical or X-ray evidence of lobar consolidation is required. **CURB-65** Score - 1 for each of the following (British Thoracic Society) • Acute unexplained **C**onfusion (mental test score <8, or disorientation in time/place/person) • **U**rea > 7mmol/l • **R**espiratory rate ≥30/min • **B**lood pressure – systolic <90 mmHg and/or diastolic ≤60 mmHg • Age 65 years or over **THE CURB-65 SCORE IS NOT A SUBSTITUTE FOR GOOD CLINICAL JUDGEMENT**		
Perform additional investigations as appropriate[2].	**Amoxicillin** oral 500mg-1g every 8 hours **and Clarithromycin[4]** oral 500mg every 12 hours DO NOT use in penicillin allergic patients **DURATION: 5 days[7]**	**Doxycycline[5]** oral 100mg every 12 hours DO NOT use doxycycline in pregnancy **Clarithromycin[4]** oral 500mg every 12 hours **Levofloxacin[4,5,6]** oral 500mg every 24 hours (If unable to take orally, use IV 500mg every 12 hours) **DURATION: 5 days[7]**

Notes

1. NICE Guideline NG138: Pneumonia (community-acquired): antimicrobial prescribing https://www.nice.org.uk/guidance/ng138
2. Specimens: fresh sputum and blood for culture; blood for serology, throat swabs for viral and 'atypical' bacterial PCR should be collected at onset of disease, and two weeks later. Urine samples for antigen testing should be sent in a universal white top bottle (contains no boric acid).
3. These treatments do cover atypical pathogens. Review antibiotic choice and target more accurately once results including urine legionella and pneumococcal antigens are known.
4. Can be given IV, but review and switch to oral as soon as possible.
5. Chelation interaction with bivalent ions reduces dose absorption, time doses accordingly.
6. Caution in patients with history of seizures, cardiac or musculoskeletal problems. Check drug-drug and drug-disease interactions first.
7. Stop antibiotic treatment after 5 days unless microbiological results suggest a longer course is needed or the person is not clinically stable (fever in past 48 hours or more than 1 sign of clinical instability [systolic blood pressure < 90mmHg, heart rate >100/min, respiratory rate <24/min, arterial oxygen saturation <90% or PaO_2 under 60 mmHg in room air]).

4.3.5 Community Acquired Pneumonia, Severe

Community Acquired Pneumonia[1] Severe (CURB Score ≥3 or Pa O2 <8 KPa or Sa O2 <92% on any Fi O2)	First Line Choices[4]	Alternatives where first line choices contraindicated (e.g. allergy), not tolerated or not effective[4]
Clinical or X-ray evidence of lobar consolidation is required. **CURB-65** Score - 1 for each of the following (British Thoracic Society) • Acute unexplained **C**onfusion (mental test score <8, or disorientation in time/place/person) • **U**rea > 7mmol/l • **R**espiratory rate ≥30/min • **B**lood pressure – systolic <90 mmHg and/or diastolic ≤60 mmHg • Age 65 years or over **THE CURB-65 SCORE IS NOT A SUBSTITUTE FOR GOOD CLINICAL JUDGEMENT**		

Community Acquired Pneumonia[1] Severe (CURB Score ≥3 or Pa O2 <8 KPa or Sa O2 <92% on any Fi O2)	**First Line Choices[4]**	**Alternatives where first line choices contraindicated (e.g. allergy), not tolerated or not effective[4]**
Perform additional investigations as appropriate[2,3,4]	**Co-amoxiclav*** IV 1.2g every 8 hours **and Clarithromycin[5]** IV or oral 500mg every 12 hours *DO NOT use in penicillin allergic patients **DURATION: Review at 5 days[8]**	**Cefuroxime*** IV 1.5g every 8 hours **and Clarithromycin[5]** IV or oral 500mg every 12 hours *CAUTION in penicillin allergic patients **Levofloxacin**[5,6,7] IV or oral 500mg every 12 hours **DURATION: Review at 5 days[8]**

Notes

1. NICE Guideline NG138: Pneumonia (community-acquired): antimicrobial prescribing https://www.nice.org.uk/guidance/ng138
2. Specimens: fresh sputum and blood for culture; blood for serology, throat swabs for viral and 'atypical' bacterial PCR should be collected at onset of disease, and two weeks later. Urine samples for antigen testing should be sent in a universal white top bottle (contains no boric acid).
3. Consider underlying disease processes (e.g. need for HIV test).
4. These treatments cover atypical pathogens. Review antibiotic choice and target more accurately once results including urine legionella and pneumococcal antigens are known.
5. Can be given IV, but review and switch to oral as soon as possible.
6. Caution in patients with history of seizures, cardiac or musculoskeletal problems. Check drug-drug and drug-disease interactions first.
7. Chelation interaction with bivalent ions reduces dose absorption, time doses accordingly.
8. Stop antibiotic treatment after 5 days unless microbiological results suggest a longer course is needed or the person is not clinically stable (fever in past 48 hours or more than 1 sign of clinical instability [systolic blood pressure < 90mmHg, heart rate >100/min, respiratory rate <24/min, arterial oxygen saturation <90% or PaO_2 under 60 mmHg in room air]).

4.3.6 Hospital Acquired Pneumonia

Hospital Acquired Pneumonia[1]	**First Line Choices**	**Alternatives where first line choices contraindicated (e.g. allergy), not tolerated or not effective**
Consider following the Community Acquired Pneumonia guidance for choice of antibiotic for adults with symptoms/signs of pneumonia starting within 3 to 5 days of hospital admission, who are not at higher risk of resistance. This includes relevant comorbidity (such as severe lung disease or immunosuppression), recent use of broad-spectrum antibiotics, colonisation with multidrug-resistant bacteria, and recent contact with health and social care settings before current admission. Respiratory samples are essential.		
Non severe symptoms/signs[2,3]	**Doxycycline**[4] oral 100mg every 12 hours DO NOT use doxycycline in pregnancy **DURATION: Review at 5 days[6]**	**Co-amoxiclav** oral 625mg every 8 hours DO NOT use in penicillin allergic patients **Co-trimoxazole** oral 960mg every 12 hours **Levofloxacin**[4,5] oral 500mg once daily **DURATION: Review at 5 days[6]**

Hospital Acquired Pneumonia[1]	First Line Choices	Alternatives where first line choices contraindicated (e.g. allergy), not tolerated or not effective
Severe[2] symptoms/signs	**Piperacillin/Tazobactam** IV 4.5g every 8 hours[7] DO NOT use in penicillin allergic patients **DURATION: At least 5 days treatment**[6,9]	**Ceftazidime** IV 2g every 8 hours. CAUTION in penicillin allergic patients **Co-trimoxazole**[8] IV 1.44g every 12 hours **Levofloxacin**[4,5,9] IV 500mg every 12 hours *MRSA risk*: **add Vancomycin**[10,11] IV (target blood level range 10-15mg/L) **DURATION: At least 5 days treatment**[6,9]

Notes
1. NICE Guideline NG139: Pneumonia (hospital-acquired): antimicrobial prescribing https://www.nice.org.uk/guidance/ng139
2. According to NG139, there are no validated severity assessment tools available for hospital-acquired pneumonia. Severity of symptoms or signs should be based on clinical judgement.
3. Only oral route is recommended for antibiotics in non-severe cases.
4. Chelation interaction with bivalent ions reduces dose absorption, time doses accordingly.
5. Caution in patients with history of seizures, cardiac or musculoskeletal problems. Check drug-drug and drug-disease interactions first.
6. Seek advice from on-call Consultant Microbiologist if no significant improvement at 72 hours.
7. In very severe cases, increase frequency to every 6 hours.
8. Review daily with a view to oral switch, to a dose of 960mg oral every 12 hours.
9. Review daily with a view to early IV to oral switch. Has very good oral bioavailability, so can be switched as soon as oral absorption of medication is felt to be reliable.
10. Vancomycin drug dosing and monitoring information in Section 3.4.2.1.
11. Can use Teicoplanin as alternative if poor renal function at 6mg/kg. Dosing and monitoring information in Section 3.4.2.2.

4.3.7 Aspiration Pneumonia

Aspiration Pneumonia	First Line Choices	Alternatives where first line choices contraindicated (e.g. allergy), not tolerated or not effective
Aspiration can result in a chemical pneumonitis in the absence of infection. Antibiotics are only indicated if clear signs of pneumonia based on radiological findings and other clinical parameters such as fever and raised inflammatory markers.	**Co-amoxiclav** IV 1.2g every 8 hours DO NOT use in penicillin allergic patients **DURATION[5]: 5 days**	**Cefuroxime*** IV 1.5g every 8 hours **and Metronidazole** IV 500mg every 8 hours *CAUTION in penicillin allergic patients **Levofloxacin**[1,2,3] oral or IV 500mg every 12 hours **and Metronidazole** IV 500mg every 8 hours **Co-trimoxazole**[4] IV 960mg every 12 hours **and Metronidazole** IV 500mg every 8 hours **DURATION[5]: 5 days**

Notes
1. Has very good oral bioavailability, so use (or switched to) oral as soon as absorption of medication is felt to be reliable.
2. Chelation interaction with bivalent ions reduces dose absorption, time doses accordingly.

3. Caution in patients with history of seizures, cardiac or musculoskeletal problems. Check drug-drug and drug-disease interactions first.
4. Increase the dose to 1.44g BD if severe presentation.
5. Consider oral therapy if patient's condition permits. With exception of Cefuroxime, all options can step down to the same agent at usual dose recommendation.

4.3.8 COVID Pneumonia

COVID Pneumonia[1]	First Line Choices	Alternatives where first line choices contraindicated (e.g. allergy), not tolerated or not effective
Antibiotics not usually indicated for mild cases (community or hospital acquired) as unlikely to have bacterial co-infection. Severity of COVID-19 pneumonia should be based on clinical judgement as CURB-65 Score is not validated in this context. Seek advice from a Consultant Microbiologist for patients who are immunocompromised, pregnant, in critical care, or have history of infection with resistant organisms, repeated infective exacerbations of lung disease. Perform additional investigations where bacterial co-infection is suspected[2].		
Community acquired	**Doxycycline**[3] oral 200mg on day 1, then 100mg once daily DO NOT use doxycycline in pregnancy **Co-amoxiclav*** oral 625mg every 8 hours **and Clarithromycin[5]** oral 500mg every 12 hours *DO NOT use in penicillin allergic patients **DURATION: 5 days**	**Cefuroxime*** IV 1.5g every 8 hours **and Clarithromycin[5]** IV or oral 500mg every 12 hours *CAUTION in penicillin allergic patients **Levofloxacin**[3,4,5] oral 500mg every 24 hours in moderate cases, or every 12 hours where severe **DURATION: 5 days**
Hospital acquired Use right hand column options if severe case (e.g., suspected sepsis, ventilator-associated pneumonia).	**Doxycycline**[3] oral 200mg on day 1, then 100mg once daily DO NOT use doxycycline in pregnancy **Co-amoxiclav** oral 625mg every 8 hours DO NOT use in penicillin allergic patients **Co-trimoxazole** oral 960mg every 12 hours **DURATION: 5 days**	**Piperacillin/Tazobactam** IV 4.5g every 8 hours DO NOT use in penicillin allergic patients **Ceftazidime** IV 2g every 8 hours. CAUTION in penicillin allergic patients **Levofloxacin**[3,4,5] oral 500mg every 24 hours in moderate cases, or every 12 hours where severe *MRSA risk*: **add Vancomycin[6]** IV (target blood level range 10-15mg/L) **DURATION: 5 days**

Notes

1. NICE Guideline NG191 COVID-19 rapid guideline: managing COVID-19 https://www.nice.org.uk/guidance/ng191
2. In addition to a COVID-19 swab, the following investigations will help review decisions around antibiotics: Microbiological samples for routine culture and sensitivities (i.e., sputum, tracheal aspirate, blood), chest imaging (X-ray, CT or ultrasound), and urinary antigen tests. COVID-19 pneumonia usually raises CRP levels, so this does not indicate bacterial cause. A full blood count will help as bacterial pneumonia will often be accompanied by raised neutrophil count.
3. Chelation interaction with bivalent ions reduces dose absorption, time doses accordingly.
4. Can use IV but has very good oral bioavailability, so use (or switched to) oral as soon as absorption of medication is felt to be reliable.
5. Caution in patients with history of seizures, cardiac or musculoskeletal problems. Check drug-drug and drug-disease interactions first.
6. Drug dosing and monitoring information in Section 3.4.2.1.

4.3.9 Empyema or Lung Abscess

Empyema or Lung Abscess[1]	First Line Choices	Alternatives where first line choices contraindicated (e.g. allergy), not tolerated or not effective
Every effort should be made to obtain a diagnostic sample, preferably before initiating antimicrobial therapy. Therapy should be directed at any bacteria isolated from fluid, pus or blood cultures, potentially also including cover for anaerobic organisms which are more difficult to isolate. Planned empirical therapy should be discussed with Microbiology.		
Empirical options whilst awaiting microbiology test results	**Co-amoxiclav** IV 1.2g every 8 hours DO NOT use in penicillin allergic patients **DURATION[5]: Review at 5 days**	**Cefuroxime*** IV 1.5g every 8 hours **and Metronidazole** IV 500mg every 8 hours * CAUTION in penicillin allergic patients **Clindamycin** IV 600mg every 6 hours **and consider adding Levofloxacin**[2,3,4] oral 500mg every 24 hours in moderate cases, or every 12 hours where severe **DURATION[5]: Review at 5 days**

Notes

1. British Thoracic Society: Pleural Disease Guideline 2010 https://www.brit-thoracic.org.uk/document-library/guidelines/pleural-disease/bts-pleural-disease-guideline/
2. Chelation interaction with bivalent ions reduces dose absorption, time doses accordingly.
3. Can use IV but has very good oral bioavailability, so use (or switched to) oral as soon as absorption of medication is felt to be reliable.
4. Caution in patients with history of seizures, cardiac or musculoskeletal problems. Check drug-drug and drug-disease interactions first.
5. Treatment duration usually 4-6 weeks in total. Initial review at 5 days to ensure in line with microbiology cultures and advice, and ensure patient is stabilising.

4.3.10 Bronchiectasis

Bronchiectasis[1,2]	First Line Choices	Alternatives where first line choices contraindicated (e.g. allergy), not tolerated or not effective
Obtain a sputum sample from people with an acute exacerbation of bronchiectasis and send for culture and susceptibility testing. Consultant local Chest Physicians and the BTS Guidelines[1,2] Offer an antibiotic to people with an acute exacerbation of bronchiectasis taking into account severity of symptoms, risk of complications and previous culture results. Review the choice of antibiotics with results of sputum cultures but only change the antibiotic if bacteria are resistant and symptoms are not already improving (using a narrow-spectrum antibiotic wherever possible).		
Empirical oral antibiotics[3]:	**Amoxicillin** oral 500mg every 8 hours DO NOT use in penicillin allergic patients **DURATION[4]: 7-14 days**	**Doxycycline**[5] oral 200mg on day 1, then 100mg once daily DO NOT use doxycycline in pregnancy **Clarithromycin** oral 500mg every 12 hours **DURATION[4]: 7-14 days**
If at higher risk of resistance due to repeated courses of antibiotics[6]	**Co-amoxiclav** oral 625mg every 8 hours DO NOT use in penicillin allergic patients **DURATION[4]: 7-14 days**	**Levofloxacin**[5,7] oral 500mg every 12 hours **DURATION[4]: 7-14 days**

Bronchiectasis[1,2]	First Line Choices	Alternatives where first line choices contraindicated (e.g. allergy), not tolerated or not effective
If severely unwell or oral route not available	**Co-amoxiclav** IV 1.2g every 8 hours DO NOT use in penicillin allergic patients **DURATION:7-14 days**	**Piperacillin/Tazobactam** IV 4.5g every 8 hours DO NOT use in penicillin allergic patients **Levofloxacin**[5,7,8] IV 500mg every 12 hours **DURATION:7-14 days**

Notes

1. NICE Guideline NG117 Bronchiectasis (non-cystic fibrosis), acute exacerbation: antimicrobial prescribing https://www.nice.org.uk/guidance/ng117
2. British Thoracic Society: Bronchiectasis (non-cystic fibrosis), acute exacerbation: antimicrobial prescribing Guideline 2018 https://www.brit-thoracic.org.uk/quality-improvement/guidelines/bronchiectasis-in-adults/
3. When a person is receiving antibiotic prophylaxis, treatment should be with an antibiotic from a different class.
4. Course length based on an assessment of the severity of bronchiectasis, exacerbation history, severity of exacerbation symptoms, previous culture and susceptibility results, and response to treatment.
5. Chelation interaction with bivalent ions reduces dose absorption, time doses accordingly.
6. Guided by sputum cultures where available.
7. Caution in patients with history of seizures, cardiac or musculoskeletal problems. Check drug-drug and drug-disease interactions first.
8. Can use IV but has very good oral bioavailability, so use (or switched to) oral as soon as absorption of medication is felt to be reliable.
9. Review at 48 hours and switch to oral antibiotics when possible

4.3.11 Tuberculosis

Tuberculosis[1]	First Line Choices	Alternatives where first line choices contraindicated (e.g. allergy), not tolerated or not effective
Contact the Consultant Respiratory Physician for advice. Isolate patient until non-infective. Refer to TB specialist.		

Notes

1. NICE Guideline NG33: Tuberculosis. January 2016. https://www.nice.org.uk/guidance/ng33

4.3.12 Pneumocystis (PCP)

Pneumocystis (PCP)[1,2]	First Line Choices	Alternatives where first line choices contraindicated (e.g. allergy), not tolerated or not effective
Mild or moderate (PaO2 >9.3kpa on room air)	**Co-trimoxazole**[3] IV 90mg/kg/day in 3-4 divided doses (or oral 1920mg TDS) **DURATION: 21 days**	**Clindamycin** oral 450mg every 6 hours **and Primaquine**[4] oral 30mg every 24 hours **DURATION: 21 days**
Severe[5] (PaO2 ≤9.3kpa on room air)	**Co-trimoxazole**[6] IV 120mg/kg/day in 3-4 divided doses **DURATION: 21 days**	**Pentamidine isetionate**[7,8,9] **IV** 4mg/kg every 24 hours **DURATION: 21 days**

Pneumocystis (PCP)[1,2]	First Line Choices	Alternatives where first line choices contraindicated (e.g. allergy), not tolerated or not effective

Notes

1. BHIVA and BIA guidelines for the treatment of Opportunistic Infection in HIV-seropositive Individuals 2011 https://www.bhiva.org/file/SwhaEzgXmAGOt/hiv_v12_is2_Iss2Press_Text.pdf
2. Contact the Duty Microbiologist for advice about diagnosis and management.
3. In obese patients, doses of 120mg/kg/TDS have been used. Adjust for renal function if needed.
4. Before starting primaquine, blood should be tested for glucose-6-phosphate dehydrogenase (G6PD) activity since the drug can cause haemolysis in G6PD-deficient patients. Specialist advice should be obtained in G6PD deficiency.
5. If O2 saturations <92% or PaO2 ≤9.3kpa on room air, start steroids at the same time as treatment. Prednisolone oral 40mg bd for 5 days, 40mg od for 5 days then 20mg daily for 11 days then stop. If IV required use methylprednisolone at 75% of oral prednisolone dose.
6. May consider stepping down to moderate dosing recommendations after 3 days.
7. Made in Pharmacy Aseptic Unit, please liaise with department as soon as the need is anticipated.
8. Dose to be given as infusion (250ml 5% glucose over at least 60 minutes) infusion set must be flushed to ensure total dose administration.
9. Reduce dose to 3mg/kg every 24 hours if develop toxicity, hypotension, or hypoglycaemia.

4.4 Skin and Soft Tissue Infections

4.4.1 Insect bites and stings

Insect bites and stings[1]	First Line Choices	Alternatives where first line choices contraindicated (e.g. allergy), not tolerated or not effective
Do not offer an antibiotic for an insect bite or sting if no symptoms or signs of an infection.	Rapid-onset skin reaction from an insect bite or sting is likely to be an inflammatory or allergic reaction, rather than an infection. Consider oral antihistamines to help relieve itching. Reassess if: • symptoms or signs of an infection develop. • condition worsens rapidly or significantly, or systemically unwell. • severe pain out of proportion to the wound is experienced, which may indicate the presence of toxin producing bacteria.	
For insect bite or sting with symptoms or signs of infection.	Manage as Cellulitis or Erysipelas[2] as appropriate. Seek specialist advice if: • systemically unwell • severely immunocompromised • previous serious reaction to same type of bite or sting. • in the mouth, throat, or around the eyes. • unusual or exotic insect. • fever or persisting lesions associated with a bite or sting that occurred while travelling outside the UK. • target-like rash consistent with erythema migrans develops after suspected tick exposure (consider Lyme's disease).	

Notes

1. NICE Guideline NG182: Insect bites and stings: antimicrobial prescribing. September 2020. https://www.nice.org.uk/guidance/ng182
2. See section 4.4.5 of these guidelines. Based on recommendations from NICE Guideline NG141: Cellulitis and erysipelas: antimicrobial prescribing September 2019. https://www.nice.org.uk/guidance/ng141.

4.4.2 Human and Animal Bites

Human and Animal Bites[1,2,3]	First Line Choices[1,2,3]	Alternatives where first line choices contraindicated (e.g. allergy), not tolerated or not effective
Antibiotic prophylaxis is not routinely indicated for bites that have not broken the skin.		
For bites that have broken the skin: assess type and severity of bite, wound site and depth, whether infected (take swabs and assess for other infection risks[4]). Consider irrigation and debridement as necessary. Give oral antibiotics if the person can take oral medicines. If severe, treat with IV antibiotics and review for oral switch at 48 hours.	**Co-amoxiclav** oral 625mg every 8 hours (or IV 1.2g every 8 hours) DO NOT use in penicillin allergic patients **DURATION[9]:** **Prophylaxis 3 days** **Treatment 5 days**	**Doxycycline[5]** oral 200mg oral daily **and Metronidazole** oral 400mg oral every 8 hours DO NOT use doxycycline in pregnancy **Cefuroxime*[6]** IV 750mg every 8 hours[6] **and Metronidazole** IV 500mg every 8 hours *CAUTION in penicillin allergic patients For severely penicillin allergic patient needing IV treatment **Ciprofloxacin[5,7]** IV 400mg every 12 hours **and Clindamycin[8]** IV 600mg every 6 hours **DURATION[9]:** **Prophylaxis 3 days** **Treatment 5 days**

Notes

1. NICE Guideline NG184: Human and animal bites: antimicrobial prescribing. November 2020. https://www.nice.org.uk/guidance/ng184
2. NICE Clinical knowledge summary: Bites – human and animal. October 2020. https://cks.nice.org.uk/bites-human-and-animal
3. UKHSA/NICE: Managing common infections: guidance for primary care. November 2020. https://www.gov.uk/government/publications/managing-common-infections-guidance-for-primary-care
4. Consider Tetanus immune status – is further vaccination/immunoglobulin required? If exotic animal bites or bites sustained overseas: Consider Rabies risk. If human bite: Consider risks of blood borne viral infection e.g. Hepatitis B, C and HIV.
5. Chelation interaction with bivalent ions will reduce absorption of dose, time doses accordingly.
6. If severe, use higher dose of Cefuroxime IV 1.5g every 8 hours.
7. Caution in patients with history of seizures, cardiac or musculoskeletal problems. Check drug-drug and drug-disease interactions first.
8. Use Metronidazole IV 500mg every 8 hours instead of Clindamycin if concerned about high risk of C. difficile associated diarrhoea. Clindamycin is preferred if bone penetration is required.
9. Duration of treatment can be increased to 7 days (with review) based on clinical assessment of the wound, for example, if significant tissue destruction or penetrated bone, joint, tendon or vascular structures.

4.4.3 Boils and Carbuncles

Boils and Carbuncles	First Line Choices	Alternatives where first line choices contraindicated (e.g. allergy), not tolerated or not effective
No antibiotic therapy is indicated, unless there are signs of cellulitis, fever, a facial lesion or severe pain; a carbuncle is present; or where other comorbidities (i.e., diabetes or immunosuppression[1,2]). In such cases, refer to section for facial or non-facial cellulitis as appropriate. Urgent same-day incision and drainage should be arranged for: ALL fluctuant boils, unless they are small (in which case they will usually drain spontaneously after application of moist heat).		

Boils and Carbuncles	First Line Choices	Alternatives where first line choices contraindicated (e.g. allergy), not tolerated or not effective
ALL fluctuant carbuncles If widespread or recurrent boils seek advice from Dermatologist and consider investigation for Panton-Valentine Leukocidin (PVL) producing Staphylococcus aureus[3]		
Notes 1. NICE Clinical Knowledge Summary. Boils, carbuncles, and staphylococcal carriage. January 2017. https://cks.nice.org.uk/topics/boils-carbuncles-staphylococcal-carriage/ 2. NHS Overview Patient Leaflet: Boils. September 2020. https://www.nhs.uk/conditions/boils/ 3. For more information regarding diagnosis and management go to https://www.gov.uk/government/collections/panton-valentine-leukocidin-pvl-guidance-data-and-analysis		

4.4.4 Burns

Burns	First Line Choices	Alternatives where first line choices contraindicated (e.g. allergy), not tolerated or not effective
Uncomplicated[1,2]	Routine use of systemic antibiotics is NOT indicated Early complications can include Cellulitis and Sepsis.	
Complicated[2,3] Requires input from/ transfer to specialist burn care providers.	Seek Microbiology input Infection related complications can include Sepsis (stemming from Cellulitis), and Toxic Shock Syndrome. **Note**: diagnosis of sepsis is difficult here as systemic inflammatory response induced by the burn is a normal finding.	
Notes 1. NICE Clinical Knowledge Summary: Burns and scalds. September 2020. https://cks.nice.org.uk/topics/burns-scalds/ 2. UKHSA advises to consider tetanus immunisation status where significant breach of the skin, particularly if contact with soil or manure. 3. British Burn Association: National Standards for Provision and Outcomes in Adult and Paediatric Burn Care. November 2018. https://www.britishburnassociation.org/standards/		

4.4.5 Cellulitis or Erysipelas (Non Facial)

Cellulitis or Erysipelas[1,2] (Non Facial)	First Line Choices[3]	Alternatives where first line choices contraindicated (e.g. allergy), not tolerated or not effective[3]
Usual presentation – painful, hot and swollen skin, with raised inflammatory markers. Assessment should include inflammatory markers and body map/marking to indicate size and location of affected area. Note: bilateral cellulitis is very uncommon. Consider varicose eczema or underlying vascular insufficiency. Seek senior clinical review. If recurrent cellulitis please discuss with Consultant Microbiologist or Antimicrobial Pharmacists first[4].	**Flucloxacillin** oral/IV 1g every 6 hours (increase IV dose to 2g every 6 hours if severely unwell) DO NOT use in penicillin allergic patients IF (suspected or confirmed) MRSA infection **Vancomycin**[5] IV (target blood level range 10-15mg/L) **DURATION**[6]**: 5-7 days**	**Clarithromycin**[7,8] oral/IV 500mg every 12 hours **Doxycycline**[9] oral 200mg on day 1, then 100mg daily DO NOT use doxycycline in pregnancy **DURATION**[6]**: 5-7 days**
IF ambulatory care is an option	**Ceftriaxone** IV 2g once daily (with oral step down options as above) CAUTION in penicillin allergic patients **DURATION**[10]**: 5-7 days**	**Teicoplanin**[5] IV (with oral step down options as above) **DURATION**[10]**: 5-7 days**

Cellulitis or Erysipelas[1,2] (Non Facial)	First Line Choices[3]	Alternatives where first line choices contraindicated (e.g. allergy), not tolerated or not effective[3]
IF cellulitis is associated with water immersion	IF fresh water immersion, **add Ciprofloxacin[9,11]** 500mg oral every 12 hours	
	IF salt water immersion, **add Doxycycline[9]** 100mg oral every 12 hours DO NOT use doxycycline in pregnancy	

Notes

1. NICE Guideline NG141: Cellulitis and erysipelas: antimicrobial prescribing September 2019. https://www.nice.org.uk/guidance/ng141
2. NHS Overview Patient Leaflet: Cellulitis. March 2021. https://www.nhs.uk/conditions/cellulitis/
3. Give oral antibiotics first line if the person can take oral medicines. If severe, treat with intravenous antibiotics. Review IV to oral at 48 to 72 hours.
4. Do not prescribe prophylaxis before discussing with the Consultant Microbiologist.
5. See section 3.4.2 for drug dosing and monitoring information for Vancomycin and Teicoplanin.
6. A longer course (up to 14 days in total) may be needed based on clinical assessment. Note that, skin does take some time to return to normal, after infection has cleared.
7. Erythromycin is preferred in pregnancy.
8. IV formulation for Clarithromycin is available, but not recommended if oral route is available.
9. Chelation interaction with bivalent ions will reduce absorption of dose, time doses accordingly.
10. Limit of 7 days if ambulatory patient. Need reassessment if infection not resolved by this point.
11. Caution in patients with history of seizures, cardiac or musculoskeletal problems. Check drug-drug and drug-disease interactions first.

