North Bristol NHS
NHS Trust

Antibiotic Guidelines
2020

These are empirical guidelines – treatment should be reviewed clinically at 48-72 hours with the results of clinical findings, pathology and imaging results, and microbiological cultures. Antimicrobials can then be stopped, switched to oral therapy, changed to a narrow spectrum agent or continued with further review.

Updated 27th March 2020 – Lower Respiratory Tract Infections SECTION and COVID-19 ADDENDUM

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INTRODUCTION

This document outlines the antimicrobial guidelines for North Bristol NHS Trust.

The guidelines are designed with the specific objective of reducing to a minimum the use of cephalosporins, fluoroquinolones and co-amoxiclav. These agents have been implicated as risk factors for the acquisition and infection with multidrug resistant bacteria such as MRSA and ESBL producing E.coli and Klebsiella species. In addition, they have been associated with increased risk of infection with Clostridium difficile and C.difficile associated diarrhoea.

The guidelines are based on policies used by other NHS Trusts in England to reduce the risk of these infections as well as data from Scandinavia and The Netherlands where hospital infections due to multi resistant bacteria and C.difficile are much rarer than in English hospitals.

It follows therefore that these recommendations are not always based on national guidelines either published in the British National formulary or by professional societies. In most cases, the guidelines have been developed by infection specialists and the relevant clinical specialities.

The guidelines should not be used in isolation but be cross-referenced with relevant specialty protocols, and also the Trust Infection Control policies, Microbiology User Guide and the Antibiotic Prescribing Policy. These are all available on the Microbiology homepage on the Trust Intranet.

This document can be found at:

http://homepage/Clinical_Support/Pathology/New%20Pathology%20Main%20Page/Microbiology/Microbiology.htm

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1.2 Switching from intravenous to oral therapy

Treatment which is initially administered by the parenteral route should be switched to the oral route as early as possible according to the following criteria. Where IV antibiotics are continuing beyond 72 hours there must be a reason stated in the notes.

- temperature <38°C for 24 hours and improvement clinically and in blood biomarkers of infection
- patient able to tolerate oral food and fluids
- absence of ongoing or potential problem of absorption
- required antibiotic concentrations can be achieved by oral therapy
- oral formulation or suitable alternative is available

Suggested options for oral step down therapy are listed in the table below.

IV therapy	**oral step down therapy**
amoxicillin	amoxicillin
amoxicillin + gentamicin + metronidazole	co-amoxiclav
azithromycin	azithromycin
clindamycin	clindamycin
co-trimoxazole	co-trimoxazole
co-trimoxazole + metronidazole	co-trimoxazole + metronidazole
ceftriaxone	consult a Medical Microbiologist
flucloxacillin	flucloxacillin
gentamicin	ciprofloxacin, co-trimoxazole or co-amoxiclav (pivmecillinam, nitrofurantoin or trimethoprim may be suitable for a simple UTI)
meropenem	consult a Medical Microbiologist
piperacillin-tazobactam	
vancomycin	

If a decision is made to continue with IV antibiotics then the rationale for this should be clearly recorded in the medical notes.

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1.3 Recommended Durations of Antibiotics

Antibiotic courses should comply with the following durations. Any exception should be documented in the medical notes.

Indication	Length of course
GI	
Peritonitis	5 days
appendicitis	5 days
pancreatitis	Not recommended
diverticulitis	5 days
Biliary tract infection	5 days
Typhoid fever	7-14 days
Gastro enteritis	not usually indicated
Oesophageal rupture	Discuss with a Medical Microbiologist
Antibiotic associated colitis	10 days
Peritoneal dialysis associated peritonitis	14 days
peritonitis in patients with liver cirrhosis	5 days
Prevention of infection in upper GI haemorrhage	5 days
Chest	
CAP high severity	5 days
CAP moderate severity	5 days
CAP low/mild severity	5 days
Acute exacerbation COPD	5 days
Aspiration pneumonia	5 days
HAP	5 days
acute exacerbations of bronchiectasis	14 days
CNS	
Meningitis	7-10 days
Brain abscesses, neurosurgical infections	Discuss with a Medical Microbiologist
Uro-genital	
Uncomplicated UTI	Males: 5 days, females: 3 days
Complicated UTI	5 days
Acute Pyelonephritis	7 days
Epididymo-orchitis	10 days
Prostatitis	28 days
Sepsis	
Sepsis	Depends on source - discuss with a Medical Microbiologist
Neutropenic sepsis	7 days
Skin, soft tissue and bone	
Cellulitis/ erysipelas	5 days
Animal and human bites	5 days
Wound infection following clean surgery	5 days
Wound infection following contaminated surgery	5 days
Perianal infection/abscess	5 days
Cellulitis at a cannula site	5 days
Cellulitis in a current injecting drug user	5 days
Mastitis and breast abscesses	5 days
Diabetes mellitus foot infection	7-14 days
Burn Wound Infection	5 days, 3 days if no pathogen isolated
Limb Abscess	7 days
Necrotising fasciitis	Discuss with a Medical Microbiologist
Prevention of infection during leech therapy	duration of contact

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Open fracture	72 hours or until soft tissue closure, whichever is sooner
Septic arthritis	4 weeks in total (5-7 days IV, remainder PO)
Acute Osteomyelitis – not related to prosthetic joints	minimum 6 weeks in total (5-10 days IV, remainder PO);
Orthopaedic infections with metalwork *in situ*	Discuss with a medical microbiologist
Cardiovascular	
Endocarditis	Discuss with a Medical Microbiologist
Obs & Gynae	
Pelvic Inflammatory Disease	14 days
Third or fourth degree perineal tears	5 days
Manual removal of the placenta	5 days
Hysterosalpingitis	7 days
Post op wound infection	5 days

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2. TREATMENT GUIDELINES

Suggested treatments are given below. They apply to adult patients with normal renal function. When the pathogen is isolated, treatment may be changed to a more appropriate antibacterial if necessary. If no bacterium is cultured the antibacterial can be continued or stopped on clinical grounds.

2.1 Gastro-intestinal system

Review antibiotics at 48-72 hours. Therapy should be amended once a definite pathogen has been identified.
IV antibiotics can be de-escalated once IV/oral switch criteria are met. Stop antibiotics if infection has been ruled out. Record all decisions in the notes. State the duration and indication on the drug chart.