4.4.6 Eczema (and other skin conditions)

Eczema (and other skin conditions)[1,2]	First Line Choices	Alternatives where first line choices contraindicated (e.g. allergy), not tolerated or not effective
Evidence of secondary bacterial infection, but **Patient is <u>not</u> systemically unwell**	**Do not routinely offer either a topical or oral antibiotic**	
Evidence of localised, non-severe secondary bacterial infection, **Patient <u>not</u> systemically unwell,** but risk of complications	**Fusidic acid 2%** topical. Apply to affected area only, three times a day **DURATION[3]: 5 days** Take into account previous use of topical antibiotics, because antimicrobial resistance can develop rapidly with extended or repeated use.	
Evidence of widespread, or severe secondary bacterial infection, or **Patient systemically unwell**	**Flucloxacillin** oral 500mg every 6 hours DO NOT use in penicillin allergic patients **DURATION[3]: 5 days**	**Clarithromycin[4]** oral 500mg every 12 hours **DURATION[3]: 5 days**
IF (suspected or confirmed) MRSA infection	Discuss with Consultant Microbiologist	

Notes

1. NICE Guideline NG190: Secondary bacterial infection of eczema and other common skin conditions: antimicrobial prescribing. March 2021 https://www.nice.org.uk/guidance/ng190
2. The most commonly infected skin conditions are eczema, psoriasis, chicken pox, shingles and scabies.
3. For localised infections only. Can extend to 7 days. Extended or recurrent use may increase the risk of developing antimicrobial resistance.
4. Erythromycin is preferred in young women who are pregnant.

4.4.7 Facial Cellulitis or Erysipelas

Facial Cellulitis or Erysipelas[1]	First Line Choices[2]	Alternatives where first line choices contraindicated (e.g. allergy), not tolerated or not effective[2]
Consider seeking specialist advice[3]. For orbital or periorbital cellulitis refer to respective tables. If recurrent cellulitis please discuss with Consultant Microbiologist or Antimicrobial Pharmacists first. Do not prescribe prophylaxis before discussing with Consultant Microbiologist.	**Co-amoxiclav** oral 625mg every 8 hours (or IV 1.2g every 8 hours) DO NOT use in penicillin allergic patients **Clarithromycin**[4,5] oral/IV 500mg every 12 hours **and Metronidazole** oral 400mg every 8 hours (or IV 500mg every 8 hours) IF (suspected or confirmed) MRSA infection **Vancomycin**[6,7] IV (target blood level range 10-15mg/L) **DURATION**[9]**: 7 days**	**Cefuroxime***[8] IV 750mg every 8 hours **and Metronidazole** IV 500mg every 8 hours * CAUTION in penicillin allergic patients **Clindamycin** oral 450mg every 6 hours (or IV 600mg every 6 hours) **DURATION**[9]**: 7 days**

Notes

1. NICE Guideline NG141: Cellulitis and erysipelas: antimicrobial prescribing September 2019. https://www.nice.org.uk/guidance/ng141
2. Give oral antibiotics first line if the person can take oral medicines. If severe, treat with intravenous antibiotics. Review IV to oral at 48 to 72 hours.
3. If associated with water immersion, discuss with Consultant Microbiologist as there may be other associated issues to discuss (e.g. near drowning, aspiration)
4. Erythromycin is preferred in pregnancy.
5. IV formulation for Clarithromycin is available, but not recommended if oral route is available.
6. Must contact Consultant Microbiologist to discuss further.
7. Vancomycin drug dosing and monitoring information in section 3.4.2.1.
8. If severe, use higher dose of Cefuroxime IV 1.5g every 8 hours.
9. A longer course (up to 14 days in total) may be needed based on clinical assessment. Note that skin does take some time to return to normal, after infection has cleared.

4.4.8 Impetigo

Impetigo[1]	First Line Choices	Alternatives where first line choices contraindicated (e.g. allergy), not tolerated or not effective
Localised non-bullous impetigo *where patient is not systemically unwell and risk of complications is low*	**Hydrogen peroxide 1%** Apply two or three times a day **for 5 days**[2] **Fusidic acid 2%** - if hydrogen peroxide unsuitable (for example, if impetigo is around eyes) or ineffective[3] Apply three times a day **for 5 days**[2,3] **Mupirocin 2%** - if fusidic acid resistance suspected or confirmed[3]. Apply three times a day **for 5 days**[2,3]	

Impetigo[1]	First Line Choices	Alternatives where first line choices contraindicated (e.g. allergy), not tolerated or not effective
Widespread non-bullous impetigo *where patient is not systemically unwell and risk of complications is low*	Offer a short course of a topical **OR** oral antibiotic as equally effective at treating impetigo (as per recommendations made above and below). Consider patient preference, practicalities (if applying to large areas), and possible adverse effects. Take into account previous use of topical antibiotics, because antimicrobial resistance can develop rapidly with extended or repeated use.	
Bullous impetigo or impetigo in people who are systemically unwell or have high risk of complications	**Flucloxacillin** oral 500mg every 6 hours DO NOT use in penicillin allergic patients **DURATION[2]: 5 days**	**Clarithromycin[4]** oral 500mg every 12 hours **DURATION[2]: 5 days**
IF (suspected or confirmed) MRSA infection	Discuss with Consultant Microbiologist	

Notes
1. NICE Guideline NG153: Impetigo: antimicrobial prescribing. February 2020 https://www.nice.org.uk/guidance/ng153
2. A five-day course is appropriate for most people with impetigo but can be increased to 7 days based on clinical judgement, depending on the severity and number of lesions
3. As with all antibiotics, extended or recurrent use of topical fusidic acid or Mupirocin may increase the risk of developing antimicrobial resistance.
4. Erythromycin is preferred in pregnancy.

4.4.9 Necrotising Fasciitis (inc. Fournier's & Synergistic Gangrene)

Necrotising Fasciitis[1,2] (inc. Fournier's & Synergistic Gangrene)	First Line Choices	Alternatives where first line choices contraindicated (e.g. allergy), not tolerated or not effective
Urgent surgical debridement and discussion with Consultant Microbiologist mandatory.	**Meropenem** IV 2g every 8 hours **and Clindamycin** IV 1.2g every 6 hours CAUTION in penicillin allergic patients IF (suspected or confirmed) MRSA infection **add Vancomycin[3]** IV (target blood level range 15-20mg/L) **DURATION[7]: Review at 5 days since last surgery**	*For severely penicillin allergic patients:* **Vancomycin[3]** IV (target blood level range 15-20mg/L) **and Clindamycin** IV 1.2g every 6 hours **and Ciprofloxacin[4,5,6]** IV 400mg every 12 hours **DURATION[7]: Review at 5 days since last surgery**

Notes
1. UpToDate: Necrotizing soft tissue infections. May 2020. https://www.uptodate.com/contents/necrotizing-soft-tissue-infections
2. IDSA Practice Guidelines for the Diagnosis and Management of Skin and Soft Tissue Infections. June 2014. https://pubmed.ncbi.nlm.nih.gov/24947530/
3. Vancomycin drug dosing and monitoring information in Section 3.4.2.1.
4. Caution in patients with history of seizures, cardiac or musculoskeletal problems. Check drug-drug and drug-disease interactions first.
5. Gentamicin is an alternative option. Maximum 5 days unless Microbiology advise longer.
6. Chelation interaction with bivalent ions reduces dose absorption, time doses accordingly.
7. Review antibiotic treatment 5 days after the last surgical debridement and plan to stop treatment if improved clinically and no further surgery planned.

4.4.10 Surgical Site Infections

Surgical Site Infections[1]	First Line Choices	Alternatives where first line choices contraindicated (e.g. allergy), not tolerated or not effective
Gastrointestinal tract surgery Genitourinary tract surgery	**Co-amoxiclav** oral 625mg every 8 hours DO NOT use in penicillin allergic patients **DURATION: 5 days**	**Ciprofloxacin**[2,3] oral 500mg every 12 hours **and** **Metronidazole** oral 400mg every 8 hours IF (suspected or confirmed) MRSA: Treat according to susceptibility pattern. **DURATION: 5 days**
'Clean' Surgery not involving GI/GU tract	**Flucloxacillin** oral 500mg every 6 hours DO NOT use in penicillin allergic patients **DURATION: 5 days**	**Clindamycin** oral 450mg every 6 hours IF (suspected or confirmed) MRSA: Treat according to susceptibility pattern. **DURATION: 5 days**
Notes 1. NICE Guideline NG125: Surgical site infections: prevention and treatment August 2020. https://www.nice.org.uk/guidance/ng125 2. Chelation interaction with bivalent ions will reduce absorption of dose, time doses accordingly. 3. Caution in patients with history of seizures, cardiac or musculoskeletal problems. Check drug-drug and drug-disease interactions first.		

4.4.11 Ulcers and other Wound Infections

Ulcers and other Wound Infections[1]	First Line Choices	Alternatives where first line choices contraindicated (e.g. allergy), not tolerated or not effective
Diabetic foot ulcer	Refer to separate table.	
Chronic Stable Wounds (non-complicated, for any area, surgical or non-surgical)	**Antibiotics have no place in the management of chronic, stable wounds.** Chronic or established wounds (> 1 month) develop a thick, avascular, fibrous tissue layer, which neither underlying bacteria nor antibiotics cannot easily permeate. Such chronic wounds may include: varicose leg ulcers and pressure sores, post-surgical wounds, sinuses and fistulae, stoma sites (colostomy, urostomy, etc. Wound debridement or cleaning without antibiotics will promote healing in most cases.	
Acute, Complicated, or Non-Stable Wounds (for any area, surgical or non-surgical)	Manage associated cellulitis, osteomyelitis, etc., as appropriate but be mindful antibiotic treatment is being given for these complications not for the ulcer or wound. Use of topical antibiotics is strongly discouraged.	
Leg Ulcers	Refer to separate table.	
Gastrostomy site infections – superficial[2] Patient NOT systemically unwell	If swab indicates **bacterial infection**: Mupirocin 2% topical[3] applied three times a day for 5 days. If no improvement, escalate to Flucloxacillin oral 500mg every 6 hours for 5 days. Review at day 3. If still not resolving, contact microbiology for advice. If swab indicates **fungal infection**[4]: Clotrimazole 1% topical[3] TDS for 5 days. If not resolving[5], consider whether secondary bacterial cellulitis is an issue, treating accordingly with flucloxacillin. If still not resolving, contact microbiology for advice.	
Tracheostomy site infections	Take swabs. Manage associated cellulitis as appropriate. (See table for non-facial cellulitis). If not responding by day 3, check culture and sensitivity results on swab. Discuss with microbiology if needed.	

Ulcers and other Wound Infections[1]	First Line Choices	Alternatives where first line choices contraindicated (e.g. allergy), not tolerated or not effective
Infected Lacerations (non-soiled)[6]	Treat as Cellulitis (facial or non-facial, as appropriate).	
Infected Lacerations (soiled)[6]	**Co-amoxiclav** oral 625mg every 8 hours DO NOT use in penicillin allergic patient **DURATION: 5-7 days**	**Clindamycin** oral 450mg every 6 hours **DURATION: 5-7 days**

Notes

1. IF (suspected or confirmed) MRSA: Treat accordingly to the susceptibility pattern.
2. UpToDate: Gastrostomy tubes: Complications and their management. January 2021. https://www.uptodate.com/contents/gastrostomy-tubes-complications-and-their-management#H230615749
3. Avoid applying any of these topical creams on the gastrostomy tube.
4. IF possible, gastrostomy tube should be changed at the start and end of the treatment. Seek dietician advice.
5. Fungal swabs are prone to being over-interpreted, leading to prescription of fluconazole more often than appropriate. Superimposing bacterial cellulitis is more likely in these situations and should be considered first.
6. NICE Clinical Knowledge Summary. Lacerations: Management. January 2021. https://cks.nice.org.uk/topics/lacerations/management/

4.4.12 Leg Ulcers

Leg Ulcers[1,2]	First Line Choices[3]	Alternatives where first line choices contraindicated (e.g. allergy), not tolerated or not effective[2]
Underlying conditions, such as venous insufficiency and oedema, should be managed to promote healing. Most leg ulcers are not clinically infected but are likely to be colonised with bacteria. **Only offer an antibiotic for adults with a leg ulcer when there are symptoms or signs of infection.**	**Flucloxacillin** oral 500mg to 1g every 6 hours DO NOT use in penicillin allergic patients **Doxycycline**[4,5] oral 200mg on day 1, then 100mg daily DO NOT use doxycycline in pregnancy **Clarithromycin**[6] oral 500mg every 12 hours **DURATION**[7]**: 7 days**	**Co-amoxiclav** oral 625mg every 8 hours DO NOT use in penicillin allergic patient **Co-trimoxazole** oral 960mg every 12 hours **DURATION**[7]**: 7 days**
IF severely unwell	**Flucloxacillin***[8] IV 2g every 6 hours **and Metronidazole** IV 500mg every 8 hours *DO NOT use in penicillin allergic patients **Co-amoxiclav**[8] IV 1.2g every 8 hours DO NOT use in penicillin allergic patient **Co-trimoxazole**[8,9] IV 960mg every 12 hours **and Metronidazole** IV 500mg every 8 hours **DURATION**[3,7]**: 7 days**	**Piperacillin/Tazobactam** IV 4.5g every 8 hours (increase to every 6 hours if very severe) DO NOT use in penicillin allergic patients **Ceftriaxone*** 2g IV daily **and Metronidazole** IV 500mg every 8 hours * CAUTION in penicillin allergic patients **DURATION**[3,7]**: 7 days**
IF (suspected or confirmed) MRSA infection	**Vancomycin**[10] IV (target blood level range 10-15mg/L if limited to skin and soft tissue, or 15-20mg/L if includes osteomyelitis)	

Leg Ulcers[1,2]	First Line Choices[3]	Alternatives where first line choices contraindicated (e.g. allergy), not tolerated or not effective[2]

Notes

1. NICE Guideline NG152: Leg ulcer infection: antimicrobial prescribing. February 2020. https://www.nice.org.uk/guidance/ng152
2. NHS Overview Patient Leaflet: Venous leg ulcer. January 2019. https://www.nhs.uk/conditions/leg-ulcer/
3. Give oral antibiotics as a first line if the person can take oral medicines. If severe, treat with intravenous antibiotics. Review IV to oral at 48 to 72 hours.
4. Chelation interaction with bivalent ions will reduce absorption of dose, time doses accordingly.
5. May increase dose to 200mg daily if slow response or severe infection.
6. Erythromycin is preferred in pregnancy.
7. Full resolution not expected until after the antibiotic course is completed. A longer course (up to 14 days) may be needed in severe cases.
8. Gentamicin may also be added to provide additional gram negative cover. Maximum 5 days unless Microbiology advise longer. Drug dosing and monitoring information in Section 3.4.3.2
9. Dose may be increased to 1.44g every 12 hours if very severe infection.
10. Vancomycin drug dosing and monitoring information in Section 3.4.2.1.

4.4.13 Diabetic Foot Infection

Diabetic Foot Infection[1,2]	First Line Choices	Alternatives where first line choices contraindicated (e.g. allergy), not tolerated or not effective
Refer to diabetic team for review as soon as possible. A formal MDT may be necessary. Send wound cultures prior to initiation of antibiotics.		
Uninfected	**Symptomatic treatment only**	
Mild Infection NO evidence of systemic infection	**Flucloxacillin** oral 1g every 6 hours DO NOT use in penicillin allergic patients IF (suspected or confirmed) MRSA: Discuss with Microbiologist. **DURATION[3]: 7 days**	**Doxycycline[4]** oral 100mg every 12 hours DO NOT use doxycycline in pregnancy **Clarithromycin** oral 500mg every 12 hours **DURATION[3]: 7 days**
Moderate or Severe Infection Systemic infection; fever, vomiting, rigor, confusion. Start with IV antibiotics[6]. Make urgent referral to the Diabetes team, according to the Trust guidelines on inpatient management of diabetic foot patients. **Consider addition of Gentamicin[5]** to any of these options. Maximum 5 days unless Microbiology advise longer.	IF no antibiotics within 90 days: **Flucloxacillin*** IV 2g every 6 hours[7] **and Metronidazole** IV 500mg every 8 hours *DO NOT use in penicillin allergic patients IF recent antibiotic therapy: **Co-amoxiclav** IV 1.2g every 8 hours DO NOT use in penicillin allergic patients **DURATION[10]: 7 days**	IF no antibiotics within 90 days: **Co-trimoxazole** IV 960mg every 12 hours **and Metronidazole** IV 500mg every 8 hours IF recent antibiotic therapy: **Clindamycin[9]** IV 600mg every 6 hours **and Ciprofloxacin[4,8]** IV 400mg every 12 hours **DURATION[10]: 7 days**
IF (suspected or confirmed) MRSA	**Vancomycin[11,12]** IV (target blood level range 15-20mg/L) **and Ciprofloxacin[4,8]** IV 400mg every 12 hours **and Metronidazole** IV 500mg every 8 hours **DURATION[10]: 7 days**	Discuss with Microbiology. Will need to treat according to susceptibility pattern. **DURATION[10]: 7 days**

Diabetic Foot Infection[1,2]	First Line Choices	Alternatives where first line choices contraindicated (e.g. allergy), not tolerated or not effective
IF Pseudomonas (suspected or confirmed)	**Piperacillin/Tazobactam** IV 4.5g every 8 hours DO NOT use in penicillin allergic patients	If penicillin allergic, choose from any of the above listed options that include **Ciprofloxacin**.

Notes

1. NICE Guideline NG19: Diabetic foot problems: prevention and management. October 2019. https://www.nice.org.uk/guidance/ng19
2. International Working Group on the Diabetic Foot (IWGDF 2019 update) Guidelines on the diagnosis and treatment of foot infection in persons with diabetes. https://onlinelibrary.wiley.com/doi/epdf/10.1002/dmrr.3280
3. A longer course (up to 14 days in total) may be needed based on clinical assessment. Note that, skin does take some time to return to normal, after infection has cleared.
4. Chelation interaction with bivalent ions will reduce absorption of dose, time doses accordingly.
5. Gentamicin drug dosing and monitoring information in Section 3.4.3.2.
6. IF severe infection, give IV antibiotics for at least 48 hours (until stabilised).
7. Please note: Flucloxacillin oral stepdown dose is 1g every 6 hours.
8. Caution in patients with history of seizures, cardiac or musculoskeletal problems. Check drug-drug and drug-disease interactions first
9. Can replace with Gentamicin if risk of C. diff associated diarrhoea is very high. Drug dosing and monitoring information in Section 3.4.3.2.
10. Course length is based on clinical assessment: minimum of 7 days and up to 6 weeks for osteomyelitis (use oral antibiotics for prolonged treatment)
11. Vancomycin drug dosing and monitoring information in Section 3.4.2.1
12. Alternative option is Daptomycin 6mg/kg IV every 24 hours.

4.4.14 Mastitis and Breast Abscesses

Mastitis and Breast Abscesses[1,2]	First Line Choices	Alternatives where first line choices contraindicated (e.g. allergy), not tolerated or not effective
Mastitis[3] IF recurrent, consider if lactational abscess	**Flucloxacillin** oral 500mg every 6 hours DO NOT use in penicillin allergic patients **DURATION: 7-10 days**	**Clarithromycin** oral 500mg every 12 hours **DURATION: 7-10 days**
Lactational Abscess[3] Note: Abscess drainage important	**Flucloxacillin** oral 500mg every 6 hours DO NOT use in penicillin allergic patients **DURATION: 7-10 days**	**Clindamycin** oral 450mg every 6 hours (or IV 600mg every 6 hours) **DURATION: 7-10 days**
Non-Lactational Abscess	**Co-amoxiclav** oral 625mg every 8 hours DO NOT use in penicillin allergic patients **DURATION: 5 days**	**Ciprofloxacin[4,5]** oral 500mg every 12 hours **and Metronidazole** 400mg oral every 8 hours **DURATION: 5 days**

Notes

1. NICE Clinical Knowledge Summary: Mastitis and Breast Abscess. October 2018. https://cks.nice.org.uk/topics/mastitis-breast-abscess/
2. NHS Overview Patient Leaflet: Mastitis. October 2019. https://www.nhs.uk/conditions/mastitis/
3. Monitor the infant for possible effects on the gastrointestinal flora, such as diarrhoea, candidiasis (thrush, diaper rash).
4. Chelation interaction with bivalent ions will reduce absorption of dose, time doses accordingly.
5. Caution in patients with history of seizures, cardiac or musculoskeletal problems. Check drug-drug and drug-disease interactions first.

4.5 Central Nervous System

4.5.1 Brain Abscesses

Brain Abscesses[1,2,3]	First Line Choices – seek Consultant microbiologist advice if alternative options required (i.e., severe penicillin allergy)
Community onset brain abscess without previous neurosurgery	**Ceftriaxone*** IV 2g every 12 hours **and Metronidazole** IV 500mg every 8 hours *CAUTION in penicillin allergic patients **Cefotaxime*** IV 2g every 6 hours **and Metronidazole** IV 500mg every 8 hours * CAUTION in penicillin allergic patients
Previous neurosurgery Urgent referral to Neurosurgeon	**Meropenem*** IV 2g every 8 hours **and Vancomycin[4]** IV (target blood level range 15-20mg/L) * CAUTION in penicillin allergic patients

Notes
1. UpToDate: Treatment and prognosis of bacterial brain abscess. October 2019. https://www.uptodate.com/contents/treatment-and-prognosis-of-bacterial-brain-abscess
2. Sonneville et al., Clinical Microbiology & Infection 2017:23;614-620
3. Duration to be determined in line with management plan and Microbiologist advice.
4. Vancomycin drug dosing and monitoring information in Section 3.4.2.1.

4.5.2 EMPIRICAL TREATMENT for Bacterial Meningitis

EMPIRICAL TREATMENT for suspected or confirmed Bacterial Meningitis[1]	First Line Choices	Alternatives where first line choices contraindicated (e.g. allergy), not tolerated or not effective
Unknown aetiology **NB***:* treatment should not be withheld in suspected cases of bacterial meningitis whilst laboratory specimens are collected.	Pre-admission Treatment: **Benzylpenicillin** IV 1.2g stat DO NOT use in penicillin allergic patients	
	Cefotaxime IV 2g every 6 hours CAUTION in penicillin allergic patients **Ceftriaxone** IV 2g every 12 hours CAUTION in penicillin allergic patients	**Chloramphenicol** IV 25mg/kg every 6 hours
If penicillin resistant *Streptococcus pneumoniae* is suspected[2]	**Add Vancomycin[3]** IV (target blood level range 15-20mg/L)	**Add Rifampicin** IV 600mg or oral every 12 hours
If age is greater than 55 years, or if significantly immunocompromised	**Add Amoxicillin** IV 2g every 4 hours DO NOT use in penicillin allergic patients	**Add Co-trimoxazole** IV 15mg/kg every 6 hours
If signs of encephalitis	**Add Aciclovir** IV 10mg/kg every 8 hours	

Notes
1. NICE Clinical Knowledge Summary. Meningitis - bacterial meningitis and meningococcal disease. July 2021. https://cks.nice.org.uk/topics/meningitis-bacterial-meningitis-meningococcal-disease/
2. E.g. patient recently returned from areas of prevalence (e.g. Spain, South East Asia, USA)
3. Vancomycin drug dosing and monitoring information in Section 3.4.2.1.

4.5.3 SPECIFIC TREATMENT for Bacterial Meningitis

SPECIFIC TREATMENT for suspected or confirmed Bacterial Meningitis[1,2]	First Line Choices[3]	Alternatives where first line choices contraindicated (e.g. allergy), not tolerated or not effective
Meningitis (Meningococcal)	**Benzylpenicillin** IV 2.4g every 4 hours DO NOT use in penicillin allergic patients **Ceftriaxone** IV 2g every 12 hours CAUTION in penicillin allergic patients **Cefotaxime** IV 2g every 6 hours CAUTION in penicillin allergic patients **DURATION: 5-7 days**	Contact Consultant Microbiologist as treatment choice will be determined by culture sensitivities.
Meningitis (Pneumococcal)[4]	**Benzylpenicillin** IV 2.4g every 4 hours DO NOT use in penicillin allergic patients **Cefotaxime** IV 2g every 6 hours CAUTION in penicillin allergic patients **Ceftriaxone** IV 2g every 12 hours CAUTION in penicillin allergic patients **DURATION: 10-14 days**	If reduced susceptibility to beta-lactams, microbiology will specifically advise whether there is a need to add in **Vancomycin[5]** IV (target level 15-20mg/L) **and / or Rifampicin** IV/oral 600mg every 12 hours
Meningitis (Haemophilus)	**Cefotaxime** IV 2g every 6 hours **for 7-10 days** CAUTION in penicillin allergic patients **Ceftriaxone** IV 2g every 12 hours **for 10 days in total** CAUTION in penicillin allergic patients	Contact Consultant Microbiologist as treatment choice will be determined by culture sensitivities.
Meningitis (Listeria)	**Amoxicillin** IV 2g every 4 hours DO NOT use in penicillin allergic patients **DURATION: 21 days**	**Co-trimoxazole** IV 30mg/kg every 6 hours **DURATION: 21 days**
Unconfirmed, uncomplicated, but still clinically suspected bacterial meningitis	Continue with the empirical treatment that was started as per the table above. Complete **7-10 days**	
Encephalitis (viral)[6]	**Aciclovir[7]** IV 10mg/kg ideal body weight every 8 hours **for 14-21 days**	
Meningitis (viral)	Antiviral therapy is not recommended for viral meningitis. If encephalitis is suspected then treat as above	

Notes

1. BNF: Central nervous system infections, antibacterial therapy https://bnf.nice.org.uk/treatment-summary/central-nervous-system-infections-antibacterial-therapy.html
2. BIA guidance. The UK joint specialist societies guideline on the diagnosis and management of acute meningitis and meningococcal sepsis in immunocompetent adults McGill et al J Infect 2016:72;405-438
3. Unless directed otherwise, guided by the results of antibiotic sensitivities
4. In hospital, consider adjunctive treatment with dexamethasone (particularly if pneumococcal meningitis suspected in adults), preferably starting before or with first dose of antibacterial, but no later than 12 hours after starting antibacterial; avoid dexamethasone in septic shock, meningococcal septicaemia, or if immunocompromised, or in meningitis following surgery. Note: dexamethasone may reduce penetration of vancomycin into CNS.
5. Vancomycin drug dosing and monitoring information in Section 3.4.2.1.
6. BIA encephalitis guidance Solomon et al. J Infect 2012:64;347-373
7. Oral aciclovir is inadequate for treating CNS infections as only partially absorbed from the gut.