Peritonitis	amoxicillin 1g TDS IV + gentamicin IV (see section 6.1 for dosing) + metronidazole 500mg TDS IV for 5 days Penicillin allergy: co-trimoxazole 960mg BD + metronidazole 500mg IV TDS + gentamicin IV If the patient's eGFR is <20ml/min, please discuss with a medical microbiologist. If there are concerns with the use of gentamicin, please discuss with a medical microbiologist. Do not just omit the gentamicin, an alternative is required. oral step down: co-trimoxazole 960mg BD + metronidazole 400mg TDS
Patients at high risk of emergency laparotomy	Co-trimoxazole 960mg IV BD + metronidazole 500mg IV TDS for 5 days
appendicitis	amoxicillin 1g TDS IV + gentamicin (see section 6.1 for dosing) + metronidazole 500mg TDS IV for 5 days oral step down: co-trimoxazole 960mg BD + metronidazole 400mg TDS If the patient's eGFR is <20ml/min, please discuss with a medical microbiologist.
pancreatitis	Not recommended. Consult a Medical Microbiologist
diverticulitis	amoxicillin 1g TDS IV + gentamicin (see section 6.1 for dosing) + metronidazole 500mg TDS IV for 5 days penicillin allergy: co-trimoxazole 960mg BD + metronidazole 500mg IV TDS + gentamicin IV oral step down: co-trimoxazole 960mg BD + metronidazole 400mg TDS; or co-amoxiclav 625mg TDS If the patient's eGFR is <20ml/min, please discuss with a medical microbiologist.
Biliary tract infection (cholecystitis/cholangitis)	gentamicin (see section 6.1 for dosing) for 5 days oral step down: ciprofloxacin 500mg BD If the patient's eGFR is <20ml/min, please discuss with a medical microbiologist.
H pylori eradication	Clarithromycin 500mg BD + metronidazole 400mg TDS + omeprazole 20mg BD for 7 days; or amoxicillin 1g BD PO + clarithromycin 500mg BD PO + omeprazole 20mg BD PO for 7 days
Typhoid fever	ceftriaxone 2g BD IV and ciprofloxacin 400mg BD IV/ 750mg BD PO

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	Infection from the Indian subcontinent, Middle East and South East Asia may be multiple antibacterial resistant Ongoing management should be discussed with an Infectious Diseases Physician or Medical Microbiologist
Gastro enteritis	antibacterials not usually indicated
Oesophageal rupture	Co-trimoxazole 960mg IV BD + metronidazole 500mg IV TDS + fluconazole 400mg IV OD for 5 days
Clostridium difficile associated colitis	See chapter 4.1 (page 33)
Peritoneal dialysis associated peritonitis	See renal policy.
Oral candidiasis	Nystatin mouthwash 100,000units QDS for 7 days or fluconazole 50mg OD PO for 7 days
Oesophageal candidiasis	Fluconazole 100mg OD PO for 7 days

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2.2 Lower Respiratory Tract Infections

2.2.1 Community acquired pneumonia (CAP)

Diagnosis

Pneumonia is typically an acute febrile illness with cough, breathlessness, often productive of sputum and pleurisy in a patient with or without existing chest disease and new shadowing on chest X-ray. Pneumonia is defined as 'community-acquired' if it presents prior to or within 48 hours of admission.

Initial Management - use an ABCDE approach when assessing acutely unwell patients

- Patients should receive appropriate oxygen therapy with monitoring of oxygen saturations as per NBT guidelines
- Patients should be assessed for volume depletion and may require intravenous fluids
- Order bloods (FBC, U&Es, CRP and LFTs)
- Ensure a chest x-ray is performed within 4 hours
- Start antibiotics **within 4 hours** or within 1 hour if sepsis present

Mortality Score

The CURB65 score should be used and **documented in the patient's notes** to assess the severity of pneumonia. Score one point for each and record the score in the notes. Clinical judgment should be used in addition. Patients with sepsis should be treated as for high severity regardless of CURB65 score.

- **C**onfusion (Mental Test Score of 8 or less, new disorientation in person, place or time)
- **U**rea > 7mmol/L
- **R**espiratory rate ≥ 30/min
- **B**lood pressure: SBP < 90mmHg and/or DBP ≤ 60mmHg
- Age ≥ **65** years

Severity	Management	Empirical Antibiotic therapy
Review antibiotics at 48-72 hours. Therapy should be amended once a definite pathogen has been identified. IV antibiotics can be de-escalated once IV/oral switch criteria are met. Stop antibiotics if infection has been ruled out. Record all decisions in the notes. State the duration and indication on the drug chart. IV antibiotics that continue beyond 72 hours must have a duration in the notes.		
High severity CURB65 score 3-5	Take sputum and blood cultures. Perform legionella and pneumococcal urinary antigen test (use the CAP order set on ICE) Consider ICU referral if CURB65 score 4-5. For ICU patients see pathway here	Co-amoxiclav 1.2g TDS IV plus azithromycin 500mg OD IV for 5 days Oral step down: co-amoxiclav 625mg TDS + azithromycin 500mg OD If macrolides are contraindicated use doxycycline 200mg stat then 100mg OD instead of azithromycin If already receiving amoxicillin or penicillin allergy: co-trimoxazole 960mg BD IV plus azithromycin 500mg OD IV for 5 days *If there are risk factors for S. aureus pneumonia such as a history of influenza or chicken pox, add flucloxacillin 2g QDS IV (unless the patient is already receiving co-trimoxazole).* Add gentamicin IV if suspected urinary infection also present
Moderate severity CURB65 score 2	Take sputum and blood cultures. Consider legionella and pneumococcal urinary antigen test (use the CAP order set on	Co-amoxiclav 625mg TDS PO for 5 days plus azithromycin 500mg OD PO for 3 days If already receiving amoxicillin or penicillin allergy: co-trimoxazole

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	ICE)	960mg BD PO for 5 days plus azithromycin 500mg OD PO for 3 days **or** doxycycline (monotherapy) 200mg stat then 100mg OD for 5 days total
Low/mild severity CURB65 score 1	Take sputum cultures	Amoxicillin 500mg TDS PO for 5 days If already receiving amoxicillin or penicillin allergy: doxycycline 200mg stat then 100mg OD for 5 days in total; or azithromycin 500mg OD for 3 days.

Other investigations

Examination of sputum for *Mycobacterium tuberculosis* should be considered for patients if any of the following are present: upper lobe consolidation, cavities, miliary changes, a persistent productive cough or present for > 3 weeks and unresponsive to standard course of antibiotics, especially if malaise, weight loss or night sweats, or risk factors for tuberculosis (eg. ethnic origin, social deprivation, elderly). If TB is suspected, avoid the use of quinolones or rifampicin.

Failure to Improve

For patients who fail to improve as expected refer to a respiratory physician microbiologist or infectious disease physician. Common complications of CAP may include parapneumonic effusion, empyema or lung abscess. Failure to respond is not a reason for escalation of therapy without further investigation.

Discharge and follow up

Do not routinely discharge patients with CAP if in the past 24 hours they have had 2 or more of the following: temperature higher than 37.5°C, respiratory rate 24 breaths per minute or more, heart rate over 100 beats per minute, systolic blood pressure 90 mmHg or less, oxygen saturation under 90% on room air, abnormal mental status, inability to eat without assistance.

Explain to patients with CAP that after starting treatment their symptoms should steadily improve, although the rate of improvement will vary with the severity of the pneumonia, and most people can expect that by:

- 1 week: fever should have resolved
- 4 weeks: chest pain and sputum production should have substantially reduced
- 6 weeks: cough and breathlessness should have substantially reduced
- 3 months: most symptoms should have resolved but fatigue may still be present
- 6 months: most people will feel back to normal.

Advise patients with CAP to consult their GP if they feel that their condition is deteriorating or not improving as expected. Clinical review, including an X-ray to confirm resolution, should be arranged for all patients at around 6 weeks, either with their GP or by a hospital physician. It is the responsibility of the hospital team to arrange the follow-up plan with the patient and the GP. At discharge or at follow-up patients should be offered access to information about CAP.

All patients aged >65 years or at risk of invasive pneumococcal disease who are admitted with CAP and who have not previously received pneumococcal vaccine should receive 23-valent pneumococcal polysaccharide vaccine (23-PPV) at convalescence in line with DH guidelines.

Smoking cessation advice should be offered to all patients with CAP who are current smokers.

References

NICE guidance 191. Pneumonia in adults: diagnosis and management. December 2014

2.2.2 Acute exacerbation of Chronic Obstructive Pulmonary Disease (COPD)

Acute exacerbations of COPD are characterized by worsening of a previously static situation. Important symptoms include increased sputum purulence, volume, dyspnoea, wheeze, chest tightness or fluid retention. The differential diagnosis includes pneumonia, pneumothorax, heart failure, pulmonary embolism, lung cancer and upper airway obstruction.

Differentiation from pneumonia is based on the absence of new shadowing on the chest X-ray and localizing physical signs in the chest.

Antibiotics are appropriate if there is purulent sputum, increased breathlessness and increased sputum volume.

Severe (including patients on bipap): co-amoxiclav 1.2g TDS IV for 5 days.

Oral step down: amoxicillin 625mg TDS

If patient has already received amoxicillin or penicillin allergy: co-trimoxazole 960mg BD IV/PO for 5 days.

Moderate/mild: doxycycline 200mg stat then, 100mg OD for 5 days

2.2.3 Community acquired aspiration pneumonia

When patients aspirate gastric contents, they develop aspiration pneumonitis for which antimicrobial chemotherapy is not required. Consider aspiration pneumonia if there is a history of impaired swallowing or vomiting with possible aspiration ≥48hr before. Infection is indicated by change in sputum quality to purulent, mucopurulent fever and new chest X-ray changes.

amoxicillin 1.2g TDS IV or 500mg PO TDS for 5 days

If penicillin allergic or patient has already received amoxicillin in last 2 weeks:

co-trimoxazole 960mg BD IV/PO for 5 days

2.2.4 Hospital acquired pneumonia (HAP) and aspiration pneumonia

Diagnosis
Pneumonia is typically an acute febrile illness with cough, breathlessness, often productive of sputum and pleurisy in a patient with or without existing chest disease and **new shadowing on chest X-ray**. Pneumonia is defined as 'hospital-acquired' if it presents at any point 3 days after admission or the patient has had a hospital admission within the last 3 months. HAP is over diagnosed clinically, alternative diagnoses which do not require antibiotics should be actively excluded.

Suspect **aspiration pneumonia** if there is a history of impaired swallowing or vomiting with possible aspiration >48hr before. When patients aspirate gastric contents they develop aspiration pneumonitis for which antimicrobials are not required. Aspiration pneumonia should be treated as pneumonia and specific anti-anaerobic cover such as metronidazole is **not** required

Initial Management - use an ABCDE approach when assessing acutely unwell patients

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- Patients should receive appropriate oxygen therapy with monitoring of oxygen saturations as per NBT guidelines. Consider arterial blood gases.
- Check and monitor temperature, respiratory rate, pulse, blood pressure and mental status.
- If the patient has a NEWS of 5 (or 3 in one parameter) complete a Sepsis Screening Tool, start antibiotics within 1 hour and take blood cultures. Otherwise start antibiotics within 4 hours.
- Patients should be assessed for volume depletion and may require intravenous fluids
- Monitor U&Es, CRP, LFTs and FBC
- Ensure a chest x-ray is performed as soon as possible and certainly **within 4 hours**
- Take a sputum culture
- Review the patient's previous cultures and start treatment according to table below
- If severe infection, ventilator associated infection or drug intolerance, discuss with a medical microbiologist

Classification	**Antibiotic therapy**
Early onset ≤5 days after admission and no antibiotics given in last 2 weeks	amoxicillin 1g TDS IV or amoxicillin 500mg TDS PO for 5 days.
Early onset ≤5 days after admission and antibiotics given in last 2 weeks or penicillin allergy	co-trimoxazole 960mg BD IV/PO for 5 days
Late onset >5 days after admission and no antibiotics given in last 2 weeks	co-trimoxazole 960mg BD IV/PO for 5 days
Late onset >5 days after admission and antibiotics given in last 2 weeks	piperacillin/tazobactam 4.5g TDS IV for 5 days. Discuss with a medical microbiologist or respiratory physician at the earliest opportunity
Previous infection, or colonised, with *Pseudomonas aeruginosa*	Ceftazidime 2g TDS IV or ciprofloxacin 750mg BD PO for 5 days depending on severity and confirm sensitivities with a microbiologist
Previous infection, or colonised, with MRSA	vancomycin IV for 5-10 days
Review after 48-72 hours. Therapy should be amended once a definite pathogen has been identified. IV antibiotics can be de-escalated once IV/oral switch criteria are met. Stop antibiotics if infection has been ruled out. Record all decisions in the notes. State duration and indication on the drug chart.	

Failure to Improve

For patients who fail to improve as expected refer to a respiratory physician or microbiologist. Common complications of CAP may include parapneumonic effusion, empyema or lung abscess.

Discharge and follow up

Do not routinely discharge patients with HAP if in the past 24 hours they have had 2 or more of the following findings: temperature higher than 37.5°C, respiratory rate 24 breaths per minute or more, heart rate over 100 beats per minute, systolic blood pressure 90 mmHg or less, oxygen saturation under 90% on room air, abnormal mental status, inability to eat without assistance.

References

NICE guidance 191. Pneumonia in adults: diagnosis and management. December 2014

Guidelines for the management of hospital-acquired pneumonia in the UK: Report of the Working Party on Hospital-Acquired Pneumonia of the British Society for Antimicrobial Chemotherapy. 2008

NICE guideline [NG51] Sepsis: recognition, diagnosis and early management Published date: July 2016

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Addendum to North Bristol NHS Trust Antimicrobial Guidelines for patients infected or probably infected with COVID-19 (SARS-Co-V-2)

This guideline applies to patients with COVID-19 infection proven by a positive PCR, and those with suspected infection.

The assessment of severity should follow the algorithm entitled "Suspected COVID" which allows the classification of patients as mild, moderate and severe or critical.

There are no proven specific antiviral therapies for hospitalised patients with COVID-19 infection and as many patients as possible will be recruited into Randomised Controlled Trials of novel antiviral therapy.