4.5.4 CSF Leak

CSF Leak	First Line Choices – seek Consultant Microbiologist advice if alternative options required (i.e., severe penicillin allergy)
Antimicrobial therapy **NOT** routinely indicated. *Streptococcus pneumoniae* (Pneumococcal) vaccination should be considered.	
Notes 1. BSAC Guideline. Antimicrobial prophylaxis in neurosurgery and after head injury: Infection in Neurosurgery Working Party of the British Society for Antimicrobial Chemotherapy. Lancet 1994:344, 1547 – 1551 2. Public Health England. Immunisation against infectious disease. Chapters 7 and 25 (both last updated January 2020). https://www.gov.uk/government/collections/immunisation-against-infectious-disease-the-green-book	

4.6 Gastrointestinal: Gastroenteritis (diarrhoea and vomiting) and Intra-Abdominal Infection

4.6.1 Gastroenteritis

Gastroenteritis[1,2]	**First Line Choices**	**Alternatives where first line choices contraindicated (e.g. allergy), not tolerated or not effective**
Usual duration of diarrhoea is 5–7 days and in most it stops within 2 weeks. Usual duration of vomiting is 1- 2 days and in most it stops within 3 days. Seek specialist advice if the symptoms do not resolve within these timeframes.	Majority of the cases are self-limiting and require NO antibiotic therapy. Suggest rehydration and electrolyte replacement. Refrain from prescribing antimicrobial therapy, unless systemic invasion is suspected or the patient has risk factors for an adverse outcome, including but not limited to pregnancy, immune dysfunction, underlying inflammatory bowel disease. For patient who have recently been abroad, seek specialist advice about antibiotic therapy. Consider potential for *C.difficile* infection.	
Notes 1. NICE Clinical knowledge summary: Gastroenteritis. August 2020 https://cks.nice.org.uk/topics/gastroenteritis/ 2. BNF: Gastro-intestinal system infections, antibacterial therapy. https://bnf.nice.org.uk/treatment-summary/gastro-intestinal-system-infections-antibacterial-therapy.html		

4.6.2 Campylobacter

Campylobacter[1,2,7]	**First Line Choice[1,2]**	**Alternatives where first line choice contraindicated (e.g. allergy), not tolerated or not effective**
	Treatment is indicated only if immunocompromised or in severe infections.	
Most cases are self-limiting within 2–3 days and usually resolve within 1 week.	**Clarithromycin[3]** oral 500mg every 12 hours **DURATION[6]: 5-7 days**	**Ciprofloxacin[4,5,6]** oral 500-750mg every 12 hours **DURATION[6]: 5-7 days**

Notes
1. NICE Clinical knowledge summary: Campylobacteriosis. August 2020 https://cks.nice.org.uk/topics/gastroenteritis/management/adult-gastroenteritis/
2. BNF: Gastro-intestinal system infections, antibacterial therapy. https://bnf.nice.org.uk/treatment-summary/gastro-intestinal-system-infections-antibacterial-therapy.html
3. Erythromycin is preferred in young women who are pregnant. Azithromycin may be preferred where compliance is a concern, as a shorter course duration can be used.
4. Strains with decreased sensitivity to ciprofloxacin are isolated frequently, hence not first line.
5. Chelation interaction with bivalent ions will reduce absorption of dose, time doses accordingly.
6. Caution in patients with history of seizures, cardiac or musculoskeletal problems. Check drug-drug and drug-disease interactions first.
7. BMJ Best Practice: Campylobacter infection. September 2018. https://bestpractice.bmj.com/topics/en-gb/1175/pdf/1175/Campylobacter%20infection.pdf

4.6.3 *E. coli* 0157

***E.coli* 0157[1,2]**	**First Line Choice**	**Alternatives where first line choice contraindicated (e.g. allergy), not tolerated or not effective**
Usually self-limiting and symptoms will clear within 10 days. Advise rehydration and electrolyte replacement.	There is no effective antibiotic treatment available for Shiga toxin-producing *E. coli* (STEC) infection, seek specialist advice on monitoring for haemolytic uraemic syndrome. Seek specialist advice if the symptoms do not resolve within these timeframes.	

Notes
1. NICE Clinical knowledge summary: Gastroenteritis. August 2020 https://cks.nice.org.uk/topics/gastroenteritis/background-information/causes/#bacteria
2. E. Coli VTEC O157. Authored by Dr Colin Tidy. Last edited March 2018.

4.6.4 Salmonella

Salmonella (non-typhoid species)[1]	**First Line Choice**	**Alternatives where first line choice contraindicated (e.g. allergy), not tolerated or not effective**
Usually self-limiting and the illness resolves after 4–7 days. Antibiotics only indicated in (or for patients at risk of) severe or invasive infections[2] Note: Treatment is indicated for all cases of *Salmonella typhi* (see Typhoid, below)	**Cefotaxime[2]** IV 2g every 8 hours CAUTION in penicillin allergic patients Then switch to **Azithromycin[2]** oral 500mg every 24 hours when clinically improved **DURATION: 7 days**	**Ciprofloxacin[3,4,5]** IV 400mg (or oral 500mg) every 12 hours **DURATION: 7 days**

Notes
1. NICE Clinical knowledge summary: Gastroenteritis. August 2020 https://cks.nice.org.uk/topics/gastroenteritis/background-information/causes/#bacteria
2. BNF: Gastro-intestinal system infections, antibacterial therapy. https://bnf.nice.org.uk/treatment-summary/gastro-intestinal-system-infections-antibacterial-therapy.html
3. Caution in patients with history of seizures, cardiac or musculoskeletal problems. Check drug-drug and drug-disease interactions first
4. Ciprofloxacin has very good oral bioavailability, so can be used as soon as oral absorption of medication is felt to be reliable.
5. Chelation interaction with bivalent ions will reduce absorption of dose, time doses accordingly

4.6.5 Typhoid

Typhoid[1,2,3]	First Line Choice	Alternatives where first line choice contraindicated (e.g. allergy), not tolerated or not effective
Severe symptoms include persistent vomiting, severe diarrhoea or a swollen stomach. Antibiotics should be administered intravenously to start with. Where there are complications, please discuss case with Microbiologist. Check travel history[4]	**Ceftriaxone[2]** IV 2g every 24 hours CAUTION in penicillin allergic patients Then switch to **Azithromycin[2]** oral 500mg every 24 hours when clinically improved **DURATION[5]: 7 days**	**Ciprofloxacin[6,7,8]** IV 400mg (or oral 500mg) every 12 hours *Check if micro-organism sensitive* **DURATION[5]: 7-14 days**

Notes

1. Typhoid and Paratyphoid Fever Authored by Dr Mary Lowth. Last edited Feb 2015 https://patient.info/doctor/typhoid-and-paratyphoid-fever-pro#nav-8
2. BNF: Gastro-intestinal system infections, antibacterial therapy. https://bnf.nice.org.uk/treatment-summary/gastro-intestinal-system-infections-antibacterial-therapy.html
3. NHS Overview Patient Leaflet Typhoid Fever June 2018 https://www.nhs.uk/conditions/typhoid-fever/
4. Infections from Middle-East, South Asia, and South-East Asia may be multiple-antibacterial-resistant and sensitivity should be tested.
5. Improvement usually noted within 3 to 5 days, but recovery period continues after antibiotic course completed. Consider IV to PO switch by day 3.
6. Caution in patients with history of seizures, cardiac or musculoskeletal problems. Check drug-drug and drug-disease interactions first
7. Ciprofloxacin has very good oral bioavailability, so can be used as soon as oral absorption of medication is felt to be reliable.
8. Chelation interaction with bivalent ions will reduce absorption of dose, time doses accordingly

4.6.6 Shigella Dysentery

Shigella Dysentery[1,2,3,4]	First Line Choice	Alternatives where first line choice contraindicated (e.g. allergy), not tolerated or not effective
Antibacterial not indicated for mild cases[4].	**Ciprofloxacin[5,6]** oral 500mg every 12 hours **DURATION[7]: 3 days**	**Amoxicillin** oral 500mg every 8 hours (if sensitive**)** DO NOT use in penicillin allergic patients **Trimethoprim** oral 200mg every 12 hours (if sensitive) **DURATION[7]: 3 days**

Notes

1. NICE Clinical knowledge summary: Gastroenteritis. August 2020 https://cks.nice.org.uk/topics/gastroenteritis/management/adult-gastroenteritis/
2. BNF: Gastro-intestinal system infections, antibacterial therapy. https://bnf.nice.org.uk/treatment-summary/gastro-intestinal-system-infections-antibacterial-therapy.html
3. NHS Overview Patient Leaflet Dysentry January 2020.https://www.nhs.uk/conditions/dysentery/
4. UpToDate: Shigella infection: Treatment and prevention in adults. June 2019. https://www.uptodate.com/contents/shigella-infection-treatment-and-prevention-in-adults#H2223623723
5. Caution in patients with history of seizures, cardiac or musculoskeletal problems. Check drug-drug and drug-disease interactions first
6. Chelation interaction with bivalent ions will reduce absorption of dose, time doses accordingly
7. Longer course may be required in severe cases (up to 14 days in rare event of bacteraemia).

4.6.7 Amoebic Dysentery

Amoebic Dysentery[1,2]	First Line Choice	Alternatives where first line choice contraindicated (e.g. allergy), not tolerated or not effective
Antibiotics usually recommended for all confirmed cases after specialist advice[3]	**Metronidazole**[4, 5,6] oral 800mg every 8 hours **DURATION**[6]**: 5 days, THEN prescribe a 10 day course of Diloxanide furoate**[8]	**Tinidazole**[7] oral 2g once daily **DURATION: 3 days THEN prescribe a 10 day course of Diloxanide furoate**[8]

Notes

1. NICE Clinical knowledge summary: Gastroenteritis. August 2020 https://cks.nice.org.uk/topics/gastroenteritis/management/adult-gastroenteritis/
2. NHS Overview Patient Leaflet: Dysentry January 2020 https://www.nhs.uk/conditions/dysentery/
3. Seek specialist advice regarding the need for microbiological clearance to confirm treatment success, 1 week after completing treatment.
4. BNF: Metronidazole https://bnf.nice.org.uk/drug/metronidazole.html
5. Note: Metronidazole tablets provide the active drug. The tablets may be crushed and dispersed (unlicenced) for administration via mouth or feeding tube if applicable. Metronidazole liquid suspension contains a prodrug of Metronidazole needing activation by gastric enzymes. This may render it less effective in situations of rapid gut transit.
6. Five days recommended for intestinal infection, but may need to extend duration to 10 days in extra-intestinal infection. https://bnf.nice.org.uk/drug/metronidazole.html
7. BNF: Tinidazole https://bnf.nice.org.uk/drug/tinidazole.html
8. Diloxanide furoate is not effective against hepatic amoebiasis, but a 10-day course should be given at the completion of Metronidazole or Tinidazole treatment to destroy any amoebae in the gut https://bnf.nice.org.uk/treatment-summary/antiprotozoal-drugs.html

4.6.8 Giardia

Giardia[1,2]	First Line Choice	Alternatives where first line choice contraindicated (e.g. allergy), not tolerated or not effective
Usually resolves by 7-10 days with the right treatment.	**Metronidazole**[3,4] oral 400mg every 8 hours **DURATION:5 days**	**Tinidazole**[5] oral 2g STAT[6] **Mepacrine**[7] oral 100mg every 8 hours **DURATION**: **5-7 days**

Notes

1. NICE Clinical knowledge summary: Gastroenteritis. August 2020 https://cks.nice.org.uk/topics/gastroenteritis/management/adult-gastroenteritis/
2. NHS Overview Patient Leaflet: Giardiasis October 2017 https://www.nhs.uk/conditions/giardiasis/
3. BNF: Metronidazole https://bnf.nice.org.uk/drug/metronidazole.html
4. Note: Metronidazole tablets provide the active drug. The tablets may be crushed and dispersed (unlicenced) for administration via mouth or feeding tube if applicable. Metronidazole liquid suspension contains a prodrug of Metronidazole needing activation by gastric enzymes. This may render it less effective in situations of rapid gut transit.
5. BNF: Tinidazole https://bnf.nice.org.uk/drug/tinidazole.html
6. BNF suggests that dose may be repeated once if necessary.
7. BNF: Mepacrine https://bnf.nice.org.uk/drug/mepacrine-hydrochloride.html

4.6.9 Suspected Intra-abdominal Infection

Suspected Intra-abdominal Infection[1]	First Line Choice	Alternatives where first line choice contraindicated (e.g. allergy), not tolerated or not effective
Includes • Appendicitis, • Acute Cholangitis • Cholecystitis, • Diverticulitis, • Hepatobiliary infection • Peritonitis (where not dialysis associated)	**Co-amoxiclav** IV 1.2g every 8 hours DO NOT use in penicillin allergic patients If slow response **add Metronidazole** IV 500mg every 8 hours If slow response **add Gentamicin[2]** IV STAT **DURATION[3]: 5-10 days**	**Cefuroxime*** IV 1.5g every 8 hours **and Metronidazole** IV 500mg every 8 hours *CAUTION in penicillin allergic patients *If risk of MRSA, or where severe beta lactam allergy:* **Vancomycin[4]** IV (target blood level range 10-15mg/L) **and Metronidazole** IV 500mg every 8 hours **and Ciprofloxacin[5,6,7]** IV 400mg every 12 hours If slow response **add Gentamicin[3]** IV STAT **DURATION[3]: 5-10 days**

1. BNF: Gastro-intestinal system infections, antibacterial therapy. https://bnfc.nice.org.uk/treatment-summary/gastro-intestinal-system-infections-antibacterial-therapy.html
2. Gentamicin drug dosing and monitoring information in Section 3.4.3.2.
3. Review at 48-72 hours for improvement and consider oral switch. Total duration determined based on severity of initial presentation.
4. Vancomycin drug dosing and monitoring information in Section 3.4.2.1.
5. Caution in patients with history of seizures, cardiac or musculoskeletal problems. Check drug-drug and drug-disease interactions first.
6. Ciprofloxacin has very good oral bioavailability, so can be used as soon as oral absorption of medication is felt to be reliable.
7. Chelation interaction with bivalent ions will reduce absorption of dose, time doses accordingly

4.6.10 Peritonitis (peritoneal dialysis associated)

Peritonitis (peritoneal dialysis-associated)[1]	First Line Choice	Alternatives where first line choice contraindicated (e.g. allergy), not tolerated or not effective
ISPD 2016[1] states: • Cloudy dialysate • WCC > 0.1 x 10^9/litre Seek Consultant Microbiologist advice	**Vancomycin[2] and Ceftazidime*,** both via intraperitoneal route[3] *CAUTION in penicillin allergic patients **DURATION[4]: 14 days**	**Vancomycin[2]** via Intraperitoneal route[3] **and Ciprofloxacin[5,6]** oral 500mg every 12 hours **DURATION[4]: 14 days**

Notes

1. International Society for Peritoneal Dialysis: ISPD Peritonitis Recommendations: 2016 Update on Prevention and Treatment https://ispd.org/ispd-guidelines/
2. Vancomycin drug dosing and monitoring information in Section 3.4.2.1.
3. Administer in the normal treatment volume for that patient, e.g. 1.0L or 2.5L PD fluid, and left to dwell for 6 hours.
4. Review at 48-72 hours for improvement. May need longer than 14 days depending on severity of initial presentation.
5. Caution in patients with history of seizures, cardiac or musculoskeletal problems. Check drug-drug and drug-disease interactions first
6. Chelation interaction with bivalent ions will reduce absorption of dose, time doses accordingly

4.6.11 Spontaneous Bacterial Peritonitis (Hepatic Failure)

Spontaneous Bacterial Peritonitis (Hepatic Failure)[1]	First Line Choice	Alternatives where first line choice contraindicated (e.g. allergy), not tolerated or not effective
Gold standard of diagnosis: Ascitic fluid neutrophil count of >250 cells/mm^3 Ascitic fluid culture should guide antibiotic choice where possible		
Mild/Moderate	**Co-trimoxazole** oral 960mg every 12 hours **DURATION: 5 days**	**Ciprofloxacin**[2,3] oral 500mg every 12 hours **DURATION: 5 days**
Severe	**Piperacillin/Tazobactam** IV 4.5g every 8 hours DO NOT use in penicillin allergic patients **DURATION**[4,5]**: 5-7days**	**Cefuroxime*** IV 1.5g every 8 hours **and Metronidazole** IV 500mg every 8 hours *CAUTION in penicillin allergic patients **Ciprofloxacin**[2,3] IV 400mg every 12 hours **and Metronidazole** IV 500mg every 8 hours **DURATION**[4,5]**: 5-7days**
Secondary prophylaxis	Please discuss Secondary prophylaxis with Gastroenterologist / Microbiologist first	
	Ciprofloxacin[2,3] oral 500mg every 24 hours	**Co-trimoxazole** oral 960mg every 24 hours
Gastrointestinal bleeding and underlying ascites due to hepatic cirrhosis (Primary prevention)	**Co-amoxiclav**[4] IV 1.2g every 8 hours DO NOT use in penicillin allergic patients **DURATION: 5 days**	**Ciprofloxacin**[2,3,4] IV 400mg every 12 hours **DURATION: 5 days**

Notes

1. British Society of Gastroenterology: Guidelines on the Management of Ascites in Cirrhosis 2020 https://www.bsg.org.uk/clinical-resource/guidelines-on-the-management-of-ascites-in-cirrhosis/
2. Caution in patients with history of seizures, cardiac or musculoskeletal problems. Check drug-drug and drug-disease interactions first
3. Chelation interaction with bivalent ions will reduce absorption of dose, time doses accordingly
4. Consider oral switch at earliest opportunity
5. Oral stepdown recommendations as listed for mild/moderate.

4.6.12 Acute Pancreatitis

Acute Pancreatitis[1,2,3]	First Line Choice	Alternatives where first line choice contraindicated (e.g. allergy), not tolerated or not effective
Prophylactic antibiotics are not recommended in patients with acute pancreatitis, regardless of the type (interstitial or necrotizing) or disease severity (mild, moderately severe, or severe). Hence, antibiotic use should be restricted to patients in whom infection is strongly suspected. It is possible that injudicious use of antibiotics in walled off necrosis (WON) may lead to the development of resistant organisms once infection does develop. **NOTE**: Antibiotics may be needed for treatment of associated infections e.g. cholangitis or Lower Respiratory Tract Infection. Contact Microbiologist for further advice if needed.		

Notes
1. NICE Guideline NG104: Pancreatitis. Last updated December 2020. https://www.nice.org.uk/guidance/ng104
2. NICE Clinical knowledge summary: Management of suspected acute pancreatitis. May 2016 https://cks.nice.org.uk/topics/pancreatitis-acute/management/management-of-suspected-acute-pancreatitis/
3. British Society of Gastroenterology: Practical guide to the management of acute pancreatitis 2019 https://www.bsg.org.uk/clinical-resource/practical-guide-to-the-management-of-acute-pancreatitis/

4.6.13 Pyogenic Bacterial Hepatic Abscess

Pyogenic/ Bacterial Hepatic Abscess	First Line Choice	Alternatives where first line choice contraindicated (e.g. allergy), not tolerated or not effective
Drainage, where possible, is essential. If amoebic abscess or parasites suspected, contact Microbiologist for advice	**Co-amoxiclav**[1] IV 1.2g every 8 hours DO NOT use in penicillin allergic patients **DURATION**[2]**: 7 days**	**Ciprofloxacin**[3,4,5] oral 500mg every 12 hours **and** **Metronidazole** IV 500mg every 8 hours **DURATION**[2]**: 7 days**
Notes: 1. Consider increasing to every 6 hours, or the need for additional amoxicillin. 2. Prolonged treatment may be necessary. 3. Caution in patients with history of seizures, cardiac or musculoskeletal problems. Check drug-drug and drug-disease interactions first. 4. Ciprofloxacin has very good oral bioavailability, so can be used as soon as oral absorption of medication is felt to be reliable. 5. Chelation interaction with bivalent ions will reduce absorption of dose, time doses accordingly.		

4.6.14 *Helicobacter pylori*

Helicobacter pylori[1,2]	First Line Choice[3]	Alternatives where first line choice contraindicated (e.g. allergy), not tolerated or not effective
Always test for H. pylori before giving antibiotics. Treat all positives Do not offer eradication for GORD. <u>Do not</u> use Clarithromycin, Metronidazole or Quinolone if used in the past year for <u>any</u> infection.	**Amoxicillin*** oral 1g every 12 hours **and Clarithromycin** oral 500mg every 12 hours **Add** oral **PPI**[4] *DO NOT use in penicillin allergic patients **Amoxicillin*** oral 1g every 12 hours **and Metronidazole** oral 400mg every 8 hours **Add** oral **PPI**[4] *DO NOT use in penicillin allergic patients **DURATION**[5,6]**: 7 days**	**Clarithromycin** oral 500mg every 12 hours **and** **Metronidazole** oral 400mg every 8 hours **Add** oral **PPI**[4] For further options please refer to the local primary care antimicrobial guidelines. **DURATION**[5,6]**: 7 days**
Notes: 1. UKHSA Helicobacter pylori in dyspepsia: test and treat https://www.gov.uk/government/publications/helicobacter-pylori-diagnosis-and-treatment 2. BNF: Peptic ulceration. https://bnf.nice.org.uk/treatment-summary/peptic-ulceration.html 3. Two-week dual-therapy regimens using a proton pump inhibitor and a single antibacterial produce low rates of *H. pylori* eradication and are not recommended. 4. Using an appropriate proton pump inhibitor or H2-receptor antagonist		

5. There is usually no need to continue anti-secretory treatment (with a proton pump inhibitor or H2-receptor antagonist); however, if the ulcer is large, or complicated by haemorrhage or perforation then anti-secretory treatment is continued for a further 3 weeks.
6. Two-week triple-therapy regimens offer the possibility of higher eradication rates compared to one-week regimens, but adverse effects are common and poor compliance is likely to offset any possible gain.

4.6.15 C. difficile associated diarrhoea

C. difficile associated diarrhoea[1,2,3]	First Line Choice	Alternatives where first line choice contraindicated (e.g. allergy), not tolerated or not effective
Mild infection: no WCC increase. Less than 3 episodes of Type 6-7 stools per day. **Moderate infection**: increased WCC (but <15), with 3 to 5 episodes of Type 6-7 stools per day. **Severe infection:** Any of the following: WCC >15, acute increase in serum creatinine concentration to >50% above baseline, temperature >38.5ºC, or evidence of severe colitis (abdominal or radiological signs). The number of stools may be a less reliable indicator of severity. **Life-threatening infection**: symptoms and signs include hypotension, partial or complete ileus, toxic megacolon or CT evidence of severe disease.		
Review medications urgently. Rationalise existing antibiotic treatment. Stop or narrow down spectrum of cover where appropriate. Review proton pump inhibitors, medicines that speed up, or slow down gastrointestinal transit (i.e., antiemetics, laxatives). Do not offer antimotility medicines such as loperamide, as these will increase toxin damage. **Ensure adequately hydration**, be mindful of effects of non-steroidal anti-inflammatory drugs, angiotensin-converting enzyme inhibitors, angiotensin-2 receptor antagonists and diuretics. **Seek Multidisciplinary team input**. i.e., microbiologist, gastroenterologist, surgeon, pharmacist, dietitian, as needed.		
First episode or Recurrence[4] (whether mild, moderate or severe)	**Vancomycin[5]** oral 125mg every 6 hours **for 10 days**[6,7]	**Fidaxomicin[5]** oral 200mg every 12 hours **for 10 days**[6,7]
If initial treatment with the above ineffective[7,9]	**Must seek Microbiology and Gastroenterology input.** **Vancomycin[5-8]** oral 250mg every 6 hours **for 10 days**	
If patient critically unwell	**Seek URGENT MDT input.** **Vancomycin**[5,8] oral 500mg every 6 hours **and Metronidazole** IV 500mg every 8 hours **for 10 days**	
Relapse[4]	**Fidaxomicin**[5,7] oral 200mg every 12 hours for **10 days**	
Prophylaxis	NOT recommended (Antibiotic, prebiotic, probiotics). Optimise infection control measures and careful antimicrobial stewardship[10]	

Notes:

1. NICE Guideline NG199: Clostridioides difficile infection: antimicrobial prescribing. Published July 2021. https://www.nice.org.uk/guidance/ng199
2. BNF: Gastro-intestinal system infections, antibacterial therapy. https://bnf.nice.org.uk/treatment-summary/gastro-intestinal-system-infections-antibacterial-therapy.html
3. UKHSA Updated guidance on management and treatment of Clostridium difficile infection. 2013. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/321891/Clostridium_difficile_management_and_treatment.pdf
4. Classed as 'Relapse' if further episode of C.difficile infection less than 12 weeks since symptom resolution. Classed as 'Recurrence' if more than 12 weeks have passed since resolution of previous episode.

5. For patients with swallowing difficulties, or enteral feeding tubes, seek pharmacy advice and see Annex 3.
6. Daily review required. If patient not improving as expected, rapidly or significantly deteriorates at any time, consider alternative or escalation. Seek Antimicrobial Pharmacist input.
7. Use clinical judgement to determine whether antibiotic treatment for C. difficile is ineffective. Unless no improvement noted on daily review, or significant worsening (both of which require action, it may take until day 7 to determine effectiveness and another 7 days to fully resolve.
8. If needing to step up to Vancomycin oral 250mg doses, addition of Metronidazole IV 500mg doses may be considered.
9. Considerations such as intracolonic Vancomycin or Faecal Microbiota Transplant should be made following specialist input only. See Annex 3 for more information.
10. Bezlotoxumab also not recommended for prophylaxis, as not cost effective (NICE NG199).