The role of antibacterial therapy in COVID-19 infection is unclear, however the general principles of antibacterial therapy still apply in terms of a) treatment of potential co infection with COVID plus another pathogen, b) appropriate use of antibacterial to reduce adverse events, emergence of resistance, minimise super infection with more resistant pathogens, and *C.difficile* infection.

The following approach should be followed:-

Mild infection
(Sats >94% on air (or normal for patient if know type 2 respiratory failure) and respiratory rate <20)
No antibacterials necessary

Moderate infection
(Sats <94% on air, respiratory rate ≥20 and responds to oxygen)
Co-amoxiclav 625mg TDS PO for a total of 3 days antibiotic therapy

In penicillin allergy
co-trimoxazole 960mg BD PO for a total of 3 days
Adjust doses as needed according to renal function

Severe infection/critical or sepsis
(Sats <94% on air, respiratory rate ≥20 but poor response to oxygen therapy; poor response to CPAP/NIV, respiratory distress, multi organ failure)

azithromycin 500mg OD IV plus co-amoxiclav 1.2g TDS IV for a total of 3 days antibiotic therapy

In penicillin allergy
azithromycin 500mg OD IV plus co-trimoxazole 960mg BD IV for a total of 3 days antibiotic therapy
Adjust doses as needed according to renal function

Patients with a history of COPD should be treated for a total of 5 days. Patients with CT proven bronchiectasis may need longer courses – for example, 10 days.

Patients who have diagnoses positive for other pathogens (influenza A, *S.pneumoniae*, *H.influenzae, M.catarrhalis*, *S.aureus*, etc.) should have specific therapy for these. These can be discussed with Infection (Medical Microbiology) as needed.

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2.2.5 Pleural Infection

Community Acquired: Amoxicillin 1g TDS IV plus metronidazole 500mg TDS IV
If penicillin allergic: clindamycin 1.2g QDS IV + ciprofloxacin 500mg BD PO

Oral therapy: Co-amoxiclav 625mg TDS PO or if penicillin allergic clindamycin 300mg QDS PO + ciprofloxacin 500mg BD PO

Hospital Acquired: Piperacillin/tazobactam 4.5g TDS IV. Add vancomycin (see section 6.3 for dosing) if MRSA screen positive or MRSA infection in last 3 months.

If penicillin allergy, discuss with Medical Microbiology.

Duration of therapy should be determined by a respiratory physician or a Medical Microbiologist

2.2.6 Acute Exacerbations of Bronchiectasis

Patients with an acute exacerbation of bronchiectasis should have their antibiotic therapy guided by sputum culture. Sputum should be sent before treatment is started and previous sputum cultures reviewed as a guide to therapy - BTS Guidelines, Thorax 2010, 65il-58, gives more details on the overall management of such patients.

Empirical therapy (no sputum for this episode)	**Drug and Dose**
No previous antibiotics	Amoxicillin 1g IV TDS
Previous antibiotics and not colonised by P.aeruginosa or other multi-drug resistant pathogens	Co-trimoxazole 960g IV BD
Known colonisation with P.aeruginosa	Ceftazidime 2g IV TDS

Once a pathogen is isolated or pathogen is known at start of therapy:-

Pathogen	**Drug and Dose**
S.pneumoniae	amoxicillin 1g IV TDS
H.influenzae amoxicillin sensitive amoxicillin resistant	 Amoxicillin 1g IV TDS Co-trimoxazole 960g IV BD
Moraxella catarrhalis	Co-trimoxazole 960g IV BD
MRSA	Vancomycin IV. See section 6.3 for dosing.
E.coli, Klebsiella, Proteus, Citrobacter, Enterobacter etc	Ceftazidime 2g IV TDS
P.aeruginosa	Ceftazidime 2g IV TDS

All patients should be treated for 14 days. Consider oral switch when appropriate.

Patients who are infected with P.aeruginosa may also benefit from inhalational therapy, the dosing being:

Drug	**Dose**	**Frequency**
Gentamicin	80mg	BD
Tobramycin	160mg	BD
Tobramycin nebs	300mg	BD
Colistin	1-2 MU	BD

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2.3 Central Nervous System

Community acquired bacterial meningitis

Empirical therapy: ceftriaxone 2g BD IV 10 days

If patient is ≥60 years old, pregnant or immunocompromised consider the addition of amoxicillin 2g 4hrly IV to cover Listeriosis. If patient is penicillin allergic add co-trimoxazole 120mg/kg IV daily in four divided doses instead.

Once the aetiology is known:

Neisseria meningitidis	amoxicillin 2g 4hrly IV 5 days
Streptococcus pneumonia - penicillin susceptible	amoxicillin 2g 4hrly 10 days
Streptococcus pneumoniae – penicillin non susceptible	discuss with medical microbiologist
No pathogen isolated	ceftriaxone 2g BD IV 10 days
Other pathogens	Discuss with a Medical Microbiologist

Consider adjunctive treatment with dexamethasone 10mg QDS IV for 4 days, especially if pneumococcal meningitis in adults, starting before or within 12 hours of the first dose of antibacterial. Avoid dexamethasone in septic shock or if immunocompromised or in post operative meningitis.

For neurosurgical infection, see section 5.1.

Herpes Simplex Encephalitis

Aciclovir 10mg/kg IV TDS for 14-21 days

Treatment should be reviewed once the results of the CSF viral PCR are available. Discuss with a Medical Microbiologist.

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2.4 Urinary Tract

Diagnosis

Urinary tract infections (UTIs) typically present as pyuria, dysuria and suprapubic tenderness. Pyelonephritis is a syndrome associated with local symptoms as well as flank or back pain. Complicated UTIs are those in patients with a predisposition to persistent infection or treatment failure such as urinary stricture, tumour, stones, obstruction, stents, a catheter or pregnancy; or where systemic signs are present.

Signs and symptoms compatible with catheter-associated UTI include: new onset or worsening of fever, rigors, altered mental status, malaise, or lethargy with no other identified cause; flank pain; costovertebral angle tenderness; acute haematuria; pelvic discomfort dysuria, urgent or frequent urination, or supra-pubic pain or tenderness in patients whose catheters have been removed.

Management

- **Ensure urine cultures are taken prior to starting antibiotics**.
- Check and monitor temperature, respiratory rate, pulse, blood pressure and mental status.
- If the patient has a NEWS of 5 (or 3 in one parameter) complete a Sepsis Screening Tool, take blood cultures and start antibiotics within 1 hour.
- Check and monitor U&Es, CRP, LFTs and FBC.
- Patients should be assessed for volume depletion and may require intravenous fluids.
- Review the patient's previous cultures and start treatment according to table below.
- **Do not prescribe antibiotics based on urinary dipstick alone**.

Treatment

Classification	Management	Antibiotic therapy
Review at 24-48hrs with culture results and susceptibility tests and aim to switch to an oral agent. IV antibiotics can be de-escalated once IV/oral switch criteria are met. Stop antibiotics if infection has been ruled out. **Record all decisions in the notes**. **State duration and indication on the drug chart.**		
Community acquired infections are those presenting on, or within, 48 hours of admission in patients who have not been hospitalised in the previous 3 months.		
Uncomplicated UTI	If possible delay starting therapy until urine cultures are reported	First line: Nitrofurantoin 50mg QDS PO Duration: women 3 days, men 5 days Second line: Pivmecillinam 400 mg TDS PO Duration: women 3 days, men 5 days Please note that pivmecillinam is a penicillin. In patients with penicillin allergy discuss with a microbiologist.
Complicated UTI	If the patient has a catheter, consider removal if possible or replacement once antimicrobial therapy has been started	Patients requiring IV therapy: gentamicin IV (see section 6.1 for dosing). Duration: 5 days. If the patient's eGFR is <20ml/min, please discuss with a medical microbiologist. Patients requiring oral therapy: nitrofurantoin 50mg QDS or pivmecillinam 400mg TDS for 5 days
Acute pyelonephritis In female patients ≤50 years and who are fit for discharge (i.e. patients in ED/AMU).	Consider taking blood cultures. For pregnant patients refer to O&G guidelines.	Gentamicin IV single dose (see section 6.1 for dosing) plus ciprofloxacin 500mg BD PO for 7 days. If the patient's eGFR is <20ml/min, discuss with a medical microbiologist Do not use nitrofurantoin or pivmecillinam due to poor tissue concentrations.

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All other patients with acute pyelonephritis	Take blood cultures	Gentamicin IV (see section 6.1 for dosing). Total duration: 7 days. Discuss oral step down with a Microbiologist. If the patient's eGFR is <20ml/min, discuss with a medical microbiologist. Do not use nitrofurantoin or pivmecillinam due to poor tissue concentrations.
Catheter associated UTI		Treat as for complicated UTI Do not offer antibiotic prophylaxis routinely when changing catheters in patients with long term indwelling urinary catheters. Consider antibiotic prophylaxis in those with a history of symptomatic UTI after catheter change or who experience trauma during catheterisation. If indicated, a single dose of gentamicin 80mg IM/IV can be given but consider prior urine culture and sensitivity results
Epididymo-orchitis	Assess risk for sexually transmitted infection (STI): -age >35 low risk for STI -low-risk sexual history -previous urological instrumentation/ catheterisation and/ or known urinary tract abnormality – low risk for STI	Low risk for STI: ciprofloxacin 500 mg BD PO for 10 days High risk for STI: doxycycline 100 mg BD for 10-14 days PO plus single dose ceftriaxone 500 mg IM/IV Consider referring patient and partner to GUM clinic.
Prostatitis		Ciprofloxacin 500mg BD PO for 28 days
Hospital acquired infections are those presenting 48 hours after admission and in patients who have been hospitalised in the previous 3 months.		
UTI		Patients requiring IV therapy: Amikacin IV (see section 6.2 for dosing) Total duration: 5 days If the patient's eGFR is <20ml/min, please discuss with a medical microbiologist. Patients requiring oral therapy: Nitrofurantoin 50mg QDS PO for 5 days Second line: Pivmecillinam 400 mg TDS PO for 5 days
Vaginal candidiasis		Clotrimazole 200mg OD PV for 3 days

Notes: ***If eGFR <30ml/min do not use Nitrofurantoin. If eGFR 30-45mls/min use with caution and only if there is no alternative.***

References

PHE. Management of infection guidance for primary care for consultation and local adaptation
https://www.gov.uk/government/publications/managing-common-infections-guidance-for-primary-care
SIGN. Management of suspected bacterial urinary tract infection in adults
http://www.sign.ac.uk/guidelines/fulltext/88/index.html
[1] BASHH. 2010 United Kingdom national guideline for the management of epididymo-orchitis
http://www.bashh.org/documents/3546.pdf

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2.5 Blood

ANTIBIOTICS MUST BE GIVEN WITHIN ONE HOUR OF DIAGNOSIS FOR SEVERE SEPSIS

Antibiotic management of severe sepsis and septic shock requiring intensive care

Patients with sepsis and septic shock will require intensive care. For patients with hypotension, tachycardia, temperatures >38°C or <36°C, tachypnea, poor renal function and other variables associated with severe sepsis, early appropriate antimicrobial therapy has a major impact on outcome. The Surviving Sepsis Campaign recommends the following in terms of antibiotic therapy.

- begin IV antibiotics as early as possible, and always within one hour of recognising severe sepsis and septic shock
- broad spectrum: one or more agents active against the likely pathogens
- reassess the regimen daily to optimise efficacy, prevent resistance, avoid toxicity and minimise costs
- combination therapy for no more than 3-5 days and de-escalate following susceptibilities
- duration of therapy is typically 7-10 days
- stop antibiotics if cause found to be non-infectious

Patients without severe sepsis or septic shock often also require intensive care. In all patients transferring to ICU, aminoglycosides should be avoided and substitutes given. Discussion with an intensivist and medical microbiologist is essential.

2.5.1 Community acquired sepsis (focus unknown)

Amoxicillin 1g TDS IV + flucloxacillin 2g QDS IV + gentamicin (see section 6.1 for dosing).

penicillin allergy: Establish nature of allergy and discuss with a Medical Microbiologist.

If the patient's eGFR is <20ml/min, please discuss with a medical microbiologist.

Add metronidazole 500mg TDS IV if anaerobic infection suspected. If MRSA infection suspected (previous MRSA infection, colonised with MRSA), discuss with medical microbiologist.

2.5.2 Community acquired sepsis (origin pneumonia and/or urinary tract infection)

Amoxicillin 1g TDS IV + azithromycin 500mg OD IV + gentamicin (see section 6.1 for dosing)

penicillin allergy: Establish nature of allergy and discuss with a Medical Microbiologist.

If the patient's eGFR is <20ml/min, please discuss with a medical microbiologist.

2.5.3 Hospital acquired sepsis (focus unknown)

discuss with medical microbiologist

Please note: do not treat with combination of vancomycin plus gentamicin, as the risk of nephrotoxicity is significant.

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2.6 Antibiotic Management of Patients with Neutropenic Sepsis

This summary is based on NBT Policy CP17 (Feb 2016) "Management of Patients at Risk of Neutropenic Sepsis Policy". It should be read in conjunction with the whole policy which can be accessed here.

The policy is limited to those who are neutropenic secondary to haemato-oncology diagnosis or treatment.

- Neutropenia is defined as a neutrophil count of $<0.5 \times 10^9$/L.
- Fever is defined as an oral or tympanic membrane temperature of ≥38°C sustained for 1 hour or a single temperature of ≥38.5°C.
- Neutropenic sepsis, also called neutropenic fever, is diagnosed in those having anti-cancer treatment with a neutrophil count of $<0.5 \times 10^9$/L and a temperature of ≥38°C **or** other signs and symptoms consistent with infection.

If neutropenic fever is not confirmed - i.e. the neutrophil count is $>1.0 \times 10^9$ stop piperacillin/tazobactam and follow the NBT Antibiotic Guidelines.