4.7 Genital Tract

- Pelvic Inflammatory Disease
- PROM Pre-labour Rupture Of Membranes at term (<37 weeks)
- Puerperal Sepsis of pelvic origin
- Maternal fever in labour (inc. Chorioamnionitis)
- Epididymo-orchitis
- Sexually-Transmitted Infections Suspected

4.7.1 Pelvic Inflammatory Disease

Pelvic Inflammatory Disease[1,2]	First Line Choices	Alternatives where first line choices contraindicated (e.g. allergy), not tolerated or not effective
Usually the result of infection ascending from the endocervix causing endometritis, salpingitis, parametritis, oophoritis, tubo-ovarian abscess and/or pelvic peritonitis. The insertion of an intrauterine device (IUD) increases the risk of developing PID for 4-6 weeks after insertion. This risk is probably highest in women with pre-existing gonorrhoea or *trachomatis*. NOTE in Pregnancy / breastfeeding: PID in pregnancy is uncommon but associated with an increase in both maternal and fetal morbidity. Seek expert advice. None of the suggested evidence based regimens are of proven safety in this situation. A pharmacist should be consulted for advice on safety in pregnancy and excretion of the antibiotics in breastmilk.		
Out-patient regimen	**Ceftriaxone*** IM 1g single dose **and Doxycycline**[3,6] oral 100mg every 12 hours **and Metronidazole**[6] oral 400mg every 12 hours *CAUTION in penicillin allergic patients DO NOT use doxycycline in pregnancy **DURATION: 14 days**	**Ofloxacin**[3,4,5] oral 400mg every 12 hours **and Metronidazole** oral 400mg every 8 hours **DURATION: 14 days**
In-patient regimen Intravenous therapy should be continued until 24 hours after clinical improvement and then switched to oral.	**Ceftriaxone*** IV 2g daily **and Doxycycline**[3,6] oral 100mg every 12 hours *CAUTION in penicillin allergic patients DO NOT use doxycycline in pregnancy **Followed by oral switch to: Doxycycline**[3,6] oral 100mg every 12 hours **and Metronidazole**[6] oral 400mg every 8 hours DO NOT use doxycycline in pregnancy **TOTAL DURATION: 14 days**	**Clindamycin**[6] IV 900mg every 6 hours **and Gentamicin**[3] IV **Followed by oral switch to: Doxycycline**[3,6] oral 100mg every 12 hours **and Metronidazole**[6] oral 400mg every 8 hours DO NOT use doxycycline in pregnancy **TOTAL DURATION: 14 days**

Pelvic Inflammatory Disease[1,2]	First Line Choices	Alternatives where first line choices contraindicated (e.g. allergy), not tolerated or not effective
Post-operative pelvic infection (STI not suspected)	**Co-amoxiclav[7]** IV 1.2g every 8 hours DO NOT use in penicillin allergic patients **DURATION: 7 days**	**Cefuroxime*[7,8]** IV 1.5g every 8 hours **and Metronidazole** IV 500mg every 8 hours **and** Gentamicin[9] IV *CAUTION in penicillin allergic patients In case of penicillin anaphylaxis, please discuss with a consultant microbiologist**.** **DURATION: 7 days**
Notes 1. BASHH Guidelines 2. Causative organisms: Neisseria gonorrhoeae and Chlamydia trachomatis account for a quarter of UK cases. Gardnerella vaginalis, anaerobes (Prevotella, Atopobium and Leptotrichia) and other organisms commonly found in the vagina likely play a role. Mycoplasma genitalium has been associated with upper genital tract infection in women and is a very likely cause of PID. 3. Chelation interaction with bivalent ions reduces dose absorption, time doses accordingly. 4. Caution in patients with history of seizures, cardiac or musculoskeletal problems. Check drug-drug and drug-disease interactions first. 5. Quinolones should be avoided in patients who are at high risk of gonococcal PID because of increasing quinolone resistance in the UK. Quinolones are not licensed in under 18s 6. If unable to tolerate Doxycycline, use Clindamycin oral 450mg every 6 hours instead 7. Review at 72 hours is recommended to ensure clinical improvement, particularly if moderate or severe signs. Consider IV to oral switch if appropriate. 8. Oral switch option for this regime is Cefalexin 500mg every 8 hours, with Metronidazole 400mg every 8 hours. The additional gentamicin cover is not required on switching to oral treatment. 9. Gentamicin drug dosing and monitoring information in Section 3.4.3.2.		

4.7.2 PROM Pre-labour Rupture Of Membrane at term

PROM Pre-labour Rupture Of Membranes at term (<37 weeks)	First Line Choices	Alternatives where first line choices contraindicated (e.g. allergy), not tolerated or not effective
Consider evidence of infection; maternal pyrexia >37.8°C/tachycardia, foetal tachycardia, uterine tenderness, abnormal vaginal discharge.		
If infection is clinically suspected, commence intravenous antibiotics and perform a partial septic screen (FBC, CRP, Blood cultures, HVS, MSU).	**Cefuroxime*** IV 1.5g every 8 hours **and Metronidazole** IV 500mg every 8 hours *CAUTION in penicillin allergic patients IF patient critically unwell, add **Gentamicin[1]** IV STAT **DURATION[2,3]: 7 days**	**Clindamycin[4]** IV 900mg every 8 hours IF patient critically unwell, add **Gentamicin[1]** IV STAT **DURATION[2]: 7 days**
Notes 1. Gentamicin drug dosing and monitoring information in Section 3.4.3.2. 2. Review IV antibiotics after 48 hours with view to oral switch. 3. Oral switch to Cefalexin 500mg every 8 hours and Metronidazole 400mg every 8 hours 4. If the organism is not suspected to be Group B Streptococci, then discuss with Consultant Microbiologist as Clindamycin may not be appropriate.		

4.7.3 Puerperal Sepsis of pelvic origin

Puerperal Sepsis of pelvic origin	First Line Choices	Alternatives where first line choices contraindicated (e.g. allergy), not tolerated or not effective
Endometritis	**Co-amoxiclav** IV 1.2g every 8 hours DO NOT use in penicillin allergic patients **DURATION[1]: 7 days**	**Cefuroxime*** IV 1.5g every 8 hours **and Metronidazole** IV 500mg every 8 hours[2] *CAUTION in penicillin allergic patients **Clindamycin** IV 900mg every 8 hours **and Gentamicin[3]** IV **DURATION[1]: 7 days**
Endomyometritis	**Cefuroxime*** IV 1.5g every 8 hours **and Metronidazole** IV 500mg every 8 hours **and Gentamicin[3]** IV STAT *CAUTION in penicillin allergic patients **DURATION[1,4]: 7 days**	**Clindamycin** IV 900mg every 6 hours **and Gentamicin[3]** IV **DURATION[1,4]: 7 days**
Notes 1. Review IV antibiotics after 48 hours with view to oral switch. 2. Oral switch to Cefalexin 500mg every 8 hours and Metronidazole 400mg every 8 hours 3. Gentamicin drug dosing and monitoring information in Section 3.4.3.2. 4. Seek input from Microbiologist on call re oral switch.		

4.7.5 Maternal fever in labour (inc. Chorioamnionitis)

Maternal fever in labour (inc. Chorioamnionitis)	First Line Choices[2]	Alternatives where first line choices contraindicated (e.g. allergy), not tolerated or not effective
Known to Be Due to Group A or B streptococcus[1]	**Benzylpenicillin[3]** IV 1.2g every 4-6 hours DO NOT use in penicillin allergic patients **DURATION: 7 days**	**Clindamycin[3]** IV 900mg every 8 hours **DURATION: 7 days**
Unknown Organism: Without red flag sepsis / septic shock	**Co-amoxiclav*** IV 1.2g every 8 hours **and amoxicillin** IV 1g every 8 hours[4] *DO NOT use in penicillin allergic patients IF patient critically unwell, add **Gentamicin[5]** IV STAT **DURATION[6]: 7-10 days**	**Cefuroxime*** IV 1.5g every 8 hours **and metronidazole** IV 500mg every 8 hours *CAUTION in penicillin allergic patients IF patient critically unwell, add **Gentamicin[5]** IV STAT **DURATION[6]: 7-10 days**
Unknown organism: Severe sepsis (red flag or septic shock)	**Piperacillin/Tazobactam** IV 4.5g every 8 hours **and clindamycin** IV 600mg every 6 hours. DO NOT use in penicillin allergic patients **DURATION[7]: 7-10 days**	**Meropenem** IV 2g every 8 hours CAUTION in penicillin allergic patients IF SEVERE beta lactam allergy, discuss options with microbiologist on call **DURATION[7]: 7-10 days**
If (suspected of confirmed) MRSA infection	**Add** Vancomycin[8] IV (target blood level range 10-15mg/L)	

Notes
1. If either the mother or the baby is infected with Group A streptococcus (Streptococcus pyogenes) both should be treated with antibiotics.
2. If antibiotic sensitivities are available, please treat accordingly.
3. If patient does not show clinical improvement within 12 – 24 hours or deteriorates, switch to regimen for unknown organism.
4. Refer to section 3.2 on augmented dosing of Co-amoxiclav.
5. Gentamicin drug dosing and monitoring information in Section 3.4.3.2.
6. Review IV antibiotics after 48 hours, consider oral switch.
7. Seek microbiologist input with regard to oral stepdown options.
8. Vancomycin drug dosing and monitoring information in Section 3.4.2.1.

4.7.4 Epididymo-orchitis

Epididymo-orchitis[1,2]	First Line Choices	Alternatives where first line choices contraindicated (e.g. allergy), not tolerated or not effective
Epididymo-orchitis most probably due to any sexually transmitted pathogen[3]	**Ceftriaxone*** IM 1g single dose[4] **plus Doxycycline**[5] oral 100mg every 12 hours. *CAUTION in penicillin allergic patients DO NOT use doxycycline in pregnancy **DURATION: 10-14 days**	**Ofloxacin**[5,6] oral 200mg every 12 hours. If gonorrhoea likely **add azithromycin** oral 1g single dose **DURATION: 10-14 days**
If most probably due to chlamydia or other non-gonococcal organisms	**Doxycycline**[5] oral 100mg every 12 hours DO NOT use doxycycline in pregnancy **DURATION: 10-14 days**	**Levofloxacin**[5,6] oral 500mg every 24 hours **DURATION: 14 days**
Epididymo-orchitis most probably due to enteric pathogens	**Levofloxacin**[5,6] oral 500mg every 24 hours **DURATION: 10 days**	**Co-amoxiclav** oral 625mg every 8 hours DO NOT use in penicillin allergic patients **DURATION: 10 days**

Notes
1. BASHH guidelines. https://www.bashhguidelines.org/media/1242/eo-2019.pdf
2. Refer to GU for same/next day assessment
3. Quinolones treat *N. gonorrhoeae*, *C. trachomatis* and most uro-pathogens with good penetration into the prostate. However, they are not first line treatment for N. gonorrhoeae due to high levels of bacterial resistance to quinolones
4. Can give dose IV instead if preferred. Is a STAT dose only. Note: reconstitution instructions differ for IV and IM and are not interchangeable, as the IM administration involves use of lidocaine to reduce pain at injection site.
5. Chelation interaction with bivalent ions reduces dose absorption, time doses accordingly.
6. Caution in patients with history of seizures, cardiac or musculoskeletal problems. Check drug-drug and drug-disease interactions first.

4.7.6 Sexually-Transmitted Infections Suspected

Refrain from administering any form of antimicrobial therapy. Seek advice from Department of Genito-Urinary medicine.

4.8 Blood Stream Infections

- Infective Endocarditis
- Sepsis syndrome – Unknown Origin
- Neutropenic sepsis

4.8.1 Infective Endocarditis

Infective Endocarditis[1,2] – Initial Management (pending blood culture results)[3]	
Native Valve Indolent presentation[4]	**Amoxicillin** IV 2g every 4 hours DO NOT use in penicillin allergic patients
Native Valve Acute / Severe presentation[8]	**Vancomycin**[5] IV (target blood level range 15-20mg/L) **and** **Gentamicin**[6,7,8] IV 1mg/kg IBW[9] every 12 hours
Prosthetic Valve or Intracardiac Prosthesis	**Vancomycin**[5] IV (target blood level range 15-20mg/L) **and** **Gentamicin**[6,7] IV 1mg/kg IBW[9] every 12 hours **and** **Rifampicin**[10] IV or oral 600mg every 12 hours

Notes

1. Guidelines for the diagnosis and antibiotic treatment of endocarditis in adults: a report of the Working Party of the British Society for Antimicrobial Chemotherapy J Antimicrob Chemother 2012; 67: 269–289.
2. Ensure multiple blood cultures have been taken and contact Microbiology. Consider delaying antibiotic treatment until a microbiological diagnosis has been made if clinically safe to do so.
3. Therapy to be adjusted in accordance with national guidelines, once causative organism identified.
4. If patient allergic to penicillin, use Vancomycin and Gentamicin combination as per recommendations for Acute presentation
5. Vancomycin drug dosing and monitoring information in Section 3.4.2.1
6. Gentamicin drug dosing and monitoring information in Section 3.4.3.2. Dose will need to be adjusted according to renal function and serum levels.
7. If concerns about AKI / nephrotoxicity, use ciprofloxacin in place of gentamicin.
8. If risk factors for multi resistant Gram negatives, replace gentamicin with Meropenem 2g tds.
9. IBW – Ideal Body Weight – see tables in section 3.4.3.2.
10. Dose may have to be adjusted according to levels or hepatic/renal function. Seek pharmacy review for interactions with other medications that might need adjustment.

4.8.2 Sepsis syndrome – Unknown Origin

Sepsis syndrome - Unknown Origin[1]	**First Line Choices**[2,3]	**Second Line**[2,3] *Minor Penicillin rash*	**Third Line** *Severe Beta-lactam allergy*
It is essential to collect at least 1 set of blood cultures (preferably 2), before starting antibiotics[4]. **Duration:** Appropriate broad spectrum antimicrobials should be commenced within 1 hour of presentation. Review in 24-48 hours when origin of infection determined, and/or isolate and sensitivity known.			
AMBER Flag Sepsis syndrome Of Unknown Origin[1]	**Co-amoxiclav** IV 1.2g every 8 hours DO NOT use in penicillin allergic patients May add **Gentamicin** IV STAT[5]	**Cefuroxime*** IV 1.5g every 8 hours **and Metronidazole** IV 500mg every 8 hours *CAUTION in penicillin allergic patients May add **Gentamicin** IV STAT[5]	**Vancomycin**[3] IV **and Metronidazole** IV 500mg every 8 hours **and Ciprofloxacin**[6,7] PO 500mg every 12 hours
RED Flag Sepsis syndrome Of Unknown Origin[1]	**Piperacillin/Tazobactam** IV 4.5g every 8 hours DO NOT use in penicillin allergic patients	**Meropenem** IV 2g every 8 hours CAUTION in penicillin allergic patients	**Vancomycin**[3] IV **and Metronidazole** IV 500mg every 8 hours **and Ciprofloxacin**[7,8] IV 400mg every 12 hours
Septic Shock	A single, **FIRST dose of Meropenem** IV 2g should be given (as a stat dose only) **to initiate treatment in emergency** within 1 hour of recognising Septic Shock. ***Always check patient allergy status first*** Further treatment is based on Microbiologist advice and probable site of origin of the infection.		
Where IV access not possible[4]	**IF Amber Flag** Sepsis Syndrome **Ceftriaxone** 1g IM or intraosseous (IO) injection[9,10] CAUTION in penicillin allergic patients **IF Red Flag** Sepsis Syndrome or **Septic Shock** **Ceftriaxone** 2g IM or intraosseous (IO) injection[9,10] CAUTION in penicillin allergic patients . DO NOT use if beta lactam allergy.		
Neutropenic Sepsis	**See Separate table**		
Where In-dwelling Intravascular Cannulae	1st line – remove/change line if practicable 2nd line – consider line lock as per **Annex 4** (Infections Associated with In-dwelling Intravascular Cannulae)		
Where suspecting fungal infection[11]	**See Annex 5** for sepsis syndrome associated with Invasive Candidiasis in non-neutropenic patients		

Notes

1. Review in 24-48 hours when origin of infection determined or isolate and sensitivity known. Where origin of infection or suspected source is known at first presentation, refer to relevant section of the Antimicrobial Guidelines and commence with those recommendations from the outset. Common sources of infection are also covered on the Blue Man poster (Management of Infections in Adult Patients – Short guide to First-Line Antimicrobial Recommendations).
2. If MRSA suspected, add Vancomycin IV.
3. Vancomycin drug dosing and monitoring information in Section 3.4.2.1.
4. If no IV access, take blood cultures as soon as possible after IV access gained.
5. Gentamicin drug dosing and monitoring information in Section 3.4.3. Dose will need to be adjusted according to renal function and serum levels.
6. Chelation interaction with bivalent ions reduces dose absorption, time doses accordingly.
7. Caution in patients with history of seizures, cardiac or musculoskeletal problems. Check drug-drug and drug-disease interactions first
8. Quinolones have very good oral bioavailability, so switch as soon as oral absorption of medication is felt to be reliable.

9. Ceftriaxone via IM route - should be injected well within the bulk of a relatively large muscle. No more than 1g injected at one site, so need 2 sites if prescribed 2g. Solvent used for IM injection is lidocaine, so the resulting solution should never be administered intravenously. Refer to product information for more detail on reconstitution and administration.
10. Intraosseous (IO) route is unlicenced for Ceftriaxone. Recommendation based in experience in other acute NHS Trusts. Manufacturers advise IM administration, when IV route is not possible. However, clinical risk/benefit assessment to include level or likelihood of compromised blood perfusion to limbs as good perfusion is essential to systemic absorption and effectiveness.
11. Invasive Candidiasis is the most common invasive fungal infection in non-neutropenic patients. If cases with concerns around other yeasts or fungi, please discuss with on call microbiologist.

4.8.3 Neutropenic Sepsis

Neutropenic Sepsis[1]	First Line Choices[2,3]	Second Line[2,3] *Minor Penicillin rash*	Third Line *Beta-lactam allergy*
It is essential to collect at least 1 set of blood cultures (preferably 2), before starting antibiotics. Duration: Appropriate broad spectrum antimicrobials should be commenced within 1 hour of presentation. Review in 24-48 hours when origin of infection determined, and/or isolate and sensitivity known.			
Neutropenic Sepsis[1]	**Gentamicin[4]** IV STAT (or regular[5,6]) **and Piperacillin/Tazobactam** IV 4.5g every 6 hours DO NOT use in penicillin allergic patients **DURATION[7]:** Review in 48 hours	**Meropenem**[6] IV 1g every 8 hours CAUTION in penicillin allergic patients May add **Gentamicin[5,6]** IV **DURATION[7]:** Review in 48 hours	**Gentamicin[5] IV stat and Ciprofloxacin[9,10]** IV 400mg every 8 hours **and Vancomycin[3]** IV **and Metronidazole** IV 500mg every 8 hours **DURATION[7]:** Review in 48 hours

Notes

1. Refer to local policy for management of adult patients with Neutropenic sepsis. Where suspecting fungal infection, please refer to local Trust guidelines on management of Invasive Fungal Infections in Neutropenia / immunosuppressed patients.
2. If MRSA suspected, add Vancomycin IV.
3. Vancomycin drug dosing and monitoring information in Section 3.4.2.1.
4. Piperacillin/Tazobactam alone may be unreliable in up to 12% of infections due to the prevailing sensitivity patterns of local Gram-negative rods.
5. Gentamicin drug dosing and monitoring information in Section 3.4.3.2. Dose will need to be adjusted according to renal function and serum levels.
6. Decision to continue gentamicin to be based on clinical response.
7. Review in 24-48 hours when origin of infection determined or isolate and sensitivity known. Where origin of infection or suspected source is known at first presentation, refer to relevant section of the Antimicrobial Guidelines and commence with those recommendations from the outset. Common sources of infection are also covered on the Blue Man poster (Management of Infections in Adult Patients – Short guide to First-Line Antimicrobial Recommendations).
8. Increase dose to 2g every 8 hours in severe neutropenic sepsis.
9. Quinolones have very good oral bioavailability. Switch to 750mg every 12 hours, as soon as oral absorption of medication is felt to be reliable. Chelation interaction with bivalent ions reduces dose absorption, time doses accordingly.
10. Caution in patients with history of seizures, cardiac or musculoskeletal problems. Check drug-drug and drug-disease interactions first.

4.9 Ophthalmic Infections

4.9.1 Conjunctivitis

Conjunctivitis[1,2,3]	First Line Choices	Alternatives where first line choices contraindicated (e.g. allergy), not tolerated or not effective
Do not use steroid-containing eye medications. If no response after 3 days treatment, seek advice from Ophthalmologists.		
Conjunctivitis in persons who DO NOT wear contact lenses	**Chloramphenicol 0.5% eye drops**[4,5] Instil 1 drop every 2 hours for 2 days, then one drop four times daily **for 5 days**[7] **Chloramphenicol 1% eye ointment**[4,5]**:** Apply four times daily for 2 days, then twice daily **for 5 days**[7]	**Fusidic acid 1% gel/ eye drops**[6]**:** Apply one drop twice daily **for 7 days**
Conjunctivitis in persons who wear contact lenses Advise to stop contact lens use immediately until complete resolution.	**Ofloxacin 0.3% eye drops** 1 drop every 2 hours for first 2 days, then reduce to every 6 hours. **DURATION: Until 48 hours after clinical resolution- up to 7 days**[8]**.**	**Note**[9]**:** Gentamicin, Ciprofloxacin, Levofloxacin, moxifloxacin and Polymyxin B are all effective for infections caused by *Pseudomonas aeruginosa* (common cause of infection in contact lens wearers).
Chlamydia conjunctivitis Must liaise with genitourinary clinic, to exclude other STDs and advise on treatment of patient and partner(s).	**Azithromycin 1.5% eye drops.** 1 drop every 12 hours for **3 days AND** **Azithromycin** oral 1g **STAT** (prescribed by GU team)	**Ofloxacin 0.3% eye drops** 1 drop every 2 hours for first 2 days, then reduce to every 6 hours. Total **7 days** **AND Doxycycline**[10] oral 100mg every 12 hours (prescribed by GU team). Total **for 7 days** DO NOT use doxycycline in pregnancy

Notes

1. NICE Clinical knowledge summary: Conjunctivitis – infective. April 2018 https://cks.nice.org.uk/conjunctivitis-infective
2. UKHSA/NICE: Managing common infections: guidance for primary care. February 2019 https://www.gov.uk/government/publications/managing-common-infections-guidance-for-primary-care
3. BMJ Best Practice: Acute Conjunctivitis. August 2021. https://bestpractice.bmj.com/topics/en-gb/68/treatment-algorithm#patientGroup-0-2
4. Do not prescribe topical chloramphenicol to people who are pregnant or breastfeeding, hypersensitivity to the active substance or to any of the excipients, had myelosuppresssion during previous exposure to chloramphenicol, have personal or family history of blood dyscrasias including aplastic anaemia.
5. Any systemic absorption of chloramphenicol will be very small and hence not considered a risk. This can be further reduced by only using one drop, rather than flooding with several, and also by holding the tear duct down for at least a minute to minimise naso-lacrimal drainage. Alternatively, use eye ointment as there is less opportunity for nasal drainage. https://bnf.nice.org.uk/treatment-summary/eye.html

6. Has less gram negative activity than Chloramphenicol, hence not first line.
7. Topical chloramphenicol should not be used on a prolonged basis.
8. If looking to go beyond 7 days, must have Ophthalmologist approval.
9. Pseudomonas cover strongly recommended as commonly implicated in these infections. Various options listed in case of supply issues or shortages.
10. Chelation interaction with bivalent ions will reduce absorption of dose, time doses accordingly.

4.9.2 Facial Cellulitis and Erysipelas

Facial Cellulitis and Erysipelas[1]	First Line Choices	Alternatives where first line choices contraindicated (e.g. allergy), not tolerated or not effective[2]
Refer to skin and soft tissue infections table for cellulitis near eyes and nose (see table). If looking at orbital or periorbital cellulitis, refer to appropriate section (see orbital and periorbital tables).		
Notes 1. NICE Guideline NG141: Cellulitis and erysipelas: antimicrobial prescribing September 2019. https://www.nice.org.uk/guidance/ng141		

4.9.3 Orbital Cellulitis (post-septal cellulitis)

Orbital Cellulitis (post-septal cellulitis)[1,2]	First Line Choice	Alternatives where first line choice contraindicated (e.g. allergy), not tolerated or not effective
Requires urgent ophthalmology and ENT specialist review[3], and urgent imaging. If intracranial extension suspected, initiate meningitis treatment and contact microbiologist on call for urgent advice.	**Co-amoxiclav** IV 2g every 8 hours DO NOT use in penicillin allergic patients May add **Metronidazole[4] IV** **DURATION[5]: 7-10 days.**	**Cefuroxime*** IV 750mg every 8 hours **and Metronidazole** IV 500mg every 8 hours *CAUTION in penicillin allergic patients **Levofloxacin**[6,7] IV 500mg every 12 hours **and Metronidazole** IV 500mg every 8 hours **DURATION[5]: 7-10 days.**
If high risk MRSA	**Vancomycin[8] IV** (target level 15-20mg/L)	**Teicoplanin[9] IV**
Notes 1. BMJ Best Practice: Pero-orbital and orbital cellulitis. March 2018. Last updated October 2020 https://bestpractice.bmj.com/topics/en-gb/734 2. ENT UK - Orbital Cellulitis Management Guideline for Adults and Paeds 2017. Date not specified therefore potentially superseded. https://www.entuk.org/sites/default/files/files/ENT%20UK%20Revised%20Orbital%20Cellulitis%20Flow%20Chart%202017.pdf 3. Orbital cellulitis is an infection of the orbital soft tissues, usually due to underlying bacterial sinusitis. 4. Consider adding Metronidazole if possibility of intracranial involvement or if orbital cellulitis is associated with chronic sinusitis or an odontogenic source. 5. Please seek advice from Consultant Microbiologist, for duration and IV to oral switch options. If bone involvement, may need up to 6 weeks. 6. Caution in patients with history of seizures, cardiac or musculoskeletal problems. Check drug-drug and drug-disease interactions first 7. Quinolones have very good oral bioavailability, so switch as soon as oral absorption of medication is felt to be reliable. Chelation interaction with bivalent ions reduces dose absorption, time oral doses accordingly. 8. Vancomycin drug dosing and monitoring information in Section 3.4.2.1. 9. Teicoplanin drug dosing and monitoring information in Section 3.4.2.2.		

4.9.4 Peri-orbital Cellulitis (pre-septal cellulitis)

Peri-orbital Cellulitis (pre-septal cellulitis)[1]	First Line Choice	Alternatives where first line choice contraindicated (e.g. allergy), not tolerated or not effective
Periorbital cellulitis is an infection of eyelid tissues superficial to the orbital septum, usually due to superficial tissue injury.	**Co-amoxiclav** IV 1.2g every 8 hours[2] DO NOT use in penicillin allergic patients **DURATION[3]: 7-10 days**	**Cefuroxime*** IV 750mg every 8 hours **and Metronidazole** IV 500mg every 8 hours *CAUTION in penicillin allergic patients **DURATION[3]: 7-10 days**
Adults with less severe peri-orbital cellulitis who are stable may receive oral antibiotics as outpatients with daily follow-up.	**Co-amoxiclav** 625mg oral 8 hourly DO NOT use in penicillin allergic patients **DURATION: 7-10 days**	**Clindamycin** oral 450mg every 6 hours and discuss management plan with microbiologist on-call **DURATION: 7-10 days**
If high risk MRSA[3]	**Vancomycin[4] IV** (target level 15-20mg/L)	**Teicoplanin[5] IV**

Notes
1. BMJ Best Practice: Pero-orbital and orbital cellulitis. March 2018 https://bestpractice.bmj.com/topics/en-gb/734
2. If severe infection, consider adding in Clindamycin as a second agent, and contact Consultant Microbiologist on-call.
3. Please seek advice from Consultant Microbiologist, for duration and IV to oral switch options.
4. Vancomycin drug dosing and monitoring information in Section 3.4.2.1.
5. Teicoplanin drug dosing and monitoring information in Section 3.4.2.2.

4.9.5 Endophthalmitis

Endophthalmitis[1]	First Line Choice	Alternatives where first line choice contraindicated (e.g. allergy), not tolerated or not effective
Endophthalmitis is a medical emergency and requires urgent referral to an Ophthalmology specialist.	The following antibiotics are available for intravitreal injection[2,3]. 1. **Amikacin** 0.4mg in 0.1ml 2. **Amphotericin** 5micrograms in 0.1ml 3. **Ceftazidime** 2mg in 0.1ml 4. **Vancomycin** 1mg in 0.1ml 5. **Vancomycin** 2mg in 0.1 ml 6. **Voriconazole** 50micrograms in 0.1ml	

Notes
1. Refer to local Trust guidelines.
2. For information on supply of these drugs for intravitreal injection, please refer to Annex 2
3. Oral antibiotics may also be prescribed according to preference of consultant ophthalmologist.