The MASCC Index is used to categorise oncology and haematology patients into severe and non-severe groups. If the MASCC Index score is ≥21, treat as non-severe (low risk), if the score is <21, treat as severe (high risk).

Patients at low risk of septic complications

Consider outpatient antibiotic therapy for patients with confirmed neutropenic sepsis and a low risk of developing septic complications, taking into account the patient's social and clinical circumstances and discussing with them the need to return to hospital promptly if a problem develops.

MASCC Scoring chart

CHARACTERISTICS		SCORE
Age	≥ 60 years	0
	< 60 years	2
Patient dehydrated, requiring fluids	Yes	0
	No	3
Patient hypotensive	Systolic BP <90	0
	Systolic BP ≥90	5
Does the patient have COPD? (Chronic Obstructive Pulmonary Disease)	Yes	0
	No	4
Does the patient have a solid tumour or no previous fungal infection in a haematological malignancy?	Solid Tumour or no previous infection in haematological malignancy	4
	Haematological malignancy with previous fungal infection	0
Does the patient have symptoms related to this febrile neutropenic episode?	None or mild symptoms	5
	Moderate symptoms	3
	Severe symptoms	0
Was the patient already an inpatient before this episode of febrile neutropenia?	Already an inpatient	0
	Admitted with this episode	3

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Treatment of non-severe patients - Modify antibiotic choice according to previous microbiology and risk assessment for CPE

CATEGORY		ANTIBIOTIC	COURSE LENGTH	COMMENTS
Non-severe MASCC Index Score ≥21	**First Line** Patients who have had ciprofloxacin prophylaxis or treatment in the last 6 weeks should be treated as severe	**Co-amoxiclav** 625mg PO TDS PLUS **Ciprofloxacin** 750mg PO BD	7 days 7 days	Consider outpatient therapy IF: • Patient is mentally competent • Lives near the hospital (within one hour) • Has a thermometer at home • Has someone at home all of the time • Has access to transport and a telephone
	Penicillin (or beta lactam allergic)	**Clindamycin** 300mg QDS PLUS **Ciprofloxacin** 750mg PO BD	7 days	
	Second line	Switch to severe IV treatment	7 days	

Treatment of severe patients - Modify antibiotic choice according to previous microbiology and risk assessment for CPE

CATEGORY		ANTIBIOTIC	COURSE LENGTH	COMMENTS
Severe MASCC Index Score <21	**First Line**	**IV piperacillin/tazobactam** 4.5 gram QDS If penicillin allergic establish nature and discuss with medical microbiologist	7 days	Do not switch empirical antibiotics in patients with unresponsive fever unless there is clinical deterioration or a microbiological indication. If no improvement after 48-72 hours discuss with Haematology or Microbiology If no improvement 4-5 days from start of antibiotics discuss antifungal investigations/therapy with Haematology or Microbiology. Consider switching to oral therapy after 48 hours if patient low risk.
	If evidence of line/IV access or hypotensive then add:	**IV vancomycin** **Please refer to Trust Guidelines on dosing**		
	If fever persists at 48 hours and central line add: **Consider stopping antibiotics if:**	**IV vancomycin** Neutrophils >0.5x10^9/L, patient is well and apyrexial for 3 days Neutrophils <0.5x10^9/L, patient is well and apyrexial for 5 days		

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2.7 Skin

Oral therapy is suitable for many patients with cellulitis. IV therapy should be reserved for the following: severe and rapidly spreading infection, systemic signs of sepsis, immuno compromised patients such as diabetics and those unable to tolerate oral medication. However, if initial treatment is delayed, cellulitis may result in severe tissue damage, taking weeks to recover. This recovery period is not shortened by extended duration of antibiotic.

Review antibiotics at 48-72 hours. Therapy should be changed to a narrow spectrum agent once a definite pathogen has been identified.
IV antibiotics should be de-escalated once IV/oral switch criteria are met. Stop antibiotics if infection has been ruled out. Record all decisions in the notes. State the duration and indication on the drug chart.

Cellulitis/ erysipelas	flucloxacillin 500mg QDS PO or 2g QDS IV for 5 days and then review. Complicated infections may require up to 14 days. For outpatient IV therapy of cellulitis: ceftriaxone 1-2g OD or teicoplanin 400mg OD	In penicillin allergy use clindamycin 300mg QDS PO or 600mg QDS IV
Animal and human bites	Co-amoxiclav 1.2g TDS IV or co-amoxiclav 625mg TDS PO for 5 days	For patients with penicillin allergy clindamycin with or without ciprofloxacin can be used, but discuss with a Medical Microbiologist.
Wound infection following clean surgery	Flucloxacillin 500mg QDS PO or 2g QDS IV for 5 days	Penicillin allergy: clindamycin 300mg QDS PO or 450mg QDS IV for 5 days
Wound infection following contaminated surgery	Co-trimoxazole 960mg IV BD + metronidazole 500mg IV TDS for 5 days Oral step down: co-trimoxazole 960mg BD PO + metronidazole 400mg TDS PO	
Perianal infection/abscess	Co-trimoxazole 960mg IV BD + metronidazole 500mg IV TDS for 5 days Oral step down: co-trimoxazole 960mg BD PO + metronidazole 400mg TDS PO	
Cellulitis at a cannula site	Flucloxacillin 500mg QDS PO or 2g QDS IV for 5 days	Penicillin allergy: clindamycin 300mg QDS PO or 450mg QDS IV for 5 days
Cellulitis in a current injecting drug user	Flucloxacillin 500mg QDS PO or 2g QDS IV for 5 days. If known to be colonised with MRSA give vancomycin (see section 6.3 for dosing)	Penicillin allergy: clindamycin 300mg QDS PO or 450mg QDS IV for 5 days
Mastitis and breast abscesses	Flucloxacillin 500mg QDS PO or 2g QDS IV for 5 days	Penicillin allergy: clindamycin 300mg QDS PO or 450mg QDS IV for 5 days
Necrotising fasciitis	Piperacillin-tazobactam 4.5g IV TDS plus clindamycin 600mg IV QDS If the patient is colonised with MRSA, has risk factors for MRSA, or is an IVDU – add vancomycin (see section 6.2 for dosing)	penicillin allergy – consult a Medical Microbiologist

If MRSA is suspected or proven to be the cause of infection, see MRSA treatment policy or discuss with a Medical Microbiologist

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2.8 Diabetes mellitus foot infection

Antibiotic therapy is only one part of the management of diabetic foot infection. The Diabetic team should be consulted on individual patient management. Please also refer to the Diabetes Foot Team In-patient Referral Pathway

PEDIS grade	Definition	Treatment	Penicillin Allergic	Length of Treatment
4	**Septic** (Fever Tachycardia Hypotension Tachypnoea)	Piperacillin/tazobactam 4.5g TDS IV Discuss with a Medical Microbiologist for oral step down options	Clindamycin 450-600mg QDS IV + gentamicin IV (see section 6.1 for dosing)	Usually 14 days initially
3	**Deeper infection** **or** lymphangitis **or** >2cm erythema **or** failure of previous treatment	***Preferred route for inpatients*** **Flucloxacillin** 2g QDS **IV** Add **Metronidazole** 500mg TDS IV if anaerobic component suspected	**Clindamycin** 450-600mg QDS IV + **Ciprofloxacin** 500mg BD PO	Usually 14 days initially
2	Skin/sub-cutaneous infection only **and** <2cm erythema **and <u>no previous</u>** antibiotic treatment (in last 3 months)	***Preferred route for outpatients*** **Flucloxacillin** 500mg-1g QDS PO if suspected anaerobic component add metronidazole 400mg TDS PO or **Co-amoxiclav** 625mg TDS PO	**Clindamycin** 300 mg QDS PO	7 days
1	Not infected	NIL	NIL	

- If high risk for MRSA (previous MRSA colonisation/infection, hospital admission within 6 months, nursing home resident) see MRSA treatment guide.
- Osteomyelitis secondary to diabetic foot complications may be due to a wide variety of organisms. The specimens of choice are bone biopsy and deep curettage. Swabs are of limited value. Suggest discuss with medical microbiologist/diabetic foot team regards empirical and definitive therapy.

2.9 <u>Treatment of infection in Hepatology</u>

2.9.1 Treatment of peritonitis in patients with liver cirrhosis

Piperacillin/tazobactam 4.5g IV TDS for 5 days

Empirical therapy should be started in patients with an ascitic fluid neutrophil count of >250 cells/ml. Patients who fail to respond or where secondary peritonitis is suspected should be discussed with a Medical Microbiologist. Patients recovering from an episode of SBP should receive continuous prophylaxis.

2.9.2 Prophylaxis of spontaneous bacterial peritonitis (SBP)

Ciprofloxacin 500mg PO OD long term

2.9.3 Prevention of infection in upper GI haemorrhage

Piperacillin/tazobactam 4.5g IV TDS for 5 days

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Bacterial infections occur in about 20% of patients with cirrhosis with upper gastrointestinal bleeding within 48 hours of admission and the incidence increases to 35–66% within two weeks. Patients with advanced liver disease and large volumes of hematemesis should receive empirical prophylaxis.

2.10 Eye

Purulent conjunctivitis:	Chloramphenicol 0.5% eye drops every 2 hours for 2 days and then 4 hourly for 48 hours after resolution of symptoms

2.11 Ear, nose and throat

Sore throat:	phenoxymethylpenicillin 500mg QDS PO for 5 days
Sinusitis:	phenoxymethylpenicillin 500mg QDS PO for 5 days
Otitis externa:	acetic acid spray. One spray TDS for 7 days
Otitis media:	No antibiotics unless systemically unwell, complications or symptoms for > 4 days. amoxicillin 500mg TDS PO or clarithromycin 500mg BD PO for 5 days

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2.12 NBT guidelines for investigation of patients with suspected Infective Endocarditis (IE)

(A) When to consider IE in the differential diagnosis?

- **A febrile illness and presence of IE risk factor(s)**
  - History of IVDU
  - Any history of cardiac valve replacement
  - Any intra-cardiac devices or wires
  - Previous history of IE
  - Known valvular lesion (prolapsed or bicuspid valve etc.)
  - Congenital heart disease

- **Clinical presentation or history suggestive of IE**
  - Fever and vascular or immunological phenomena e.g. splinter haemorrhages, Janeway lesions, Osler's nodes, clubbing etc.
  - A protracted history of sweats, weight loss, anorexia or malaise

- **A febrile illness and new-onset cardiac signs or symptoms**
  - Cardiac failure
  - New conduction abnormality on ECG
  - New murmur suggestive of valve regurgitation.

- **Patients with any of the following positive blood cultures**
  - *Staphylococcus aureus* bacteraemia
  - Persistent/recurrent bacteraemia caused by the same organism
  - Typical IE organism (e.g. viridans group of streptococci)
  - Candidaemia

- **A febrile illness and possible embolic event(s)**
  - Stroke or Embolic event (e.g. ischaemic limb)
  - Visceral abscess (e.g. renal, splenic, cerebral, vertebral)

(B) What to do if IE is a possible/probable diagnosis?

- **Collect blood cultures before starting antibiotic therapy**
  - Ideally 3 sets of blood cultures taken from different venepunctures/sites
  - If the patient is not septic/unwell, then collect blood cultures 6-12 hours apart
  - In patients with severe sepsis start antibiotic therapy promptly after discussion with microbiologist and collect at least two sets of blood cultures via separate venepuncture

- **Discuss with on-call microbiologist before starting empirical antibiotic therapy**
- **Request a trans-thoracic echocardiography (TTE)**
- **Discuss with cardiologist for further management including any need for trans-oesophageal echocardiography(TOE), and transfer of care**
- **Discuss with microbiologist for serological tests in the diagnosis of culture-negative endocarditis**

References:

- Journal of Antimicrobial Chemotherapy (2012), 67, 269-289
- European Heart Journal (2009), 30, 2369–2413
- European Journal of Echocardiography (2010), 11, 202–219

3 ANTIBACTERIAL PROPHYLAXIS

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3.1 Non-Surgical Prophylaxis – see BNF for full details.
For vaccinations pre or post splenectomy see appendix A

3.2 Surgical Prophylaxis

3.2.1 Best practice for prescribing an antimicrobial for peri-operative prophylaxis

Best practice point	Action
Need for prophylaxis and guideline choice of agents	Prescribe prophylaxis with appropriate agents according to NBT guidelines. Use appropriate alternatives for patients with beta-lactam allergy
Timing	Administer antibiotics within 60-minutes prior to incision (or tourniquet)
Repeat doses	Single dose is indicated for majority of procedures. The reason for antibiotic administration beyond one dose should be documented and comply with criteria below: • Significant intra-operative blood loss - >1.5 litre (re-dose following fluid replacement). • Prolonged procedures (>6hours) • Primary arthroplasty, where 24 hours prophylaxis is acceptable.
Ensure allergies are clearly documented	All allergies must be recorded on the front of the drug chart and anaesthetic record. The nature of the allergy/reaction should also be stated.
MRSA positive patients	Decolonisation therapy is recommended prior to surgery and antibiotic prophylaxis should include cover for MRSA.