4.9.6 Keratitis

Keratitis[1,2,3]	First Line Choice[2]	Alternatives where first line choice contraindicated (e.g. allergy), not tolerated or not effective
Commonly related to contact lens[2,3] use. Always serious and sight threatening. Seek urgent ophthalmology input before commencing treatment		
Corneal Ulcers[3,4]	**Levofloxacin** 0.5% eye drops[5]. If severe, or Gram positive cocci implicated, or complication of a hypopyon, **Cefuroxime** preservative-free eye drops, may be added to the treatment regimen.	
Acanthamoebic Keratitis	**Polyhexanide** 0.02% eye drops OR **Chlorhexidine** 0.02% eye drops are used[6,7]. These agents are not commercially available products and need to be specially compounded. Treatment duration as per ophthalmologist advice	
Fungal Keratitis[8]	**Amphotericin** B 0.15% eye drops[9]	

Notes

1. BMJ Best Practice: Keratitis. October 2021 https://bestpractice.bmj.com/topics/en-gb/561
2. If on two types of eye drop per hour, prescribe one “on the hour” and one “on the half hour”. Patients with severe ulcers, significant loss of vision, hypopyon, or those needing treatment through the night should be admitted. However, overnight drops are not to be given for more than 2 consecutive nights, even if there is an inadequate response
3. For contact lens related keratitis and ulcers, ensure Pseudomonas cover, as usually implicated.
4. Levofloxacin has good activity against Pseudomonal eye infections.
5. Usual dose for quinolone eye drops in this indication - 1 drop into affected eye(s) every 1-6 hours until clinical and symptomatic improvement (usually 4-10 days), then taper slowly.
6. Usual dose for Acanthamoebic Keratitis - 1 drop into affected eye(s) every 30 minutes to 2 hours until clinical and symptomatic improvement (usually 2-3 weeks), then taper dose slowly.
7. Polyhexanide - also known as Polyhexamethylene biguanide (PHMB) eye drops.
8. Topical or oral antifungal therapy is recommended. A Cochrane review has found no evidence that any particular antifungal, or combination of antifungals, is more effective in the management of fungal keratitis.
9. Usual dose for fungal keratitis treatment - 1 drop into the affected eye(s) every 1-2 hours until clinical and symptomatic improvement (usually 1-3 weeks), then taper dose slowly.

4.10 Bone and Joint Infections

This is covered under surgical.
The most common infecting organisms are (in decreasing order of frequency): *Staphylococcus aureus*, other Gram positive cocci, Gram negative bacilli and anaerobes. If the causative organism(s) is (are) identified, therapy may be modified after discussion with a Microbiologist. Consider the possibility of tuberculosis and request mycobacterial culture if appropriate.

4.10.1 Osteomyelitis (Acute)

Osteomyelitis (Acute)[1,2,3,4,5,6]	First Line Choice[7]	Alternatives where first line choice contraindicated (e.g. allergy), not tolerated or not effective
Bone or tissue biopsies should be taken whenever feasible prior to commencing antimicrobial therapy. This will allow appropriate, targeted antibiotics to be used. However, treatment should not be delayed if severe cellulitis or systemic infection is present, or if neurological compromise is suspected in the case of spinal infection. Referral to Orthopaedics is recommended in all cases		
If chronic Osteomyelitis, discuss with Microbiologist[8]	LOW risk of MRSA **Flucloxacillin** IV 2g every 6 hours DO NOT use in penicillin allergic patients **DURATION**[9]: Usually 4-6 weeks. Oral treatment to commence after a minimum of 2 weeks IV and after discussion with microbiologist	HIGH risk of MRSA **Teicoplanin**[10] IV (target blood level range 20-40mg/L) **Vancomycin**[10] IV (target blood level range 15-20mg/L) **DURATION**[9]: Usually 4-6 weeks. Oral treatment to commence after a minimum of 2 weeks IV and after discussion with microbiologist
For OM related to diabetic foot – see skin and soft tissue section of the guidelines		

Notes:

1. BNF: Musculoskeletal system infections, antibacterial therapy https://bnf.nice.org.uk/treatment-summary/musculoskeletal-system-infections-antibacterial-therapy.html
2. BSR & BHPR, BOA, RCGP and BSAC Guidelines for management of the hot swollen joint in adults https://academic.oup.com/rheumatology/article/45/8/1039/1784962
3. Spellberg B, Lipsky B.A. Systemic Antibiotic Therapy for Chronic Osteomyelitis in Adults. Clinical Infectious Diseases 2012; 54(3):393-407.
4. Mruk AlisonL et al. Antimicrobial Options in the Treatment of Adult Staphylococcal Bone and Joint Infections in an Era of Drug Shortages. Pharmacology Update 2012; 35(5):401-407.
5. Lew P Daniel, Waldvogel Francis A. Osteomyelitis. Lancet 2004; 364:369-79.
6. Burke A. Cunha. Osteomyelitis in Elderly Patients. Clinical Infectious Diseases 2002; 35:287-93.
7. These regimens are empiric whilst awaiting results of cultures and other relevant investigations.
8. Surgical intervention is the mainstay of treatment. To aid diagnosis, ensure bone biopsies or deep tissue specimens collected. Discuss with microbiologist prior to commencing treatment. Tailor antibiotic choice according to culture and sensitivity results and patient response. Long duration of therapy (usually minimum of 12 weeks) required.
9. Minimum 2 weeks IV therapy as it is difficult to achieve adequate concentrations of some antibiotics (e.g. flucloxacillin) in bone/spine. May need prolonged IV antibiotic therapy. Seek Microbiology input for individual assessment if culture results negative or antibiotic sensitivities outside of the above recommendations, and before changing to oral continuation therapy.
10. Vancomycin and Teicoplanin drug dosing and monitoring information in Section 3.4.2. If AKI use Teicoplanin rather than vancomycin.

4.10.2 Septic Arthritis

Septic Arthritis[1,2,3]	First Line Choice[4]	Alternatives where first line choice contraindicated (e.g. allergy), not tolerated or not effective
Aspirates should be taken whenever feasible prior to commencing antimicrobial therapy. This will allow appropriate, targeted antibiotics to be used. However, treatment should not be delayed if severe cellulitis or systemic infection is present, or if neurological compromise is suspected in the case of spinal infection. Referral to Orthopaedics is recommended in all cases.		
Native[4] NO prosthesis / metalwork NOTE: If Prosthetic joint, duration of treatment may be longer[6]	LOW risk of MRSA: **Flucloxacillin** IV 2g every 6 hours DO NOT use in penicillin allergic patients **DURATION**[6]: Usually 2 weeks. Discuss with Consultant Microbiologist if longer duration of antibiotics required	HIGH risk of MRSA: **Teicoplanin**[5] IV (target blood level range 20-40mg/L) **Vancomycin**[5] IV (target blood level range 15-20mg/L) **DURATION**[6]: Usually 2 weeks. Discuss with Consultant Microbiologist if longer duration of antibiotics required
Notes: 1. BNF: Musculoskeletal system infections, antibacterial therapy https://bnf.nice.org.uk/treatment-summary/musculoskeletal-system-infections-antibacterial-therapy.html 2. BSR & BHPR, BOA, RCGP and BSAC Guidelines for management of the hot swollen joint in adults 3. IDSA PJI guidelines 2012 and SMI-investigation-of-orthopaedic-implant-associated-infections https://academic.oup.com/rheumatology/article/45/8/1039/1784962 4. These regimens are empiric whilst awaiting results of cultures and other relevant investigations. Stepdown should be based on culture results. If cultures negative and prolonged therapy indicated, please discuss with duty Microbiologist for stepdown options. 5. Vancomycin and Teicoplanin drug dosing and monitoring information in Section 3.4.2. If AKI use Teicoplanin rather than vancomycin. 6. Prosthetic joint infections sometimes behave in a different manner to native joint septic arthritis. Operative cultures are used to definitively diagnose prosthetic joint infection and ideally in the non-acute septic patient the patient should not receive antimicrobials at least 2 weeks prior to surgery. Also see section Prosthetic Joint infection requiring revision. 7. Prolonged IV antibiotic therapy (up to 6 weeks) may be needed. Early IV/oral switch therapy is NOT always appropriate as it is difficult to achieve adequate concentrations of some antibiotics (e.g. flucloxacillin) in bone/spine. Seek Microbiology advice before changing to oral continuation therapy. Please ensure the full course length is prescribed once the diagnosis has been confirmed.		

4.10.3 Prosthetic Joint Infection requiring revision

Prosthetic Joint infection requiring revision	First Line Choice	Alternatives where first line choice contraindicated (e.g. allergy), not tolerated or not effective
Antibiotics should be administered as soon as possible after tissue samples taken from the joint (during the surgical procedure[1]) Also see prophylaxis section	**Teicoplanin**[2] IV (target blood level range 20-40mg/L) **OR** **Vancomycin**[2] IV (target blood level range 15-20mg/L) **DURATION:** Review antibiotic choice and duration once microbiology results are available.	
Notes: 1. This is therefore an exception to the usual recommendation of antimicrobial prophylaxis being administered one hour before incision, and full therapeutic doses are advised rather than prophylactic ones. 2. Vancomycin and Teicoplanin drug dosing and monitoring information in Section 3.4.2. If AKI use Teicoplanin rather than vancomycin.		

4.10.4 Vertebral Osteomyelitis/ discitis/ epidural abscess

Vertebral Osteomyelitis/ discitis/ epidural abscess [1,2,3]	First Line Choice[4]	Alternatives where first line choice contraindicated (e.g. allergy), not tolerated or not effective[4]
Bone or tissue biopsies should still be taken 'whenever feasible' prior to commencing antimicrobial therapy. This will allow appropriate, targeted antibiotics to be used. However, treatment should not be delayed if severe cellulitis or systemic infection is present, or if neurological compromise is suspected in the case of spinal infection.		
Initial Treatment[5]	**Flucloxacillin** IV 2g every 6 hours DO NOT use in penicillin allergic patients If Gram negative cover required use **Ceftriaxone**[6] IV 2g every 24 hours. CAUTION in penicillin allergic patients If MRSA suspected[7]: **Teicoplanin**[8] IV (target blood level range 20-40mg/L) **OR** **Vancomycin**[8] IV (target blood level range 15-20mg/L) **DURATION**[9,10]: Usually 6-8 weeks, once agreed on choice of agent following discussion with microbiologist	

Notes:

1. BNF: Musculoskeletal system infections, antibacterial therapy https://bnf.nice.org.uk/treatment-summary/musculoskeletal-system-infections-antibacterial-therapy.html
2. Management of adult spontaneous spondylodiscitis and its rising incidence https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5126242/
3. Spondylodiscitis: Update on diagnosis and management - *Gouliouris T, A. S.* (2010) https://academic.oup.com/jac/article/65/suppl_3/iii11/923760
4. It is difficult to achieve adequate concentrations of some antibiotics in bone/spine. Please check intention of route if any alternative agent is advised by microbiology.
5. May be complicated by epidural abscess, para-vertebral or iliopsoas abscess. If so, discuss with Microbiology consultant.
6. For example, in patients with recurrent UTI, or recent abdominal surgery.
7. These choices will NOT cover Gram negative organisms. Please seek input from Microbiologist for options.
8. Vancomycin and Teicoplanin drug dosing and monitoring information in Section 3.4.2. If AKI use Teicoplanin rather than vancomycin.
9. Discuss with consultant Microbiologist if longer duration of antibiotics required.
10. Please ensure the full course length is prescribed once the diagnosis confirmed.

4.10.5 Treatment of Septic Bursitis

Treatment of Septic Bursitis	First Line Choice[1]	Alternatives where first line choice contraindicated (e.g. allergy), not tolerated or not effective
Initial antibiotic selection is guided by knowledge of common pathogens. In 80% of cases this is Staphylococcus aureus or other Gram-positive organisms. Aspirate bursal fluid using an aseptic technique. Rationalisation of therapy should be conducted if cultures and sensitivities indicate an atypical pathogen.		
LOW risk of MRSA:	**Flucloxacillin** IV 2g IV every 6 hours [1,2] DO NOT use in penicillin allergic patients **DURATION:** 14 days	**Clindamycin** IV 600mg every 6 hours [1,2] **DURATION:** 14 days

Treatment of Septic Bursitis	First Line Choice[1]	Alternatives where first line choice contraindicated (e.g. allergy), not tolerated or not effective
If penicillin allergy or HIGH risk of MRSA:	**Teicoplanin**[3] IV (target blood level range 20-40mg/L) **Vancomycin**[3] IV (target blood level range 15-20mg/L) **DURATION:** 14 days	Discuss with Microbiologist
Notes: 1. BNF: Musculoskeletal system infections, antibacterial therapy https://bnf.nice.org.uk/treatment-summary/musculoskeletal-system-infections-antibacterial-therapy.html 2. NICE Clinical knowledge summary: Olecranon bursitis January 2021 https://cks.nice.org.uk/topics/olecranon-bursitis/management/management/ 3. Vancomycin and Teicoplanin drug dosing and monitoring information in Section 3.4.2. If AKI use Teicoplanin rather than vancomycin.		

4.10.6 Open-compound fractures

Open compound fractures	First Line Choice[1]	Alternatives where first line choice contraindicated (e.g. allergy), not tolerated or not effective
Administer antibiotics as soon as possible after the injury, and certainly within three hours.		
Also see surgical prophylaxis section.	**Co-amoxiclav** IV 1.2g loading then repeat dose every 8 hours DO NOT use in penicillin allergic patients	**Cefuroxime*** IV 1.5g every 8 hours **and Metronidazole** IV 500mg every 8 hours *CAUTION in penicillin allergic patients
High risk of MRSA	**Add Teicoplanin**[2] IV (target blood level range 20-40mg/L) OR **Add Vancomycin**[2] IV (target blood level range 15-20mg/L)	
DURATION:	The antibiotics should be given until first debridement (excision) and further continued until soft tissue closure or for a maximum of 72 hours, whichever is sooner. If infection suspected contact Microbiology for further advice.	
Notes: 1. British Association of Plastic, Reconstructive and Aesthetic Surgeons. Standards for the Management of Open Fractures of the Lower Limb. 2009 https://www.bapras.org.uk/docs/default-source/commissioning-and-policy/standards-for-lower-limb.pdf?sfvrsn=0 2. Vancomycin and Teicoplanin drug dosing and monitoring information in Section 3.4.2. If AKI use Teicoplanin rather than vancomycin.		

5 Prophylaxis

5.1 Benefits and risks of pre-operative antibiotic prophylaxis

The final decision regarding the benefits and risks of pre-operative antibiotic prophylaxis for an individual patient will depend on:

- The patient's risk of SSI
- The potential severity of the consequences of SSI
- The effectiveness of prophylaxis in that operation
- The consequences of prophylaxis for that patient (for example, increased risk of *Clostridium difficile* colitis).

Risks of prophylaxis

One of the aims of rationalising surgical antibiotic prophylaxis is to reduce the use of antibiotics thus minimising the potential consequences both for individual patients and in terms of antimicrobial stewardship.

The duration of prophylactic antibiotic therapy should be single dose except in special circumstances (for example prolonged surgery, major blood loss).

For patients undergoing higher risk procedures and who are suspected to have colonisation by multi-resistant organisms, for example MRSA or ESBL or CPE producing Enterobacteriaceae, preoperative care should include:

- Screening for relevant organisms
- Changing the antibiotic of choice for prophylaxis

If in doubt, contact the Duty Microbiologist for advice.

5.2 Medical Prophylaxis

All recommendations are for single doses unless specified otherwise.

5.2.1 Splenectomy Patients

See Annex 1.

5.2.2 Endocarditis Prophylaxis

In keeping with current NICE recommendations (Prophylaxis against infective endocarditis, NICE Clinical guideline 64, March 2008), **routine antibiotic prophylaxis against infective endocarditis is NO LONGER ADVISED.**

Ref: https://www.nice.org.uk/guidance/cg64#

Cardiac Conditions associated with a High Risk of Endocarditis

Prosthetic cardiac valves including bio prosthetic and homograft valves.
Previous bacterial endocarditis.
Complex cyanotic heart disease (e.g. single ventricle states, transposition of the great arteries, Tetralogy of Fallot).
Surgically constructed systemic pulmonary shunts or conduits.
Acquired valvular heart disease with stenosis or regurgitation
Hypertrophic cardiomyopathy

For patients with high risk cardiac conditions (see box above), who are undergoing a gastrointestinal or genitourinary procedure **where there is a known infection**, use the following prophylactic regimen RATHER than that listed in section 5.3. If the infecting organism is known, the prophylaxis should be targeted appropriately instead.

Antibiotics For Patients Not Allergic To Penicillin	Antibiotics For Patients Allergic To Penicillin
Amoxicillin A single IV dose of 1g (children <5 years of age: 250mg; ≥5 <10 years of age: 500mg) given just before the procedure or at induction of anaesthesia DO NOT use in penicillin allergic patients **and** **Gentamicin** 1.5mg/kg IV (max.160mg) (**and add Metronidazole** if it is normally part of the routine prophylaxis for the procedure being undertaken)	**Teicoplanin** A single dose of 200mg – 800mg IV (see surgical prophylaxis table in section 3.4.2.2) (children: < 14 years 6mg/kg) given just before the procedure or at induction of anaesthesia **and** **Gentamicin** 1.5mg/kg IV (max. 160mg) (**and add Metronidazole** if it is normally part of the routine prophylaxis for the procedure being undertaken)

NB: AVOID Cephalosporins as they are ineffective against enterococci.

If in doubt, contact the Consultant Microbiologist.

5.2.3 Prophylaxis of Meningitis

Prophylaxis of contacts of infections of public health importance, for example meningococcal meningitis and invasive Group A streptococcal disease is the remit of the Consultant in Health Protection based within Public Health England. UKHSA will advise as to who requires prophylaxis and the appropriate agent(s) to use.

5.3 Surgical Prophylaxis

When surgical prophylaxis is prescribed, an explicit entry about this clinical indication must be documented in the notes and prescribed as “surgical prophylaxis” on the ‘once only’ section of the prescription chart.

Unless otherwise specified in these guidelines, prophylaxis for surgical procedures should be a single dose administered pre-operatively on induction of anaesthesia or at most within 60 minutes **prior to the first incision.**

Unless otherwise specified in these guidelines, prophylaxis should not continue beyond 24 hours post operation.

Antimicrobials continuing beyond 24 hours post operation are **no longer prophylaxis** and should be considered as **treatment** for early or established infection.

- The recommended antibiotic doses are intended for adult patients with normal renal and liver function.
- Further doses in addition to those listed are at the discretion of the Consultant.
- If the operation lasts more than 4 hours or the patient has greater than 1500 ml blood loss, an additional intra-operative dose may need to be given.

5.3.1 Head & Neck Surgery

- ***Head & Neck Surgery (Clean, Benign)***

  Antibiotic prophylaxis is not usually recommended.

  Contact duty Microbiologist if advice is needed.

- ***Head & Neck Surgery (Contaminated/Clean-contaminated)***

First Line:	**Co-amoxiclav** IV 1.2g DO NOT use in penicillin allergic patients
Second Line (Minor penicillin rash):	**Cefuroxime*** IV 1.5g **and Metronidazole** IV 500mg *CAUTION in penicillin allergic patients
Third Line (Severe beta-lactam allergy):	**Teicoplanin** IV 200 - 800mg (see section 3.4.2.2) **and Gentamicin** IV 160mg **and Metronidazole** IV 500mg

- ***Head & Neck Surgery (Clean, Malignant, Neck Dissection)***

  Antibiotic prophylaxis should be considered.

First Line:	**Co-amoxiclav** IV 1.2g DO NOT use in penicillin allergic patients
Second Line (Minor penicillin rash):	**Cefuroxime*** IV 1.5g **and Metronidazole** IV 500mg *CAUTION in penicillin allergic patients
Third Line (Severe beta-lactam allergy):	**Teicoplanin** IV 200 - 800mg (see section 3.4.2.2) **and Gentamicin** IV 160mg **and Metronidazole** IV 500mg

5.3.2 Maxillo Facial Surgery/ENT

Also see section 5.2.2 for prophylaxis against endocarditis in high risk patients.

- ***Dentoalveolar Surgery – Simple Extraction***

  Antibiotic prophylaxis not recommended.

- ***Dentoalveolar Surgery –Surgical Removal of Teeth***

  Antibiotic prophylaxis not recommended.

- ***Dentoalveolar Surgery – Wisdom Teeth Removal with Extensive Bone Removal***

First Line:	**Co-amoxiclav** IV 1.2g DO NOT use in penicillin allergic patients
Second Line (Minor penicillin rash):	**Cefuroxime*** IV 1.5g **and Metronidazole** IV 500mg *CAUTION in penicillin allergic patients
Third Line (Severe beta-lactam allergy):	**Metronidazole** IV 500mg

- ***Dentoalveolar Surgery - Apical Surgery***

  Antibiotic prophylaxis not recommended.

- ***Dentoalveolar Surgery – Intra-oral Bone Grafting***

First Line:	**Co-amoxiclav** IV 1.2g DO NOT use in penicillin allergic patients
Second Line (Minor penicillin rash):	**Cefuroxime*** IV 1.5g **and Metronidazole** IV 500mg *CAUTION in penicillin allergic patients
Third Line (Severe beta-lactam allergy):	**Clindamycin** IV 600mg

- ***Dentoalveolar Surgery – Osseointegrated Implants***

First Line:	**Co-amoxiclav** IV 1.2g DO NOT use in penicillin allergic patients
Second Line (Minor penicillin rash):	**Cefuroxime*** 1.5g IV **and Metronidazole** 500mg IV *CAUTION in penicillin allergic patients
Third Line (Severe beta-lactam allergy):	**Clindamycin** IV 600mg

- ***Facial Surgery – Open Reduction & Internal Fixation Of Compound Mandibular Fractures***

First Line:	**Co-amoxiclav** IV 1.2g DO NOT use in penicillin allergic patients
Second Line (Minor penicillin rash):	**Cefuroxime*** IV 1.5g **and Metronidazole** IV 500mg *CAUTION in penicillin allergic patients
Third Line (Severe beta-lactam allergy):	**Clindamycin** IV 600mg

- ***Facial Surgery – Intraoral Bone Grafting Procedures***

First Line:	**Co-amoxiclav** IV 1.2g DO NOT use in penicillin allergic patients
Second Line (Minor penicillin rash):	**Cefuroxime*** IV 1.5g **and Metronidazole** IV 500mg *CAUTION in penicillin allergic patients
Third Line (Severe beta-lactam allergy):	**Clindamycin** IV 600mg

- ***Routine Nose, Sinus & Endoscopic Sinus Surgery***

  Antibiotic prophylaxis not recommended.

- ***Complex Septorhinoplasty Including Grafts***

First Line:	**Co-amoxiclav** IV 1.2g DO NOT use in penicillin allergic patients
Second Line (Minor penicillin rash):	**Cefuroxime*** IV 1.5g **and Metronidazole** IV 500mg *CAUTION in penicillin allergic patients
Third Line (Severe beta-lactam allergy):	**Gentamicin** IV 160mg **and Clindamycin** IV 600mg

- ***Tonsillectomy and/or Adenoidectomy***

  Antibiotic prophylaxis not recommended.

5.3.3 Breast Surgery

- ***Breast Surgery – Breast Cancer Surgery***

First Line:	**Flucloxacillin** IV 1g DO NOT use in penicillin allergic patients
Second Line (Minor penicillin rash):	**Clindamycin** IV 600mg
Third Line (Severe beta-lactam allergy):	**Teicoplanin** IV 200 - 800mg (see section 3.4.2.2)

- ***Breast Surgery – Breast Reshaping Procedures***

First Line:	**Flucloxacillin** IV 1g DO NOT use in penicillin allergic patients
Second Line (Minor penicillin rash):	**Cefuroxime** IV 750mg CAUTION in penicillin allergic patients
Third Line (Severe beta-lactam allergy):	**Clindamycin** IV 600mg

- ***Breast Surgery – Breast Surgery With Prosthetic Implant***

First Line:	**Flucloxacillin** IV 1g every 6 hours for 24 hours DO NOT use in penicillin allergic patients
Second Line (Minor penicillin rash):	**Cefuroxime** IV 750mg every 8 hours for 24 hours CAUTION in penicillin allergic patients
Third Line (Severe beta-lactam allergy):	**Clindamycin** IV 600mg every 6 hours for 24 hours

- ***Breast Surgery – Breast Surgery Reconstruction***

First Line:	**Flucloxacillin** IV 1g DO NOT use in penicillin allergic patients
Second Line (Minor penicillin rash):	**Cefuroxime** IV 750mg CAUTION in penicillin allergic patients
Third Line (Severe beta-lactam allergy):	**Clindamycin** IV 600mg

5.3.4 Gastrointestinal Surgery

- ***Upper Gastrointestinal – Clean surgical procedures*** *(including anti-reflux, hiatus hernia repair, oesophageal stent or gastroduodenal stent insertion).* Antibiotic prophylaxis not recommended, unless intraoperative injury to the GI tract in which case use the following:

First Line:	**Co-amoxiclav** IV 1.2g DO NOT use in penicillin allergic patients
Second Line (Beta-lactam allergy):	**Gentamicin** IV 160mg **and Metronidazole** IV 500mg
IF high risk MRSA, please ADD:	**Teicoplanin** IV 200 - 800mg (see section 3.4.2.2)

- ***Upper Gastrointestinal – Oesophageal Surgery***

First Line:	**Co-amoxiclav** IV 1.2g DO NOT use in penicillin allergic patients
Second Line (Beta-lactam allergy):	**Gentamicin** IV 160mg **and Metronidazole** IV 500mg
IF high risk MRSA, please ADD:	**Teicoplanin** IV 200 - 800mg (see section 3.4.2.2)

- ***Upper Gastrointestinal – Stomach And Duodenal Surgery***

First Line:	**Co-amoxiclav** IV 1.2g DO NOT use in penicillin allergic patients
Second Line (Beta-lactam allergy):	**Gentamicin** IV 160mg **and Metronidazole** IV 500mg
IF high risk MRSA, please ADD:	**Teicoplanin** IV 200 - 800mg (see section 3.4.2.2)

- ***Upper Gastrointestinal – Gastric Bypass Surgery***

First Line:	**Co-amoxiclav** IV 1.2g DO NOT use in penicillin allergic patients
Second Line (Beta-lactam allergy):	**Gentamicin** IV 160mg **and Metronidazole** IV 500mg
IF high risk MRSA, please ADD:	**Teicoplanin** IV 200 - 800mg (see section 3.4.2.2)

- ***Upper Gastrointestinal – Small Intestine Surgery***

First Line:	**Co-amoxiclav** IV 1.2g DO NOT use in penicillin allergic patients
Second Line (Beta-lactam allergy):	**Gentamicin** IV 160mg **and Metronidazole** IV 500mg
IF high risk MRSA, please ADD:	**Teicoplanin** IV 200 - 800mg (see section 3.4.2.2)

- ***Hepatobiliary – Bile Duct Surgery***

First Line:	**Co-amoxiclav** IV 1.2g **and Metronidazole** IV 500mg DO NOT use in penicillin allergic patients
Second Line (Beta-lactam allergy):	**Gentamicin** IV 160mg **and Metronidazole** IV 500mg
IF high risk MRSA, please ADD:	**Teicoplanin** IV 200 - 800mg (see section 3.4.2.2)

- ***Hepatobiliary – Pancreatic Surgery***

First Line:	**Co-amoxiclav** IV 1.2g DO NOT use in penicillin allergic patients
Second Line (Beta-lactam allergy):	**Gentamicin** IV 160mg **and Metronidazole** IV 500mg
IF high risk MRSA, please ADD:	**Teicoplanin** IV 200 - 800mg (see section 3.4.2.2)

- ***Hepatobiliary – Liver Surgery***

First Line:	**Co-amoxiclav** IV 1.2g DO NOT use in penicillin allergic patients
Second Line (Beta-lactam allergy):	**Gentamicin** IV 160mg **and Metronidazole** IV 500mg
IF high risk MRSA, please ADD:	**Teicoplanin** IV 200 - 800mg (see section 3.4.2.2)

- ***Hepatobiliary – Cholecystectomy Open***

First Line:	**Co-amoxiclav** IV 1.2g DO NOT use in penicillin allergic patients
Second Line (Beta-lactam allergy):	**Gentamicin** IV 160mg **and Metronidazole** IV 500mg
IF high risk MRSA, please ADD:	**Teicoplanin** IV 200 - 800mg (see section 3.4.2.2)

Hepatobiliary – Cholecystectomy Laparoscopic Antibiotic prophylaxis not recommended. *Unless high risk patients e.g. if intra-operative cholangiogram, conversion to laparotomy, acute cholecystitis, pregnancy, immunosuppression, insertion of prosthetic devices. Note: if procedure involves large bile spillage always include Metronidazole as part of prophylaxis.*

First Line:	**Co-amoxiclav** IV 1.2g DO NOT use in penicillin allergic patients
Second Line (Beta-lactam allergy):	**Gentamicin** IV 160mg **and Metronidazole** IV 500mg
IF high risk MRSA, please ADD:	**Teicoplanin** IV 200 - 800mg (see section 3.4.2.2)

- ***Lower Gastrointestinal – Appendicectomy***

First Line:	**Co-amoxiclav** IV 1.2g DO NOT use in penicillin allergic patients
Second Line (Beta-lactam allergy):	**Gentamicin** IV 160mg **and Metronidazole** IV 500mg
IF high risk MRSA, please ADD:	**Teicoplanin** IV 200 - 800mg (see section 3.4.2.2)

- ***Lower Gastrointestinal – Colorectal Surgery***

First Line:	**Co-amoxiclav** IV 1.2g DO NOT use in penicillin allergic patients
Second Line (Minor penicillin rash):	**Cefuroxime*** IV 750mg **and Metronidazole** IV 500mg *CAUTION in penicillin allergic patients
Third Line (Severe beta-lactam allergy):	**Gentamicin** IV 160mg **and Metronidazole** IV 500mg
IF high risk MRSA, please ADD:	**Teicoplanin** IV 200 - 800mg (see section 3.4.2.2)

- ***Lower Gastrointestinal – Flap Surgery for Pilonidal Sinus***

First Line:	**Co-amoxiclav** IV 1.2g every 8 hours for 24 hours DO NOT use in penicillin allergic patients
Second Line (Minor penicillin rash):	**Cefuroxime*** IV 750mg every 8 hours **and Metronidazole** IV 500mg every 8 hours for 24 hours *CAUTION in penicillin allergic patients
Third Line (Severe beta-lactam allergy):	**Gentamicin** IV 160mg stat **and Teicoplanin** IV 400mg every 12 hours **and Metronidazole** IV 500mg every 8 hours for 24 hours

- ***Lower Gastrointestinal – Laparoscopy / Laparotomy - Without Mucosal Breach***

  Antibiotic prophylaxis not recommended.

- ***Lower Gastrointestinal – Stapled Haemorrhoidectomy***

First Line:	**Co-amoxiclav** IV 1.2g DO NOT use in penicillin allergic patients
Second Line (Beta-lactam allergy):	**Gentamicin** IV 160mg **and Metronidazole** IV 500mg
IF high risk MRSA, please ADD:	**Teicoplanin** IV 200 - 800mg (see section 3.4.2.2)

- ***Hernia Repair – Inguinal, Femoral or Incisional, Open or Laparoscopic***

  If not including mesh, then antibiotic prophylaxis not usually recommended.

  If includes mesh, then use the following:

First Line:	**Co-amoxiclav** IV 1.2g DO NOT use in penicillin allergic patients
Second Line (Beta-lactam allergy):	**Gentamicin** IV 160mg **and Metronidazole** IV 500mg
IF high risk MRSA, please ADD:	**Teicoplanin** IV 200 - 800mg (see section 3.4.2.2)

- ***Abdomen – Diagnostic Endoscopic Procedures***

  Antibiotic prophylaxis not recommended.

- ***Abdomen – Therapeutic Endoscopic Procedures****

First Line:	**Gentamicin** IV 160mg

* This category includes operations such as ERCP (where high risk identified as per local Trust guidelines), and PEG insertion, and defined gastrointestinal interventional radiological techniques as per local trust guidelines. Please note: Antibiotic prophylaxis is not routinely used for colonoscopic procedures.

- ***Spleen – Elective Splenectomy***

  Consider in immunosuppressed patients

First Line:	**Flucloxacillin** IV 1g DO NOT use in penicillin allergic patients
Second Line (Beta-lactam allergy):	**Teicoplanin** IV 200 - 800mg (see section 3.4.2.2)

5.3.5 Vascular Surgery

- ***Vascular Surgery – Amputation with Pre-existing Infection And / Or Diabetes etc.***

First Line:	**Co amoxiclav** IV 1.2g DO NOT use in penicillin allergic patients
Second Line (Beta-lactam allergy):	**Teicoplanin** IV 200 - 800mg (see section 3.4.2.2) **and Gentamicin** IV 160mg **and Metronidazole** IV 500mg

- ***Vascular Surgery – Amputation Following Major Trauma***

First Line:	**Co amoxiclav*** IV 1.2g followed by **Metronidazole** oral 400mg **OR** IV 500mg every 8 hours for 5 days *DO NOT use in penicillin allergic patients
Second Line (Minor penicillin rash):	**Cefuroxime*** IV 750mg **and Metronidazole** IV 500mg followed by **Metronidazole** oral 400mg **OR** IV 500mg every 8 hours for 5 days *CAUTION in penicillin allergic patients
Third Line (Severe beta-lactam allergy):	**Teicoplanin** IV 200 - 800mg (see section 3.4.2.2) **and Gentamicin** IV 160mg stat **and Metronidazole I**V 500mg followed by **Metronidazole** oral 400mg or IV 500mg every 8 hours for 5 days

- ***Vascular Surgery – Insertion of Graft Or Patch / Vein Graft Reversal***

First Line:	**Teicoplanin** IV 200 - 800mg (see section 3.4.2.2) **and Gentamicin** IV 160mg +/- **Metronidazole** IV 500mg
Second Line:	Contact Consultant Microbiologist

- ***Embolectomy***

Antibiotic prophylaxis not routinely recommended.

5.3.6 Obstetrics & Gynaecology

- ***Caesarean Section***

First Line:	**Cefuroxime*** IV 1.5g **and Metronidazole** IV 500mg *CAUTION in penicillin allergic patients
Second Line (Severe beta-lactam allergy):	**Clindamycin** IV 600mg **and Gentamicin** IV 160mg

- ***Assisted Delivery***

First Line:	**Co-amoxiclav** IV 1.2g FOLLOWING the birth DO NOT use in penicillin allergic patients
Second Line (Severe beta-lactam allergy):	**Clindamycin** IV 600mg **and Gentamicin** IV 160mg FOLLOWING the birth

- ***3rd & 4th Degree Perineal Tear***

First Line:	**Co-amoxiclav** IV 1.2g DO NOT use in penicillin allergic patients
Second Line (Minor penicillin rash):	**Cefuroxime*** IV 750mg **and Metronidazole** IV 500mg *CAUTION in penicillin allergic patients
Third Line (Severe beta-lactam allergy):	**Clindamycin** IV 600mg **and Gentamicin** IV 160mg

- ***Manual Removal of the Placenta****

First Line:	**Co-amoxiclav** IV 1.2g DO NOT use in penicillin allergic patients
Second Line (Minor penicillin rash):	**Cefuroxime*** IV 750mg **and Metronidazole** IV 500mg *CAUTION in penicillin allergic patients
Third Line (Severe beta-lactam allergy):	**Gentamicin** IV 160mg **and Clindamycin** IV 600mg

* For patients with proven chlamydia or gonorrhoea infection consider addition of **azithromycin** 1g po stat

- ***Prevention of Neonatal Sepsis With Group B streptococcus***

First Line:	**Benzylpenicillin** IV 3g at onset of labour then IV 1.2g every 4 hours until birth DO NOT use in penicillin allergic patients
Second Line (Minor penicillin rash):	**Clindamycin** IV 900mg at onset of labour **and** then every 8 hours until birth

- ***Abdominal Approach Surgery – Laparotomy / Laparoscopy (Without Mucosa Breach)***

Antibiotic prophylaxis not recommended.

- ***Abdominal Approach Surgery – Total Abdominal Hysterectomy***

First Line:	**Co-amoxiclav** IV 1.2g DO NOT use in penicillin allergic patients
Second Line (Minor penicillin rash):	**Cefuroxime*** IV 750mg **and Metronidazole** IV 500mg *CAUTION in penicillin allergic patients
Third Line (Severe beta-lactam allergy):	**Gentamicin** IV 160mg **and Clindamycin** IV 600mg

- ***Abdominal Approach Surgery – Colorectal / ileal resection***

First Line:	**Co-amoxiclav** IV 1.2g DO NOT use in penicillin allergic patients
Second Line (Minor penicillin rash):	**Cefuroxime*** IV 750mg **and Metronidazole** IV 500mg *CAUTION in penicillin allergic patients
Third Line (Severe beta-lactam allergy):	**Gentamicin** IV 160mg **and Metronidazole** IV 500mg

- ***Vaginal Approach Surgery – Vaginal Hysterectomy***

First Line:	**Co-amoxiclav** IV 1.2g DO NOT use in penicillin allergic patients
Second Line (Minor penicillin rash):	**Cefuroxime*** IV 750mg **and Metronidazole** IV 500mg *CAUTION in penicillin allergic patients
Third Line (Severe beta-lactam allergy):	**Gentamicin** IV 160mg **and Clindamycin** IV 600mg

- ***Vaginal Approach Surgery – Anterior Repair***

First Line:	**Co-amoxiclav** IV 1.2g DO NOT use in penicillin allergic patients
Second Line (Minor penicillin rash):	**Cefuroxime*** IV 750mg **and Metronidazole** IV 500mg *CAUTION in penicillin allergic patients
Third Line (Severe beta-lactam allergy):	**Gentamicin** IV 160mg **and Clindamycin** IV 600mg

- ***Vaginal Approach Surgery – Posterior Repair***

First Line:	**Co-amoxiclav** IV 1.2g DO NOT use in penicillin allergic patients
Second Line (Minor penicillin rash):	**Cefuroxime*** IV 750mg **and Metronidazole** IV 500mg *CAUTION in penicillin allergic patients
Third Line (Severe beta-lactam allergy):	**Gentamicin** IV 160mg **and Clindamycin** IV 600mg

- ***Vaginal Approach Surgery – Tension-free Vaginal Tape Obturator***

First Line:	**Co-amoxiclav** IV 1.2g DO NOT use in penicillin allergic patients
Second Line (Minor penicillin rash):	**Cefuroxime*** IV 750mg **and Metronidazole** IV 500mg *CAUTION in penicillin allergic patients
Third Line (Severe beta-lactam allergy):	**Gentamicin** IV 160mg **and Clindamycin** IV 600mg

- ***Vaginal Approach Surgery – Surgical Termination of pregnancy, Evacuation of retained products of conception, or manual vacuum aspiration of Pregnancy***

First Line:	**Doxycycline** oral 100mg twice a day for 3 days.

- ***Vaginal Approach Surgery – Intrauterine Contraceptive Device Insertion***

Antibiotic prophylaxis not recommended.

5.3.7 Ophthalmic Surgery

- ***Cataract Surgery***

Topical antimicrobials only, in line with local departmental protocols.

5.3.8 Orthopaedic Surgery

- ***Large Joint Arthroplasty***

Either	**Gentamicin** IV 160mg **and Flucloxacillin*** IV 2g followed by 3 further doses of **Flucloxacillin*** IV 1g every 6 hours if surgeon requests *DO NOT use in penicillin allergic patients
Or	**Cefuroxime** IV 1.5g; followed by 2 further doses of **Cefuroxime** IV 750mg every 8 hours if surgeon requests CAUTION in penicillin allergic patients If felt necessary, a single dose of Teicoplanin iv can be added at the discretion of the surgeon
Or *Especially if severe beta-lactam allergy or MRSA risk:*	**Teicoplanin** IV 200 - 800mg (see section 3.4.2.2) **and Gentamicin** IV 160mg. If further doses required, discuss with Microbiologist.

- ***Revision of Infected Prosthetic Joint***

Either	**Vancomycin** IV (loading dose as per treatment guidelines, see section 3.4.2.1.
Or	**Teicoplanin** IV (loading dose as per treatment guidelines, see section 3.4.2.2.

- **Small Joint/Day Case Arthroplasty**

Follow locally agreed guidelines if at variance to large joint arthroplasty above.

- ***Open Fracture (See also section 4.10)***

First Line:	**Co-amoxiclav** IV 1.2g loading thereafter IV 1.2g every 6 hours DO NOT use in penicillin allergic patients
Second Line (Minor penicillin rash):	**Cefuroxime*** IV 1.5g every 8 hours **and Metronidazole** IV 500mg every 8 hours *CAUTION in penicillin allergic patients
Third Line (Severe beta-lactam allergy):	**Clindamycin** IV 600mg every 6 hours;
If risk of MRSA:	Teicoplanin IV 200 - 800mg (see section 3.4.2.2)
Duration	Continue until soft tissue closure has been achieved or for 72 hours whichever occurs first.

- ***Open Surgery for Closed Fracture***

First Line:	**Gentamicin** IV 160mg **and Flucloxacillin** IV 2g
Second Line (Minor penicillin rash):	**Cefuroxime** IV 1.5g CAUTION in penicillin allergic patients
Third Line (Severe beta-lactam allergy):	**Teicoplanin** IV 200 - 800mg (see section 3.4.2.2) **and Gentamicin** IV 160mg

- ***Orthopaedic Surgery (Without Implant)***

Antibiotic prophylaxis not recommended.

- ***Hip Fracture (DHS)***

Either	**Gentamicin** IV 160mg **and Flucloxacillin** IV 2g DO NOT use in penicillin allergic patients
Or	**Cefuroxime** IV 1.5g; followed by 2 further doses **Cefuroxime** IV 750mg every 8 hours if surgeon requests CAUTION in penicillin allergic patients
Or *Especially if severe beta-lactam allergy/MRSA risk/ PREVIOUS MRSA Positive:*	**Teicoplanin** IV 200 - 800mg (see section 3.4.2.2) **and Gentamicin** IV 160mg. If surgeon requires further doses, discuss with Microbiologist

- ***Amputation with Pre-existing Infection and/or Diabetes etc.***

First Line:	**Co-amoxiclav** IV 1.2g DO NOT use in penicillin allergic patients
Second Line (Minor penicillin rash):	**Cefuroxime*** IV 750mg **and Metronidazole** IV 500mg *CAUTION in penicillin allergic patients
Third Line (Severe beta-lactam allergy):	**Gentamicin** IV 160mg **and Metronidazole** IV 500mg

- ***Amputation Following Major Trauma***

First Line:	**Co-amoxiclav** IV 1.2g every 8 hours for 5 days DO NOT use in penicillin allergic patients
Second Line (Minor penicillin rash):	**Cefuroxime*** IV 750mg **and Metronidazole** IV 500mg followed by **Metronidazole** IV 500mg every 8 hours (400mg oral every 8 hours) for 5 days *CAUTION in penicillin allergic patients
Third Line (Severe beta-lactam allergy):	**Teicoplanin** IV 200 - 800mg (see section 3.4.2.2) **and Gentamicin** IV 160mg **and Metronidazole** IV 500mg followed by **Metronidazole** IV 500mg every 8 hours (400mg oral every 8 hours) for 5 days

- ***Spinal – Spinal Surgery***

First Line:	**Gentamicin** IV 160mg **and Flucloxacillin*** IV 2g followed by 3 further doses of **Flucloxacillin*** IV 1g every 6 hours *DO NOT use in penicillin allergic patients
Second Line (Minor penicillin rash):	**Cefuroxime** IV 1.5g followed by 2 further doses of **Cefuroxime** IV 750mg every 8 hours if metal work inserted CAUTION in penicillin allergic patients
Third Line (Severe beta-lactam allergy):	**Teicoplanin** IV 200 - 800mg (see section 3.4.2.2) **and Gentamicin** IV 160mg. If surgeon requires further doses, discuss with Microbiologist

- ***Hand – Soft Tissue of The Hand (Elective Procedure)***

First Line:	**Co-amoxiclav** IV 1.2g DO NOT use in penicillin allergic patients
Second Line (Minor penicillin rash):	**Cefuroxime** IV 1.5g CAUTION in penicillin allergic patients
Third Line (Severe beta-lactam allergy):	**Teicoplanin** IV 200 - 800mg (see section 3.4.2.2) **and Gentamicin** IV 160mg

5.3.9 Urological Surgery

In the presence of infected urine antibiotic prophylaxis should be targeted against the infecting organism

- ***Urethral or Suprapubic Catheterisation/Catheter removal***

Antibiotic prophylaxis NOT routinely recommended.
Do not use prophylactic antibiotics for routine catheter changes unless there is a clear history of catheter-change associated UTI or trauma.
In such cases recommendation is Gentamicin 80mg IV STAT dose. If a catheter or meatal/suprapubic catheter exit site is known to be colonised with Staphylococcus aureus (including MRSA) contact microbiologist on call for advice.

- ***Shockwave Lithotripsy (ESWL)***

Prophylaxis not routinely indicated.

If higher risk patient (past history of infection, 'infection' calculi, single kidney, and immune suppression):

First Line:	**Gentamicin** IV 160mg
Second Line:	**Co-amoxiclav** IV 1.2g DO NOT use in penicillin allergic patients

- ***Percutaneous Nephrolithotomy/ Endoscopic Ureteric Removal or Fragmentation of Stone***

Either:	**Gentamicin** IV 160mg
or:	**Co-amoxiclav** IV 1.2g DO NOT use in penicillin allergic patients

- ***Percutaneous Insertion of Urostomy***

First Line:	**Gentamicin** IV 160mg
Second Line:	**Co-amoxiclav** IV 1.2g DO NOT use in penicillin allergic patients

- ***Transurethral Resection Of Bladder Tumours***

First Line:	**Gentamicin** IV 160mg

- ***Radical Cystectomy***

First Line:	**Co-amoxiclav** IV 1.2g DO NOT use in penicillin allergic patients
Second Line (Minor penicillin rash):	**Cefuroxime*** IV 750mg **and Metronidazole** IV 500mg*CAUTION in penicillin allergic patients
Third Line (Severe beta-lactam allergy):	**Gentamicin** IV 160mg **and Metronidazole** IV 500mg

- **Optical Urethrotomy**

First Line:	**Gentamicin** IV 160mg

- **Radical Orchidectomy with Prosthesis**

First Line:	**Co-amoxiclav** IV 1.2g DO NOT use in penicillin allergic patients
Second Line (Minor penicillin rash):	**Cefuroxime** IV 1.5g CAUTION in penicillin allergic patients
Third Line (Severe beta-lactam allergy):	**Gentamicin** IV 160mg

- ***Transurethral Resection of Prostate (TURP)***

First Line:	**Gentamicin** IV 160mg
Second Line:	Contact Consultant Microbiologist

In the presence of infected urine antibiotic prophylaxis should be targeted against the infecting organism

- ***Transrectal or Transperineal Prostate Biopsy***

First Line:	**Ciprofloxacin** IV 600mg (or 750mg oral) **and Metronidazole** IV 500mg (or 400mg oral)
Second Line: *(especially if multi-resistant organisms previously isolated)*	Contact Consultant Microbiologist

- **Radical Prostatectomy**

First Line:	**Gentamicin** IV 160mg

- ***Nephrectomy***

  Antibiotic prophylaxis not routinely recommended.

- ***Hydrocele repair***

  Antibiotic prophylaxis not routinely recommended.

5.3.10 Cardiology procedures

- ***Uncomplicated Insertion of Cardiac Pacemaker or Similar Device***

First Line	**Flucloxacillin** IV 1g DO NOT use in penicillin allergic patients
Second Line (Minor penicillin rash):	**Teicoplanin** IV 200 - 800mg (see section 3.4.2.2)

- **Long Line Insertion**

  Antibiotic prophylaxis not recommended.

Annex 1 Splenectomy & Splenic Dysfunction Patients

Guidelines for Prevention of Infection in Patients with an Absent or Dysfunctional Spleen

Patients with splenic dysfunction (caused by homozygous sickle cell disease, coeliac syndrome, hereditary spherocytosis and haemoglobinopathies) or asplenia are at increased risk of overwhelming sepsis caused by encapsulated bacteria and other micro-organisms.

Although most infections occur within the first two years after splenectomy, up to one third may manifest at least five years later, and cases have occurred more than 20 years later. The risk of dying of serious infection is significant and almost certainly lifelong.

Micro-organisms

Streptococcus pneumoniae (pneumococcus) is the most common pathogen, and together with *H. influenzae* and *N. meningitides* (meningococcus) accounts for 70-90% of cases.

Other infections include *E. coli,* malaria, babesiosis (caused by tick bite), and *Capnocytophaga canimorsus* (caused by dog bites), as well as secondary infections following influenza.

Preventative strategies are based on the education of staff and patients, appropriate immunisation schedules and antibiotic prophylaxis, as well as treatment of proven or suspected infection.

Immunisation/ Vaccination – Timing

Elective splenectomy:
Ideally start immunisation at least **TWO (ideally four to six) weeks** prior to surgery. If it is not possible to vaccinate beforehand, splenectomy should never be delayed.

Emergency splenectomy or prior immunisation is not possible:
If pre-splenectomy vaccination is not possible, such as in the case of emergency splenectomy, administer at hospital discharge or **at least TWO week**s post splenectomy, whichever is sooner.

Splenic dysfunction:
Ideally start immunisation **at least TWO (ideally four to six) weeks** prior to initiation of chemotherapy or radiotherapy. If it is not possible to vaccinate beforehand, chemotherapy or radiotherapy should never be delayed. Immunisation should be delayed until **at least three months** after completion of immunosuppressive therapy, or until recovery of immunological function, where this can be assessed. Immunisation of these patients should not be delayed if this is likely to result in a failure to vaccinate.

Contraindications

The vaccines should not be given to those who have had:

● a confirmed anaphylactic reaction to a previous dose of the vaccines

● a confirmed anaphylactic reaction to any component of the vaccines

There are specific contraindications associated with each vaccine. Please check the Summary of Product Characteristics (SPC) and consult a ward pharmacist.

Vaccination Programme

Splenectomy/ splenic dysfunction adults, regardless of previous vaccination, should receive:	**Source**
Summary: • One dose of **PPV23**, **4CMenB** and **MenACWY** conjugate vaccine, followed by • One additional dose of **4CMenB** 4 weeks later • Annual **influenza vaccine** each season • Primary course of **Covid-19 vaccine** (two doses) • Revaccination with **PPV23** every five years	

Splenectomy/ splenic dysfunction adults, regardless of previous vaccination, should receive:	**Source**
1. Single dose of pneumococcal polyvalent (23-valent) unconjugated pneumococcal polysaccharide vaccine (**PPV 23**) e.g. Pneumovax 23® Revaccination with **PPV23** is recommended every five years. Testing of antibody levels prior to vaccination is not required.	Green book Chapter 25, Jan 2020
2. Single dose of Meningococcal B vaccine* (**4CMenB**) e.g. Bexsero®, and then an additional **4CMenB** vaccine dose 4 weeks later	Green book, Chapter 22 v10, Sep 2016
3. Single dose of quadrivalent meningococcal (ACWY) conjugate vaccine* (**MenACWY**) e.g. Menveo® or Nimenrix®	Green book, Chapter 22 v10, Sep 2016
4. Annual **influenza vaccine**	Green book, Chapter 19, Oct 2020
5. Primary course of **Covid-19 vaccine** (two doses) Asplenia or splenic dysfunction patients are classified as clinical risk group for severe Covid-19 illness and should receive a primary course of two doses. Interval between the first and second dose is determined by the specific brand of vaccine. Please check the Green Book for guidance on re-vaccination.	Green book, Chapter 14a, Sep 2021
* Where an opportunity arises, and depending on the individual patient's circumstances, children and adults who have never received **4CMenB** or **MenACWY** conjugate vaccine should be offered these vaccines.	Green book, Chapter 22 v10, Sep 2016

Although additional vaccination against Haemophilus influenzae type b (Hib) used to be recommended for asplenic patients, current control of Hib is excellent because of a long-standing successful vaccination programme in children and the risk of Hib disease is extremely low. Therefore, additional Hib vaccination is no longer recommended (Green book, Chapter 7, Jan 2020).

Post-immunisation Antibody Testing

Green Book (Chapter 25, Jan 2020) **no longer recommends** checking the level of pneumococcal antibodies post PPV immunisation and on annual basis. In special circumstances, such as serious immunodeficiency, this can be requested via the laboratory via a plain serum sample. Please discuss such cases with Consultant Microbiologist on-call before taking the sample.

Antibiotic Prophylaxis

Most instances of serious infection are due to encapsulated bacteria, with pneumococcal disease being predominant. However, the role of life-long prophylaxis is less clear, with the emergence of penicillin resistant pneumococci. It is accepted that compliance may be a problem and that long-term antibiotic prophylaxis is controversial in the light of emerging antimicrobial resistance. The evidence for prophylactic antibiotics in adults, and outside the 2-year period after splenectomy is poor for low risk groups. Since there may be definite disadvantages of prophylactic antibiotics, the decision to use prophylactic antibiotics for life-long should be made on an individual basis with each patient, following discussion of the risk and disadvantages.

Risk factors for high risk of invasive pneumococcal disease:

- children under 16 years old,
- adults over 50 years old,
- inadequate serological response to pneumococcal vaccination,
- a history of previous invasive pneumococcal disease,
- splenectomy for underlying haematological malignancy, particularly in the context of ongoing immunosuppression,
- those who have received splenic irradiation, and
- patients with active ongoing graft-versus-host-disease (GvHD).

All patients should receive antibiotic prophylaxis for a minimum of 2 years post splenectomy, as per table below. The increased risk of infection in patients with hyposplenism is life long, but is highest early after splenectomy. The highest risk is from pneumococcal infection.

High risk patients meeting one or more of the risk factors above should receive antibiotic prophylaxis preferably life-long, following splenectomy.

Patients not at high risk should be counselled regarding the risks and benefits of life-long antibiotics, so they are able to choose whether to continue or discontinue prophylaxis beyond the first 2 years.

Fully immunised patients (high risk/ low risk) who choose not to continue prophylactic antibiotics beyond the first 2 years or refuse the prophylactic antibiotic at the outset should be supplied with **an emergency supply** of co-amoxiclav or clarithromycin (if allergic to penicillin) at hospital discharge to be available at home. Patient should be counselled to take this antibiotic treatment immediately if they develop symptoms of shivers, fever or malaise whilst immediate medical attention is sought. **This is the preferred option of the Path Links Microbiologists.**

Patients developing signs and/or symptoms of infection, despite the vaccination and prophylaxis measures, must be given systemic antibiotics and admitted to hospital. If acutely unwell and not penicillin allergic, prompt administration of intravenous benzylpenicillin or cefotaxime is recommended.

Adult Antibiotic Prophylaxis		
	Prophylaxis	**Duration**
First line	**Penicillin V** (**Phenoxymethylpenicillin**) 250mg oral every 12 hours DO NOT use in penicillin allergic patients	Minimum 2 years post splenectomy, but preferably life-long, especially for high risk patients. However, antibiotic prophylaxis may be discontinued after the first 2 years in those with sickle-cell disease who have received pneumococcal vaccination and who do not have a history of severe pneumococcal infection, as well as those who are low risks.
If penicillin allergy	**Erythromycin** 500mg oral every 12 hours	
Fully immunised patients (high risk/ low risk) who choose not to continue prophylactic antibiotics beyond the first 2 years or refuse the prophylactic antibiotic at the outset		
	Emergency 'back-up' supply	**Counselling**
First line	**Co-amoxiclav** 625mg oral every 8 hours – supply 3 doses on discharge Adjust dose according to renal function	Counsel patients to take this antibiotic treatment immediately if they develop symptoms of shivers, fever or malaise, AND seek medical help immediately.
If penicillin allergy	**Clarithromycin** 500mg oral every 12 hours – supply 2 doses on discharge Adjust dose according to renal function	

Patient Counselling and Education

- Education of the patient about their life-long increased risk of overwhelming infection.
- The need for malaria prophylaxis when travelling to affected areas is important.
- They should be told to seek urgent medical attention if they develop fevers, shivers or feel unwell, or are bitten or scratched by an animal.
- Possible occupational risk factors should be considered.
- They should be issued with an alert card (available from Department of Health).

Annex 2 Endophthalmitis - Intravitreal Reconstitution of antibiotics

The usual means of preparing ANY intravitreal injection should be via the pharmacy aseptic unit, as outlined in the National Patient Safety Alert (NPSA) 20.

In case of an emergency, reconstitution of intravitreal injections should only be undertaken in clinics / theatres, in exceptional circumstances (i.e.) out of hours. In which case, please contact Pharmacy on call to obtain a specific kit for the drug required.

Annex 3 Management options for CDI patients that cannot swallow tablets

- Administering Metronidazole enterally to patients who cannot swallow tablets

Metronidazole (oral/enteral administration) is used for first line treatment of *Clostridium difficile* infection. Oral tablet should be used wherever possible. If a patient is unable to swallow the tablets whole, the tablets can be crushed and dispersed in water (unlicensed).

Metronidazole suspension is **NOT** recommended for any patient with diarrhoea or feeding tubes. This is because metronidazole tablets contain the active drug, whereas the suspension contains a pro-drug requiring activation by gastric enzymes to take effect. Patients with feeding tubes are at risk of receiving little or no effect from the suspension because the gastric enzyme response may be reduced or bypassed. In the case of diarrhoea, it is questionable whether the gastric enzymes have had enough time to act on the drug before it is expelled from the GI tract. Therefore, it is not clear how well metronidazole suspension pro-drug will be converted to metronidazole in the stomach.

IV metronidazole is available for patient if they are nil by mouth, not keeping down oral treatment due to vomiting and it may be used with vancomycin as dual therapy for critically ill CDI patient.

How to give metronidazole tablet enterally:

1. Stop the enteral feed (If appropriate).
2. Flush the enteral feeding tube with the recommended volume of water.
3. Disperse the tablet in up to 15mL to 30mL of water, ensuring that there are no large particles of tablet.
4. Draw this into an appropriate size and type of syringe.
5. Flush the medication dose down the feeding tube.
6. Ensure that any remaining drug is drawn up from the container, using up to 15mL water. Flush this via the same syringe into the feeding tube (this will ensure total dose is administered).
7. Finally, flush the enteral feeding tube with the recommended volume of water.
8. Re-start the feed, unless a prolonged break is required.

NOTE:

- It is noted that the tablets do not taste very pleasant, especially when dispersed, but as the dose should be administered with food anyway, this should help mask the taste. Anticipated benefits include more effective antimicrobial treatment, timely recovery from infection, and reduced Length of Stay.
- When the oral route is inappropriate the rectal route may be used.
- Only certain brands and strengths can be crushed and dispersed. Always check the information leaflet. *The following is for guidance only and they are subject to change*

Metronidazole (Teva)	Tablet 200 mg, 400 mg, 500 mg	400 mg tablets do not disperse readily in water. Tablets crush easily using pestle and mortar and mix easily with water to form a milky suspension that flushes easily via an 8Fr NG tube.
Metronidazole (Norton)	Tablet 200 mg, 400 mg	400 mg tablets will disintegrate within 5 minutes if agitated continuously in 10 mL of water to form a fine dispersion, which will flush down an 8Fr NG tube but it requires frequent shaking as particles settle quickly in the syringe.
Metronidazole (Actavis, Aurobindo)	Tablet 200 mg, 400 mg	No specific data on enteral tube administration are available for this preparation.
Metronidazole (Ranbaxy)	Tablet 200 mg, 400 mg	Both 200 mg and 400 mg tablets disintegrate within 2–5 minutes when placed in 10 mL of water. Both form granular dispersions, the granules in the 200 mg tablet being slightly smaller; however, both strengths will block an 8Fr NG tube. When the tablets are crushed effectively using a pestle and mortar, the resulting powder mixes easily with water and flushes readily down a NG tube.
Flagyl (Zentiva)	Tablet 200 mg, 400 mg	Film-coated tablets. Metronidazole is slightly soluble in water.

References:

1. Handbook of Drug Administration – Metronidazole
2. NEWT Guideline - Metronidazole
3. Metronidazole 200mg Tablets SPC

- Administering Vancomycin enterally to patients who cannot swallow capsules

Vancomycin capsules are used for the treatment of *Clostridium difficile* infection, and must be swallowed whole. For patients that cannot do so, some Vancomycin preparations for injection are also licensed for oral/enteral use. Treatment duration with vancomycin may need to be tailored to the clinical course of individual patients.

Intravenous administration of vancomycin is **NOT** effective for treatment of *Clostridium difficile.*

Vancomycin given enterally is not absorbed and does **NOT** treat systemic infections.

How to give vancomycin injection enterally:

1. Dilute a 500mg vial with 10ml WFI, or a 1 gram vial with 20ml WFI, to produce a solution of 50mg/ml.
2. On the reconstituted vial record the strength (50mg/ml), and an expiry date and time of 24 hours. Store the reconstituted vial in the fridge.
3. The usual dose is 125mg (2.5ml) four times a day.
4. Each dose needs to be further diluted to 30ml for administration.
5. If necessary the dose can be mixed with flavoured syrups to improve taste, immediately before administration.
6. Enteral vancomycin MUST be administered using an enteral syringe.
7. One 500mg vial should last 24 hours at usual dose; higher doses may be used in difficult cases.

NOTE:

- Different brands have different guidance for the amount of water for injection (WFI) to add to the vial. Please double check product information leaflet to check the details.
- Write the patient's name on an IV additive label plus the date and time of expiry (24 hours after opening), clearly mark it 'For ORAL use', and attach the label to the vial.
- Store the solution in the fridge.
- Vials are for single patient use only and should not be shared.
- Common flavouring syrups may be added to the solution at the time of administration to improve the taste.

References:

1. Handbook of Drug Administration via Enteral Feeding Tubes – Vancomycin
2. NEWT Guideline – Vancomycin
3. EMC - Vancomycin 1g Powder for Solution for Infusion (Wockhardt UK Ltd)

- Intracolonic Vancomycin

Where oral/enteral options for management of CDI are not feasible or where felt to be inadequate, successful treatment of severe CDI has been reported with the use of adjunctive intracolonic vancomycin therapy. Please contact GI and Microbiology consultant to discuss the use of Intracolonic vancomycin.

How to give vancomycin via intracolonic (rectal) route

1. Prepare Vancomycin 500mg in 100ml Sodium Chloride 0.9%
2. Insert 18 gauge foley catheter with 30ml balloon per rectum
3. Instil Vancomycin
4. Clamp Catheter for 60 minutes
5. Deflate and remove from patient
6. Instil every 4-12 hours as a retention enema

NOTE:

- Consider measure plasma vancomycin levels after 24-48 hours if patient has renal impairment or colitis
- If the level is above 10mg/l discuss with Microbiology and consider discontinuing rectal vancomycin
- A bowel management system should be used to administer the vancomycin and this should be retained in the rectum for 1 hour

References:

1. Anucha Apisarnthanarak, Behzad Razavi, Linda M. Mundy, Adjunctive Intracolonic Vancomycin for Severe Clostridium difficile Colitis: Case Series and Review of the Literature, Clinical Infectious Diseases, Volume 35, Issue 6, 15 September 2002, Pages 690–696.

2. Kim PK, Huh HC, Cohen HW, et al. Intracolonic vancomycin for severe Clostridium difficile colitis. Surg Infect (Larchmt). 2013;14(6):532-539. doi:10.1089/sur.2012.158.

- Faecal Microbiota Transplant (FMT)

FMT can be considered for patients with recurrent CDI infections and have failed to respond to antibiotics and other treatments

The treatment involves the transfer of healthy bacteria from a donor into the intestines of the patient (recipient), to restore the balance of microbiota in the recipient's intestine.

Please contact Antimicrobial Pharmacist to discuss further for the use of FMT and to explore potential for obtaining supply. FMT is not stocked in pharmacy. It would be sourced from University of Birmingham Microbiome Treatment Centre (UoBMTC). For more information see https://www.birmingham.ac.uk/university/colleges/mds/facilities/advanced-therapies-facility/microbiome-treatment-centre.aspx

Acceptance Criteria:

- Confirmed recurrent or refractory CDI, defined as two or more treatment failures following appropriate antibiotic treatment and microbiologically proven active infection.
- Aged over 16 years.
- Appropriate swallow reflex to reduce the risk of aspiration post-procedure.

Risk of FMT:

- Perforation of the alimentary canal during enteral feeding tube placement.
- Risk of aspiration while enteral feeding tube in place.
- Risk of transmission of an unknown infectious agent.
- Risk of developing diarrhoea, constipation or irritable bowel like syndrome.

Logistics of FMT treatment:

- FMT samples take about three hours to defrost.
- As the FMT leaves the UoBMTC from the freezer, it is expected to be still thawing and almost ready for transfer into the enteral feeding syringe in the ward on arrival to Pharmacy department by the blood bike service.
- FMT can be administered by a doctor or a staff nurse trained to administer enteral feeding.

FMT administration:

1. Stop the CDI antibiotic the evening before the FMT treatment.
2. Patient should be nil by mouth at least 6 hours prior to FMT, but can take their regular medications for other medical conditions.
3. Give a STAT dose of oral PPI & Antiemetic 2 hours prior to FMT administration.
4. Connect FMT enteral syringe to the enteral feeding tube and administer content into the stomach over 30 minutes.
5. Flush the enteral feeding tube with 30 ml of Sodium Chloride 0.9%.
6. Remove enteral feeding tube one hour after the procedure.

NOTE:

- Patient must have received at least 4 days CDI antibiotic prior to FMT.
- FMT must be used within the time frame outlined on the UoBMTC validation certificate.
- Administration should be completed as soon as possible after delivery.
- Before administration cross check the FMT batch and lot number against the validation certificate, and retain certificate in the patient's notes.

Reference:

1. NICE guidance: Faecal microbiota transplant for recurrent Clostridium difficile infection. NICE interventional procedure guidance [IPG485], March 2014 - https://www.nice.org.uk/guidance/ipg485/resources/faecal-microbiota-transplant-for-recurrent-clostridium-difficile-infection-1899869993554885
2. NHS England and NHS Improvement Innovation and Technology Payment - Technical Notes 2019-2020 Frozen Faecal Microbiota Transplantation (FMT).

Annex 4 Guidelines for Administration of Antibiotic Line Lock Therapy, for Infected Central Venous Catheters

Diagnosis and management of infected central venous catheter:

- Consult Consultant Microbiologist and Vascular Access Team for advice
- Device removal is a priority, where possible (see 'Line salvage').
- Device/line salvage therapy should only be attempted when ALL of the following criteria are met:
    - The device cannot be removed/ alternative sites are limited or not available,
    - There is no evidence of tunnel or exit site infection,
    - The patient is clinically stable,
    - The organisms are amenable to salvage treatment.

Investigation:

- Take at least 2 sets of blood cultures with similar volumes of blood (one from peripheral vein AND another one from the catheter) prior to salvage therapy
- Do not take cultures from a haemodialysis line before consulting with renal team (see 'Line salvage')
- Mark bottles clearly to reflect the site from which the samples were collected
- If peripheral blood sample cannot be taken, it is recommended that two or more blood samples are drawn through all different catheter lumens

Diagnostic criteria for catheter-related blood stream infections (CRBSI):

- Signs and symptoms of CRBSI range from mild fever to profound sepsis with or without localised signs of exit site infection
- The overall diagnosis of CRBSI is made by a combination of clinical findings, positive blood cultures and other microbiological evidence in the absence of other identifiable source(s) of infection.
- A diagnosis of CRBSI can be made by the presence of primary bloodstream infection (bacteraemia or fungaemia) in a patient with a central venous catheter (CVC) that has been in-situ for at least 48 hours prior to onset of infection, where primary bloodstream infection is defined as:
    - Isolation of a pathogen (e.g. *S. aureus, E. coli, Klebsiella spp*) from ONE or more blood cultures that is unrelated to any other source of infection at another site

  OR
    - Isolation of a common skin contaminant organism (e.g. *Coagulase-negative Staphylococcus, diphtheroids, propionibacterium spp*) from TWO or more blood cultures drawn on separate occasions within a 48-hour period, with at least one systemic manifestation of infection (fever, chills, hypotension).

Line salvage:

Assessment of individual patients and circumstances should take place prior to salvaging CVC and initiating antibiotic line lock. In the presence of systemic infection, consult Consultant Microbiologist to start systemic antibiotic treatment.

Device/line salvage and antibiotic line lock are restricted to **tunnelled catheters (Hickman line and Portacaths)**, but device removal should be considered first.

Infected non-tunnelled catheters (e.g. PICC and midline) and temporary central lines (jugular and femoral lines) should be removed and replaced to reduce the risk of systemic infection. Contact venous access specialist team for advice.

For infected haemodialysis catheters (e.g. Vascaths or Permcaths), consult renal team for advice and refer to local Trust Guidelines on 'Haemodialysis Catheter Exit Site Infection' and 'Management of Haemodialysis Catheter Related Blood Stream Infection'.

Pathogen-specific line lock regimens:

- In the presence of CRBSI and/or systemic manifestation of infection, consult Consultant Microbiologist for systemic antimicrobial therapy. Antibiotic line lock alone will not treat systemic infection and should only be used as an adjunct to systemic antibiotics.
- Empirical systemic antimicrobial should be reviewed and optimised once the infecting organism is identified and its sensitivities are tested.
- Repeat blood cultures should be performed 72 hours into effective treatment to demonstrate clearance of bacteraemia/fungaemia.
- Choice of line lock treatment should be tailored to microbiology cultures and sensitivities.
- Antibiotic line lock therapy should not be used when the line is not the source of infection.

Pathogen	First-line management	Line lock agent (adjunct)
Candida (fungal)	• Remove the line • Give systemic antifungal therapy for at least 14 days after the first negative blood culture result	Not advised
Staphylococcus aureus	• Remove the line • Give systemic antibiotics for 14 days	Not advised
Pseudomonas	• Remove the line • Give systemic antibiotics for 7-14 days after the first negative blood culture result	Not advised
Gram-positive organisms (e.g. *coagulase-negative staphylococcus, enterococcus, corynebacteria*)	• Remove the line and give 3-5 days of systemic antibiotic **OR** • Retain the line, treat with 10-14 days of systemic antibiotic and 7-14 days of line lock therapy. Remove the line if deterioration or bacteraemia after 72 hours.	Vancomycin 5mg/mL
Gram-negative organisms (e.g. *E. coli, Klebsiella spp., Proteus spp., Enterobacter spp.*) – excluding *Pseudomonas*	• Remove the line and give 7 days of systemic antibiotic **OR** • Retain the line and treat with systemic antibiotic and line lock therapy for no more than 14 days. Remove the line if deterioration or bacteraemia after 72 hours.	Gentamicin 1mg/mL
Gentamicin-resistant organisms	Consult Consultant Microbiologist	

Lumen volume:

- The internal fill volume of different catheters varies. Always check the lumen volume of the line in situ. If unsure, consult vascular access team.
- The volume instilled should be no greater than the internal volume of the catheter.
- Treat each lumen of the CVC.

Type of CVC catheter	Lumen volume
Tunnelled access catheters (Hickman line, Vascath, Portacaths)	2mL per lumen
Temporary jugular or femoral lines	0.5mL per lumen
PICC line (single/double lumen)	2mL per lumen

Duration/ dwell time:

- Antibiotic line lock should be left in each lumen for up to 24 hours where possible. Please discuss with Antimicrobial Pharmacist if needing to use the IV line during the day, so that they can advise on IV medicines management for the patient.
- If line must be used because alternative access cannot be established, the lock must be removed before infusion of other intravenous medicines or solutions, and the line lock must be replaced following completion of infusion.
- Maximum dwell time should not exceed 48 hours. Exception is renal replacement therapy CVC where the line lock can dwell in the catheter between sessions for up to 72 hours.
- Use antibiotic line lock for a minimum of 7 days, preferably 14 days.

Preparing antibiotic line lock:

- The final concentration of line lock is essential.
- Use aseptic non-touch technique to prepare and administer.
- The line lock must be in a 10mL luer syringe **irrespective of final volume of the line**.

Antibiotic lock	Concentration of final lock solution	Reconstitution
Vancomycin	5mg/mL in 10mL	• Reconstitute a 500mg vancomycin vial with 10mL of water for injection. This gives a 50mg/mL solution. • Draw up 1mL of the reconstituted solution into a 10mL syringe. • Further dilute by drawing up 9mL of sodium chloride 0.9% into the 10mL syringe. • Label the syringe with patient details, antibiotic name, concentration, reconstitution date and time, and expiry date and time. • Administer line lock based on lumen volume (see 'Lumen volume'. Repeat this process for each lumen.
Gentamicin	1mg/mL in 10mL	• Draw up 0.25mL of an 80mg/2mL gentamicin solution vial into a 1mL syringe with a blunt filter needle. • Select a 10mL syringe and pull back the plunger. Transfer the 0.25mL into the 10mL syringe barrel. Dilute with sodium chloride 0.9% to a total volume of 10mL. • Gently mix. • Label the syringe with patient details, antibiotic name, concentration, reconstitution date and time, and expiry date and time. • Administer line lock based on lumen volume (see 'Lumen volume'. Repeat this process for each lumen.

Administering antibiotic line lock:

- Antibiotic line lock should be prescribed on the intravenous antimicrobial section of the inpatient drug chart.
- Prior to administration check patient identification and confirm allergy status.
- Check the prescription to ensure correct antibiotic choice, lumen volume and concentration.
- Use aseptic non-touch technique throughout the process of preparing and administering antimicrobial line locks.
- Check patency of the CVC by aspirating blood from the lumen. Aspirate the previous antibiotic line lock from the lumen.
- Flush CVC with 10mL sodium chloride 0.9%.

- Administer the line lock into **each lumen.**
- Administer the line locks as prescribed until results from blood cultures are negative. Frequency and duration as per 'Pathogen-specific line lock regimens'.
- Ideally the line lock should be left in place for 24 hours.
    - If the line must be used because alternative access cannot be established, then the line should be locked for at least 12 hours. If there is more than one lumen then lock each lumen for at least 12 hours. Consult Antimicrobial Pharmacy Team if this is an issue.
- For each lumen that contains a line lock, complete and attach an 'injectable medicines' label.
- After dwell time is complete, aspirate the antibiotic line lock from the lumen.
    - If unable to aspirate flush the line lock through the lumen with 10mL sodium chloride 0.9% to check patency (refer to local Trust Central Venous Access Device policy if any issues).
- Flush lumen with 10mL sodium chloride 0.9%.
- Administer next antimicrobial line lock as prescribed.

References:

Berrington A, Gould F K [2001] Use of antibiotic locks to treat colonized central venous catheters *Journal of Antimicrobial Chemotherapy* 48, pp597-603

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Annex 5 Antifungals

Guideline for management of invasive candidiasis in non-neutropenic* patients

This guideline is designed for the management of invasive candidiasis only, if infection with other fungi (such as aspergillus or mucor) are suspected, then please discuss with microbiology.

*For immunocompromised patients, please refer to local Trust guidelines on management of Invasive Fungal Infections in Neutropenia instead.

A) Empirical therapy

Empiric antifungal therapy should be considered in critically ill patients with risk factors for invasive candidiasis and no other known cause of fever (IDSA guidelines 2016), considering the following clinical factors and diagnostic markers:

Clinical risk factors

- Recent intra-abdominal surgery or signs of intra-abdominal infection.
  - particularly suspected anastomotic leak or necrotising pancreatitis.
- Central lines.
  - particularly when used for parenteral nutrition or haemofiltration.
- Corticosteroid therapy.

Diagnostic markers

- Positive serum beta-D-glucan (BDG).
  - BDG is a highly sensitive biomarker of invasive fungal infection.
- Isolation of Candida species from non-sterile sites, particularly line sites and tips.
  - Identification of *Candida spp.* from respiratory samples usually indicates colonisation and is rarely an indicator for treatment.
- Isolation of Candida from sterile sites always requires treatment (see section B below).

Empirical management

- If clinical suspicion of invasive candidiasis is high based on a combination of clinical risk factors and diagnostic markers, initiate therapy as follows:
  - Anidulafungin IV 200mg loading dose, followed by 100 mg OD.
- If known to be colonised with fluconazole susceptible Candida spp., fluconazole may be considered instead:
  - Fluconazole IV 800mg loading dose, followed by 400 mg OD.
- Ensure appropriate samples are taken including:
  - Blood cultures, particularly from indwelling lines,
  - Serum beta-D-glucan assay (BDG).
- Review of potential sources and source control is strongly advised, particularly where a line associated or intra-abdominal infection is suspected.
- Empirical therapy should be reviewed at 72 h, depending on response to treatment, and again with the results of the BDG. If the BDG is negative, invasive candidiasis is unlikely - consider discontinuing therapy.

- Empirical treatment should not usually be continued beyond 5-7 days unless there is very strong evidence for invasive candidiasis.

B) Treatment of confirmed invasive candidiasis, including candidaemia

Isolation of *Candida spp.* from sterile sites, particularly blood cultures, requires urgent initiation of antifungal therapy and source control.

Immediate actions

- Initiate therapy with anidulafungin IV 200mg loading dose, then 100mg OD.
- If the isolate is known to be fluconazole susceptible, consider initiating fluconazole 800 mg loading dose, then 400 mg OD, instead.
- Change all affected central lines.
- Review for potential sources and metastatic spread which may require an echocardiogram, and also fundoscopy to exclude retinal involvement.

Follow-up

- Repeat blood cultures after 48 h of treatment to ensure clearance of any candidaemia.
- Total duration of treatment should be 14 days from the last positive culture.
- An oral switch may be considered in certain cases, in discussion with Microbiology.

References

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Annex 6 Varicella Zoster Immunoglobulin, Hepatitis B Immunoglobulin, Human Rabies Immunoglobulin and Rabies Vaccine

Please note that many of these disease-specific immunoglobulins are centrally held by UKHSA at Colindale due to ongoing shortages. Therefore, risk assessment and eligible requests should be made promptly, ideally during working hours, taking into account the cut-off time for patient to receive these products since the day of exposure, to ensure sufficient time is allowed for the delivery and administration of these products prior to the cut-off time.

They should NOT be confused with Normal Human Immunoglobulin (IVIg/ SCIg).

Stock holding at ULHT (reviewed on 06/10/2021)

Product	ULHT Stock holding	How to request?
Varicella Zoster Immunoglobulin	0	Stock is held centrally by UKHSA Colindale. See section below.
Hepatitis B Immunoglobulin	0	
Rabies Immunoglobulin	0	
Rabies Vaccine	4 x 2.5units/mL syringes	Stock is held at Pilgrim Hospital. See section below.

Stock holding at NLaG (reviewed on 06/01/2022)

Product	NLaG Stock Holding		How to request?
	DPoWH	SGH	
Varicella Zoster Immunoglobulin	0	0	Stock is held centrally by UKHSA Colindale. See section below.
Hepatitis B Immunoglobulin	1	1	Fill – relevant paper work and return to pharmacy procurement team
Rabies Immunoglobulin	0	0	Stock is held centrally by UKHSA Colindale. See section below.
Rabies Vaccine	4 x 2.5units/mL syringes	4 x 2.5units/mL syringes	Fill – relevant paper work and return to pharmacy procurement team. Vaccine not to be issued until authorised by PHE.

Process to risk assess patient and request the product:

Step 1: Access the national guidance

Varicella Zoster Immunoglobulin (VZIg):
https://www.gov.uk/government/publications/varicella-zoster-immunoglobulin

Hepatitis B Immunoglobulin (HBIg):
https://www.gov.uk/government/publications/immunoglobulin-when-to-use
https://www.gov.uk/government/collections/hepatitis-b-guidance-data-and-analysis

Human Rabies Immunoglobulin (HRIg) and Rabies Vaccine:
https://www.gov.uk/government/publications/rabies-post-exposure-prophylaxis-management-guidelines
https://www.gov.uk/government/publications/immunoglobulin-when-to-use/rabies-and-immunoglobulin-service-rigs
https://www.gov.uk/government/publications/immunoglobulin-when-to-use/rabies-human-rabies-immunoglobulin-hrig--2

Step 2: Complete the risk assessment and check eligibility

The risk assessment should be completed by a doctor/nurse who has access to information about the nature of contact, days since exposure and specific antibody testing result.

Patient group	VZIg eligible time frame since exposure, if indicated
Pregnant	Within 10 days
Neonates/infants	Preferably within 7 days
Immunocompromised	Preferably within 7 days

HBIg and Hepatitis B vaccine eligible time frame since exposure, if indicated	Comment
Given at the same time as Hepatitis B vaccine (but different site) as soon as possible, preferably within 24 hours and ideally within 48 hours after exposure – but no later than a week after exposure.	Hepatitis B vaccine should never be delayed while waiting for HBIg administration.

HRIg and Rabies vaccine eligible time frame since exposure, if indicated	Comment
The first dose of Rabies vaccine should ideally be given within 24 hours of exposure. HRIG not required if more than 7 days after first dose of vaccine, or more than 1 day after the second dose or for partially immunised patients (unless immunosuppressed). Due to the potentially long incubation period for rabies there is no time limit for giving post-exposure treatment and all potential exposures should be risk assessed.	Rabies vaccine should never be delayed while waiting for HRIg administration. See 'Rabies Vaccine' section.

Step 3: Contact UKHSA Colindale

If patient meets the criteria to receive one of these products, the requestor should contact UKHSA Colindale on 0330 128 1020 between 8am to 7pm on Monday to Friday, and 9am to 7pm on Saturday and Sunday.

Outside these hours, if the request can wait until the next day, contact UKHSA Colindale on the next morning.

If the request cannot wait (i.e. patient presents close to or on Day 7/ Day10 since exposure), contact UKHSA Colindale on the same number to reach their on-call doctor.

Step 4: Complete the request form
This will be done between UKHSA Colindale and the requestor over the phone.

Step 5: Contact hospital Pharmacy
Once the request is approved by UKHSA Colindale, the requestor should prepare a prescription and contact the hospital Pharmacy department to make them aware of the request and expect a delivery. Outside working hours, notify the on-call pharmacist via the site-duty manager to be prepared to receive the delivery.

Please note UKHSA Colindale's courier Movianto will only deliver the product to hospital Pharmacy/ on-call pharmacist due to the cold chain requirement and quality assurance upon receipt.

Step 6: Product received and dispensed by Pharmacy
The pharmacy personnel/ on-call pharmacist should check that the packaging is intact on receipt and the case reference note that comes with delivery matches the patient details on the prescription. Note the storage requirement of these products. Dispense the product as per usual dispensing process.

Rabies Vaccine

If patient meets the criteria to receive Rabies vaccine, even when HRIg is not indicated, the requestor should still contact UKHSA Colindale on 0330 128 1020 for approval between 8am to 7pm on Monday to Friday, and 9am to 7pm on Saturday and Sunday.

If outside these hours, administer the vaccine (if patient meets the criteria) and contact UKHSA Colindale on the next day.

UKHSA Colindale will only replenish the local stock if the request has been approved by them.

UKHSA Colindale may request the Trust to supply the first dose of vaccine to local GPs in emergency cases. These requests should come from UKHSA Colindale directly and the local stock will be replenished subsequently.

Annex 7 Guidance on antimicrobial prescribing in extremes of body weight (Adults)

This guide is intended to provide antimicrobial dosing information on extremes of body weight, to allow healthcare professionals to prescribe appropriate doses for adult patients. The information in this guide has been adapted from various resources which are listed as references in this document. This document does not contain information on dosing in adults with healthy weight and normal renal function. Please refer to British National Formulary (BNF), Summary of Product Characteristic (SPC) and Trust guideline on Antibiotic Doses in Renal Impairment if you require this information.

The World Health Organisation (WHO) and The National Institute of Health and Care Excellence (NICE)1 have both defined weight categories based on a person's Body Mass Index (BMI) as follows:

- Underweight: <18.5 kg/m^2
- Healthy weight: 18.5-24.9 kg/m^2
- Overweight: 25-29.9 kg/m^2
- Obesity: ≥30 kg/m^2 or more

Adults with a BMI greater than 30 kg/m^2, or Actual Body Weight (ABW) being more than 20% of calculated Ideal Body Weight (IBW), are defined as obese. BMI is rarely used for dosing, but gives an indication on of the patient's stature. BMI should however be used with caution as may give an inaccurate picture in some patient groups. For example: highly muscular adults; adults of Asian, black African or African-Caribbean descent; or in elderly patients.

Due to the variable alterations in the volume of distribution, clearance and elimination half-life in obesity dosing adjustments can be complex. When using Ideal Body Weight (IBW), there is an assumption that the Excess Body Weight (EBW) has no influence on pharmacokinetics of drugs. However, the adipose tissue does have some vasculature and fluid, and in fact will usually have some influence. This can be accounted for by the Dose Weight Correction Factor, which a value of 0.4 is often assumed. This gives the Adjusted Body Weight (AdjBW), which has been found to provide a more accurate dosing with hydrophilic drugs, particularly aminoglycosides.
An increased proportion of adipose tissue compared with a lean tissue alters the volume of distribution of lipophilic drugs; therefore, Total Body Weight (TBW)/ Actual Body Weight (ABW) should generally be used for dosing.

In obese patients, the glomerular filtration rate (GFR) may be increased relative to a "normal" patient, so in theory drug clearance may be increased. However, complications of obesity, including diabetes and hypertension, may reduce clearance, so may negate this. Calculation of creatinine clearance using the Cockcroft & Gault method in obese patients should use Lean Body Weight (LBW) (or Maximum Body Weight (MBW)), since muscle mass is proportionately much less in obese patients.

Note: Do not confuse between Actual Body Weight (ABW) and Adjusted Body Weight (AdjBW)

Table 1.0 Common measures of weight

Descriptor	Abbreviation	Calculation
Total Body Weight/ Actual Body Weight	TBW (kg)/ ABW (kg)	Weight (kg)
Body Mass Index	BMI (kg/m^2)	Weight (kg)/ height(m^2) x height (m^2)
Ideal Body Weight	IBW (kg)	Male: 50kg + (2.3kg x no. of inches over 5 feet) using height in feet and inches OR 50kg + (0.91 x (height in cm – 152.4)) Female: 45kg + (2.3kg x no. of inches over 5 feet) using height in feet and inches OR 45kg + (0.91 x (height in cm – 152.4))
Maximum Body Weight	MBW (kg)	IBW x 1.2
Adjusted Body Weight	AdjBW (kg)	IBW + (0.4* x (ABW-IBW)) *0.4 is a commonly used Weight Correction Factor (WCF). Different WCF may be recommended for certain dosing regimens.
Lean Body Weight	LBW (kg)	Males = (9270 x ABW in kg) / [6680+(216 x BMI)] Females = (9270 x ABW in kg) / [8780+(244 x BMI)]
Excess Body Weight	EBW (kg)	TBW (or ABW) – IBW

Table 2.0 Calculated IBW and MBW

Height – metric	Height – imperial	IBW (male)	MBW (male)	IBW (female)	MBW (female)
152cm	5ft 0”	49.5Kg	60Kg	45.0Kg	54Kg
158cm	5ft 2”	54.9Kg	66Kg	50.4Kg	60Kg
163cm	5ft 4”	59.3Kg	71Kg	54.8Kg	66Kg
168cm	5ft 6”	63.8Kg	77Kg	59.3Kg	71Kg
173cm	5ft 8”	68.2Kg	82Kg	63.7Kg	76Kg
178cm	5ft 10”	72.7Kg	87Kg	68.2Kg	82Kg
183cm	6ft 0”	77.1Kg	93Kg	72.6Kg	87Kg

R These agents are restricted antimicrobials. Please refer to the Antimicrobial List in Section 3.1 for approved indications or contact microbiology for advice.

ABW = Actual Body Weight
IBW = Ideal Body Weight
AdjBW = Adjusted Body Weight
MBW = Maximum Body Weight
LBW = Lean Body Weight

Drug	Dosing in Underweight Patients	Dosing in Obese Patients	Comments	References
Aciclovir (IV)	No information available, use ABW	Calculate dose based on IBW, taking renal function into account	Literature describes acute kidney injury (AKI) in obese patients where aciclovir dose was based on actual body weight	1. United Kingdom Clinical Pharmacy Association. Critical Care Group. Drug Dosing in extremes of body weight 1st Edition. Sep 2013. 2. Wockhardt UK Ltd. Aciclovir 250mg Powder for Solution for Infusion. Available from: https://www.medicines.org.uk/emc/medicine/20512 [Accessed May 2021]. 3. Joint Formulary Committee. British National Formulary Ed. 74. London: BMJ Group and Pharmaceutical Press; 2017.
Ambisome® (Liposomal Amphotericin) (IV)	No information available, use ABW	Manufacturer recommends dosing on ABW, suggest monitoring for toxicity.	Consider rounding the dose to the nearest 50mg	1. United Kingdom Clinical Pharmacy Association. Critical Care Group. Drug Dosing in extremes of body weight 1st Edition. Sep 2013.
Amikacin (IV)	Use ABW and monitor serum levels	Use AdjBW for loading and maintenance doses, taking renal function into account and monitor serum levels regularly	R Alternatively, the BNF advises that IBW can be used to calculate doses in obese patients, with close monitoring of the serum concentrations	1. United Kingdom Clinical Pharmacy Association. Critical Care Group. How should antibiotics be dosed in obesity? March 2017. 2. Joint Formulary Committee. British National Formulary Ed. 74. London: BMJ Group and Pharmaceutical Press; 2017.
Anidulafungin (IV)	No dosing adjustments are required	No dosing adjustments are required	R	1. Pfizer Ltd. ECALTA 100 mg powder for concentrate for solution for infusion. Available from: https://www.medicines.org.uk/emc/product/454 [Accessed May 2021].
Benzylpenicillin (IV)	No information available, use standard dose for adults	Dosing should be at the upper end of the dosing limit, taking into account renal function, particularly in morbidly obese patients with severe infections		1. Joint Formulary Committee. British National Formulary Ed. 74. London: BMJ Group and Pharmaceutical Press; 2017. 2. United Kingdom Clinical Pharmacy Association. Critical Care Group. Drug Dosing in extremes of body weight 1st Edition. Sep 2013. 3. United Kingdom Clinical Pharmacy Association. Critical Care Group. How should antibiotics be dosed in obesity? March 2017.
Cefalexin (PO)	No information available, use standard dose for adults	Dosing should be at the upper end of the dosing limit, taking into account renal and hepatic function	R for all cephalosporins	1. Sandoz Ltd. Cefalexin 500mg Capsules. Available from: https://www.medicines.org.uk/emc/product/3998/smpc [Accessed on May 2021]. 2. United Kingdom Clinical Pharmacy Association. Critical Care Group. Drug Dosing in extremes of body weight 1st Edition. Sep 2013. 3. United Kingdom Clinical Pharmacy Association. Critical Care Group. How should antibiotics be dosed in obesity? March 2017.

Drug	Dosing in Underweight Patients	Dosing in Obese Patients	Comments	References
Cefotaxime (IV)	No information available, use standard dose for adults	Dosing should be at the upper end of the dosing limit, taking into account renal and hepatic function	Studies involving cephalosporins appear to suggest that as hydrophilic drugs, standard doses will achieve adequate plasma level. However higher than normal doses may be required to achieve adequate levels in subcutaneous adipose tissue	1. United Kingdom Clinical Pharmacy Association. Critical Care Group. Drug Dosing in extremes of body weight 1st Edition. Sep 2013. 2. United Kingdom Clinical Pharmacy Association. Critical Care Group. How should antibiotics be dosed in obesity? March 2017. 3. Wockhardt UK Ltd. Cefotaxime 2g Powder for solution for injection or infusion. Available from: https://www.medicines.org.uk/emc/product/6796 [Accessed May 2021].
Ceftazidime (IV)	No information available, use standard dose for adults	Dosing should be at the upper end of the dosing limit, taking into account renal and hepatic function		1. United Kingdom Clinical Pharmacy Association. Critical Care Group. Drug Dosing in extremes of body weight 1st Edition. Sep 2013. 2. United Kingdom Clinical Pharmacy Association. Critical Care Group. How should antibiotics be dosed in obesity? March 2017. 3. Wockhardt UK Ltd. Ceftazidime 1g Powder for solution for injection. Available from: https://www.medicines.org.uk/emc/product/6346 [Accessed May 2021].
Ceftriaxone (IV)	No information available, use standard dose for adults	Dosing should be at the upper end of the dosing limit (2g OD/BD), taking into account renal and hepatic function		1. United Kingdom Clinical Pharmacy Association. Critical Care Group. Drug Dosing in extremes of body weight 1st Edition. Sep 2013. 2. United Kingdom Clinical Pharmacy Association. Critical Care Group. How should antibiotics be dosed in obesity? March 2017. 3. Wockhardt UK Ltd. Ceftriaxone 1g powder for solution for injection vials. Available from: https://www.medicines.org.uk/emc/product/8754 [Accessed May 2021].
Cefuroxime (IV)	No information available, use standard dose for adults	Dosing should be at the upper end of the dosing limit, taking into account renal and hepatic function	R Studies involving cephalosporins appear to suggest that as hydrophilic drugs, standard doses will achieve adequate plasma level. However higher than normal doses may be required to achieve adequate levels in subcutaneous adipose tissue	1. United Kingdom Clinical Pharmacy Association. Critical Care Group. Drug Dosing in extremes of body weight 1st Edition. Sep 2013. 2. United Kingdom Clinical Pharmacy Association. Critical Care Group. How should antibiotics be dosed in obesity? March 2017. 3. Flynn Pharma Ltd. Cefuroxime 1.5g powder for solution for injection or infusion. Available from: https://www.medicines.org.uk/emc/product/9423 [Accessed May 2021].

Drug	Dosing in Underweight Patients	Dosing in Obese Patients	Comments	References
Ciprofloxacin (IV)	No additional information available however mg/kg dosing can be used (calculated using ABW)	Conflicting data regarding pharmacokinetics in obesity. Use standard dose for adults in mild infections. Consider increased dosing in severe infections, calculated using AdjBW as below: IBW + (0.45 x (ABW-IBW)) and 4-5mg/kg every 8 to 12 hourly	R It is also suggested that 600mg BD is better than 400mg TDS as this improves C_{max}:MIC ratio	1. United Kingdom Clinical Pharmacy Association. Critical Care Group. Drug Dosing in extremes of body weight 1st Edition. Sep 2013. 2. United Kingdom Clinical Pharmacy Association. Critical Care Group. How should antibiotics be dosed in obesity? March 2017. 3. Hospira UK Ltd. Ciprofloxacin 2 mg/ml Solution for Infusion. Available from: https://www.medicines.org.uk/emc/product/419 [Accessed May 2021].
Clarithromycin (IV)	No information available, use standard dose for adults	No information available, use standard dose for adults		1. United Kingdom Clinical Pharmacy Association. Critical Care Group. Drug Dosing in extremes of body weight 1st Edition. Sep 2013. 2. United Kingdom Clinical Pharmacy Association. Critical Care Group. How should antibiotics be dosed in obesity? March 2017.
Clindamycin (IV)	No information available, use standard dose for adults	Serious life threatening infections - use doses up to 4.8g daily in four divided doses.	R Doses of <10mg/kg/24hours in morbidly obese patients have been shown to be associated with higher rates of treatment failure.	1. United Kingdom Clinical Pharmacy Association. Critical Care Group. Drug Dosing in extremes of body weight 1st Edition. Sep 2013. 2. United Kingdom Clinical Pharmacy Association. Critical Care Group. How should antibiotics be dosed in obesity? March 2017. 3. Bowmed Ibisqus Ltd. Clindamycin 600mg/4ml solution for injection ampoules (150mg/ml in 4 ml ampoules). Available from: https://www.medicines.org.uk/emc/product/8837 [Accessed May 2021].
Colistimethate sodium (IV)	Use standard dose for adults	Use standard dose for adults	R Monitor for renal toxicity.	1. United Kingdom Clinical Pharmacy Association. Critical Care Group. How should antibiotics be dosed in obesity? March 2017. 2. Beacon Pharmaceuticals. Colistimethate Sodium 1 Million I.U. Powder for Solution for Injection. Available from: https://www.medicines.org.uk/emc/product/5648 [Accessed May 2021].

Drug	Dosing in Underweight Patients	Dosing in Obese Patients	Comments	References
Co-trimoxazole (PO & IV)	No information available, use ABW	In obesity, doses of up to 120mg/kg/day have been used. Take renal function into account when choosing a dose for the patient.	R Although co-trimoxazole is hydrophilic, low doses in morbidly obese patients have been associated with higher rates of treatment failure. Inadequate oral doses of <5mg/kg/24hrs of Trimethoprim have been shown to worsen outcomes in morbidly obese patients for PCP treatment. Consider using ABW in severe infections however there is no data to support this. Clinical outcomes should be closely monitored.	1. United Kingdom Clinical Pharmacy Association. Critical Care Group. Drug Dosing in extremes of body weight 1st Edition. Sep 2013. 2. United Kingdom Clinical Pharmacy Association. Critical Care Group. How should antibiotics be dosed in obesity? March 2017. 3. Aspen. Co-Trimoxazole 80 mg/400 mg Tablets. Available from: https://www.medicines.org.uk/emc/product/6999 [Accessed May 2021]. 4. Aspen. Co-Trimoxazole for infusion 16 mg/ 80mg per ml. Available from: https://www.medicines.org.uk/emc/product/4669 [Accessed May 2021]. 5. Janson B., Thursky K. Dosing of antibiotics in obesity. Curr Opin Infect Dis. 2012 Dec; 25(6):634-49.
Daptomycin (IV)	No information available, use ABW for dosing	Use ABW to calculate the dose. Monitor for toxicity and adjust dose for renal impairment.	R As daptomycin displays a concentration-dependent pharmacodynamic effect, dosing based on IBW may fail to achieve adequate concentration. Exposure increased by 28-42% when dose is based on ABW. This is still well tolerated in individuals ranging from 56-147kg. No dosing reduction is required. Monitor Creatine Phosphokinase (CPK) at baseline and at least weekly during treatment.	1. United Kingdom Clinical Pharmacy Association. Critical Care Group. Drug Dosing in extremes of body weight 1st Edition. Sep 2013. 2. United Kingdom Clinical Pharmacy Association. Critical Care Group. How should antibiotics be dosed in obesity? March 2017. 3. Janson B., Thursky K. Dosing of antibiotics in obesity. Curr Opin Infect Dis. 2012 Dec;25(6):634-49. 4. Merck Sharp & Dohme Ltd. Cubicin 500 mg powder for solution for injection or infusion. Available from: https://www.medicines.org.uk/emc/product/8124 [Accessed May 2021].
Doxycycline (PO)	Use standard dose for adults	Use standard dose for adults		1. United Kingdom Clinical Pharmacy Association. Critical Care Group. Drug Dosing in extremes of body weight 1st Edition. Sep 2013. 2. United Kingdom Clinical Pharmacy Association. Critical Care Group. How should antibiotics be dosed in obesity? March 2017

Drug	Dosing in Underweight Patients	Dosing in Obese Patients	Comments	References
Ertapenem (IV)	Use standard dose for adults	Use standard dose for adults. See comments	R Standard 1g dose may not provide adequate concentration in obese patients for organisms with a MIC in excess of 0.25-0.5µg/mL. These organisms include: *Strep. Pneumoniae, oxacillin susceptible coagulase negative staphylococci, Acinetobacter spp. and Pseudomonas aeruginosa.* Contact Microbiologist in such cases.	1. United Kingdom Clinical Pharmacy Association. Critical Care Group. Drug Dosing in extremes of body weight 1st Edition. Sep 2013. 2. United Kingdom Clinical Pharmacy Association. Critical Care Group. How should antibiotics be dosed in obesity? March 2017 3. Janson B., Thursky K. Dosing of antibiotics in obesity. Curr Opin Infect Dis. 2012 Dec; 25(6):634-49. 4. Merck Sharp & Dohme Ltd. INVANZ 1g powder for concentrate for solution for infusion. Available from: https://www.medicines.org.uk/emc/product/1713 [Accessed May 2021].
Erythromycin (PO & IV)	No information available, use standard dose for adults	No information available, use standard dose for adults		1. Janson B., Thursky K. Dosing of antibiotics in obesity. Curr Opin Infect Dis. 2012 Dec;25(6):634-49.
Flucloxacillin (IV)	No information available, use standard dose for adults	Doses should be at the upper end of the dosing range, taking into account patient's renal and liver function	.	1. Bowmed Ibisqus Ltd. Flucloxacillin 1g powder for solution for injection vials. Available from: https://www.medicines.org.uk/emc/product/8745 [Accessed May 2021]. 2. United Kingdom Clinical Pharmacy Association. Critical Care Group. Drug Dosing in extremes of body weight 1st Edition. Sep 2013.
Fluconazole (PO & IV)	No information available, use standard dose for adults	No sufficient information available to recommend dosing adjustment. Use standard dosing for adults, up to 800mg once a day		1. United Kingdom Clinical Pharmacy Association. Critical Care Group. Drug Dosing in extremes of body weight 1st Edition. Sep 2013. 2. Consilient Health Ltd. Fluconazole 2 mg/ml solution for infusion. Available from: https://www.medicines.org.uk/emc/product/648 [Accessed May 2021].
Gentamicin (IV)	Refer to Section 3.4.3.2 of this guidance	Refer to Section 3.4.3.2 of this guidance	BNF advised to use IBW for initial dosing in obese patients but this may lead to sub-therapeutic serum concentrations. Recent evidence suggested that using AdjBW accounts for gentamicin distribution into adipose tissues that contain small amount of water. AdjBW can be used to determine the initial doses as below: (IBW + (0.4 x (ABW-IBW))	1. United Kingdom Clinical Pharmacy Association. Critical Care Group. Drug Dosing in extremes of body weight 1st Edition. Sep 2013. 2. United Kingdom Clinical Pharmacy Asociation. Critical Care Group. How should antibiotics be dosed in obesity? March 2017 3. Wockhardt UK Ltd. Gentamicin 10mg/ml Solution for Injection or Infusion. Available from: https://www.medicines.org.uk/emc/product/2407 [Accessed May 2021].

Drug	Dosing in Underweight Patients	Dosing in Obese Patients	Comments	References
Levofloxacin (IV & PO)	No information available, use standard dose for adults	Use standard dose for adults as there is too little information available	R	1. United Kingdom Clinical Pharmacy Association. Critical Care Group. Drug Dosing in extremes of body weight 1st Edition. Sep 2013. 2. United Kingdom Clinical Pharmacy Association. Critical Care Group. How should antibiotics be dosed in obesity? March 2017 3. Bowmed Ibisqus Limited. Levofloxacin 500mg/100ml solution for infusion vials (5mg/ml in 100ml vials). Available from: https://www.medicines.org.uk/emc/product/8839 [Accessed May 2021].
Linezolid (IV & PO)	No clinical studies have used underweight patients. Use standard dose for adults.	Use standard dose for adults. Limited data from two trials suggested no dose increase is required in patients weigh up to 150kg.	R Standard doses in patients up to 150kg have been showed to provide AUC concentrations similar to normal weight patients. Fleming et. al. recommended 600mg every 8 hours for patients weigh over 120kg but more large-scale trial is needed. Lean body weight should be used for patients with cystic fibrosis.	1. United Kingdom Clinical Pharmacy Association. Critical Care Group. Drug dosing in extremes of body weight 1st Edition. Sep 2013. 2. United Kingdom Clinical Pharmacy Association. Critical Care Group. How should antibiotics be dosed in obesity? March 2017 3. Aurobindo Pharma. Linezolid 600mg film-coated tablets. Available from: https://www.medicines.org.uk/emc/product/2308#PHARMACOKINETIC_PROPS [Accessed May 2021]. 4. Fleming MR, Cheatham SC and Kays MB. Evaluation of clinical outcomes and adverse events when administering alternative doses of linezolid to obese patients [abstract]. Pharmacotherapy 2011; 31; 353e.
Meropenem (IV)	No information available, use standard dose for adults	Use standard dose for adults. See comments.	R In critically ill, morbidly obese patients with severe infections, consider using the upper end of recommended treatment ranges as continuous infusion. Consult Microbiologist for advice.	1. United Kingdom Clinical Pharmacy Association. Critical Care Group. Drug dosing in extremes of body weight 1st Edition. Sep 2013. 2. United Kingdom Clinical Pharmacy Association. Critical Care Group. How should antibiotics be dosed in obesity? March 2017. 3. Alobaid et al. What is the effect of obesity on piperacillin and meropenem trough concentration in critically ill patients? Journal of Antimicrobial Chemotherapy 2016;71:696-702 4. Pfizer Ltd. Meronem IV 500mg & 1g. Available from: https://www.medicines.org.uk/emc/product/6731#PHARMACODYNAMIC_PROPS [Accessed on 1 Mar 2018].

Drug	Dosing in Underweight Patients	Dosing in Obese Patients	Comments	References
Metronidazole (IV & PO)	No information available, use standard dose for adults. 20-30mg/kg/day in three divided doses can be used.	Use standard dose for adults.		1. United Kingdom Clinical Pharmacy Association. Critical Care Group. Drug dosing in extremes of body weight 1st Edition. Sep 2013. 2. United Kingdom Clinical Pharmacy Association. Critical Care Group. How should antibiotics be dosed in obesity? March 2017. 3. Baxter Healthcare Ltd. Metronidazole 500 mg/ 100 ml Intravenous Infusion. Available from: https://www.medicines.org.uk/emc/product/1842 [Accessed May 2021]. 4. Aurobindo Pharma - Milpharm Ltd. Metronidazole 200mg Tablets. Available from: https://www.medicines.org.uk/emc/product/12348/smpc [Accessed May 2021].
Piperacillin/ Tazobactam (IV)	For adults weigh ≤ 40kg, use 90-112.5mg/kg (max 4.5g) every 8 hours.	Consider using 4.5g every 6 hours for patients with CrCL > 50mL/min. Adjust dose according to renal function.	R	1. United Kingdom Clinical Pharmacy Association. Critical Care Group. Drug dosing in extremes of body weight 1st Edition. Sep 2013. 2. United Kingdom Clinical Pharmacy Association. Critical Care Group. How should antibiotics be dosed in obesity? March 2017. 3. Bowmed Ibisqus Limited. Piperacillin 4g / Tazobactam 500mg powder for solution for infusion vials. Available from: https://www.medicines.org.uk/emc/product/8771#PHARMACOKINETIC_PROPS [Accessed May 2021].
Rifampicin (IV & PO)	*Tuberculosis and Leprosy:* For adult weight < 50kg, use 450mg od. For adult weight ≥ 50kg, use 600mg od. *Other indications:* Refer to the SPC.	Refer to the SPC for weight-based dosing for different indications. Use IBW to calculate the dose. Maximum 600mg every 12 hours per day.	R Adjust dose according to liver and renal functions.	1. United Kingdom Clinical Pharmacy Association. Critical Care Group. Drug dosing in extremes of body weight 1st Edition. Sep 2013. 2. United Kingdom Clinical Pharmacy Association. Critical Care Group. How should antibiotics be dosed in obesity? March 2017. 3. Sanofi. Rifadin for Infusion 600mg. Available from: https://www.medicines.org.uk/emc/product/1416 [Accessed May 2021]. 4. Sanofi. Rifadin 150mg capsules. Available from: https://www.medicines.org.uk/emc/product/6382 [Accessed May 2021].

Drug	Dosing in Underweight Patients	Dosing in Obese Patients	Comments	References
Teicoplanin (IV)	Use standard dose for adults calculated using ABW	Use standard dose for adults calculated using ABW. Monitor levels closely.	R No maximum dose stated.	1. United Kingdom Clinical Pharmacy Association. Critical Care Group. Drug dosing in extremes of body weight 1st Edition. Sep 2013. 2. United Kingdom Clinical Pharmacy Association. Critical Care Group. How should antibiotics be dosed in obesity? March 2017. 3. Sanofi. Targocid 200mg. Available from: https://www.medicines.org.uk/emc/product/2926 [Accessed May 2021].
Tigecycline (IV)	No information available, use standard dose for adults	No information available, use standard dose for adults	R In clinical trials, patient weight has ranged from 34kg to 200kg, and analysis of AUC and clearance did not appear to be different, suggesting there is no pharmacokinetic justification for dose adjustment based on body weight.	1. United Kingdom Clinical Pharmacy Association. Critical Care Group. Drug dosing in extremes of body weight 1st Edition. Sep 2013. 2. United Kingdom Clinical Pharmacy Association. Critical Care Group. How should antibiotics be dosed in obesity? March 2017. 3. Pfizer Limited. Tygacil 50mg powder for solution for infusion. Available from: https://www.medicines.org.uk/emc/product/200 [Accessed May 2021].
Voriconazole (IV & PO)	Dose as per the manufacturer's guidance.	Use IBW or AdjBW in morbidly obese patients but review on a case by case basis. Avoid using Actual Body Weight.		1. United Kingdom Clinical Pharmacy Association. Critical Care Group. Drug dosing in extremes of body weight 1st Edition. Sep 2013. 2. United Kingdom Clinical Pharmacy Association. Critical Care Group. How should antibiotics be dosed in obesity? March 2017. 3. Pfizer Ltd. VFEND 200mg film-coated tablets. Available from: https://www.medicines.org.uk/emc/product/8408 [Accessed May 2021].

Annex 8 Guidance on responding to chemical, biological, radiological and nuclear (CBRN) incidents

Public Health England have developed a document covering various aspects which will assist in management of casualties following major incidents of a chemical, biological, radiological or nuclear nature. This would be the reference point for antimicrobial recommendations when dealing with victims of terrorism attacks, if the attack fits any of these categories.

The full document can be accessed via the following link:
https://www.gov.uk/government/publications/chemical-biological-radiological-and-nuclear-incidents-recognise-and-respond