3.2.2 Principles of Prophylaxis

Type of surgery	Definition	Prophylaxis
Clean	Operations in which no inflammation encountered and the respiratory, alimentary or genitourinary tracts are not entered. There is no break in aseptic operating technique.	No prophylaxis (except in implantation)
Clean-Contaminated	Operations in which the respiratory, alimentary or genito-urinary tract are entered but without significant spillage.	Single dose **except for primary arthroplasty/ implant surgery**
Contaminated	Operations where acute inflammation (without pus) is encountered, or where there is visible contamination of the wound. Examples include gross spillage from a hollow viscus during the operation or compound/open injuries operated on within 4 hours.	5 day treatment course in addition to prophylaxis
Dirty	Operations in the presence of pus, where there is a previously perforated hollow viscus, or compound/open injuries more than 4 hours old.	5 day treatment course in addition to prophylaxis

3.2.3 Timing of Prophylaxis

The aim of prophylaxis is to have maximum tissue levels at the time of first incision (the only exception is where microbiological specimens are to be taken, in which case prophylaxis should be given immediately after specimens have been obtained). Oral and intramuscular prophylaxis is usually administered 1 hour pre-op, whereas IV antibiotics are given on starting anaesthesia. However give prophylaxis earlier for operations in which a tourniquet is used.

3.2.4 Pre-operative risk assessment for likelihood of MRSA carriage for patients who have not been screened prior to surgery.

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The following questions will enable a quick risk assessment of MRSA status of those patients who have declined screening for MRSA or have not been screened for another reason prior to surgery. These are based on current recognised risk factors for MRSA carriage.

1. Is the patient known to be MRSA positive on a previous occasion? If so, this should be clearly noted by nursing staff, the patient may be put at the end of the list for infection control reasons.

2. Has the patient come from a nursing home or directly from another healthcare establishment (hospital transfer), or directly from abroad? See patients addressograph label, pre-op note may state transfer to NBT for surgery.

3. Does the patient have a long term urinary catheter? The absence of a fluid balance chart means the patient is more likely to have a long-term catheter than one recently inserted in hospital.

4. Is the patient known to be a frequent or recent hospital attender? As suggested by multiple significant co-morbidities on the anaesthetic notes, recent anaesthetics, very thick case notes or X ray folders etc.

If YES to any of the above, then MRSA colonisation is more likely and it would be reasonable to prophylax as for a known MRSA positive patient.

If NO to all above questions, use routine prophylaxis.
Where information is not available please make a judgement on whether it is likely that the patient will have had an opportunity to acquire MRSA. For example:

- A young adult with acute appendicitis, unlikely to be a regular hospital attender and is very unlikely to have MRSA
- An elderly patient with several drug allergies, or multiple X rays or very thick notes, is likely to have had several healthcare interventions in the past - may well have acquired MRSA .

Why not just prophylax every patient as if potentially MRSA colonised?

- Vancomycin and teicoplanin are not as effective antibiotics as the penicillin-based alternatives (e.g. flucloxacillin) for MSSA infection.
- They take longer to prepare and administer
- They are much more expensive
- We must avoid selecting for resistance to these antibiotics.
- <1% elective patients when screened are colonised with MRSA

Note these guidelines will not accurately identify all potentially colonised cases and do not substitute for clear documentation of MRSA screening results by the patient's clinical team.

For patients known to be MRSA positive or who have risk factors replace amoxicillin or flucloxacillin with teicoplanin 400mg IV (600mg if patient is >100kg).

3.2.6 Prophylaxis for patients with other multidrug resistant pathogens

Patients known to be colonised pre operatively with pathogens likely to be resistant prophylaxis should have their antibiotic prophylaxis discussed with a medical microbiologist pre-operatively.

3.2.7 Duration of operative procedures

For prolonged procedures (>6hours) and/or major blood loss, additional intra operative doses of 50% of the initial dose should be administered at 4h intervals (8 hourly for gentamicin) for the duration of the procedure.

3.2.8 Patients with a penicillin allergy

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Investigate the nature of the penicillin allergy (see section 8). For patients who are allergic to penicillin replace the penicillin with teicoplanin 400mg IV (600mg if patient is >100kg). For patients with renal impairment see section 6.1 for gentamicin dose reduction

3.2.9 In patients with impaired renal function a reduced doe of gentamicin should be given as per the table below.

creatine clearance (eGFR)	Dose	
	Higher dose (where 24 coverage is needed)	**Standard dose**
>80ml/min	5mg/kg	3mg/kg
40-80ml/min	3.5mg/kg	2mg/kg
<40ml/min	2mg/kg	1mg/kg

- 5mg/kg dose is used for prophylaxis in orthopaedic surgery, except lower limb amputation
- obese patient BMI ≥30kg/m^2, use ideal body weight to calculate dose

All regimens in the table below are single doses unless stated otherwise.

3.2.9 Upper gastrointestinal		**Penicillin allergy**	**comments**
Oesophageal surgery	Amoxicillin 1g IV + gentamicin 3mg/kg IV	Teicoplanin 400mg IV+ gentamicin 3mg/kg IV	
Stomach and duodenal	Amoxicillin 1g IV + gentamicin 3mg/kg IV	Teicoplanin 400mg IV + gentamicin 3mg/kg IV	
Gastric bypass surgery	Amoxicillin 1g IV + gentamicin 3mg/kg IV	Teicoplanin 400mg IV + gentamicin 3mg/kg IV	
Small intestine surgery	Amoxicillin 1g IV + gentamicin 3mg/kg IV	Teicoplanin 400mg IV + gentamicin 3mg/kg IV	
3.2.10 Lower gastrointestinal		**Penicillin allergy**	**comments**
Appendectomy	Amoxicillin 1g IV + gentamicin 3mg/kg IV + metronidazole 500mg IV	Teicoplanin 400mg IV + gentamicin 3mg/kg IV + metronidazole 500mgIV	
Colorectal surgery	Amoxicillin 1g IV + gentamicin 3mg/kg IV + metronidazole 500mg IV	Teicoplanin 400mg IV + gentamicin 3mg/kg IV + metronidazole 500mg IV	
Emergency laparotomy	Co-trimoxazole 960mg IV + metronidazole 500mg IV	Co-trimoxazole 960mg IV + metronidazole 500mg IV	
3.2.11 Abdomen		**Penicillin allergy**	**comments**
Hernia repair-groin without mesh	Prophylaxis not usually recommended		
Hernia repair with mesh	flucloxacillin 1g IV + gentamicin 3mg/kg +/- metronidazole 500mg IV	Teicoplanin 400mg IV + gentamicin 3mg/kg IV+/- metronidazole 500mg IV	
Open/laparoscopic surgery with mesh (e.g. gastric band)	Prophylaxis not recommended but should be considered in high risk patients		
Diagnostic endoscopic procedures	Prophylaxis not recommended		
PEG insertion	Flucloxacillin 1g IV + gentamicin 3mg/kg IV		
ERCP	Gentamicin 3mg/kg IV or ciprofloxacin 750mg PO single dose		ciprofloxacin should be given 2 hours before the procedure
Splenectomy	Prophylaxis not recommended		See section 3.1.6 for post-

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			surgical prophylaxis and vaccination
3.2.12 Hepatobiliary		**Penicillin allergy**	**comments**
Bile duct surgery	Gentamicin 3mg/kg IV		
Pancreatic surgery	Amoxicillin 1g IV + gentamicin 3mg/kg IV + metronidazole 500mg IV	Teicoplanin 400mg IV + gentamicin 3mg/kg IV + metronidazole 500mg IV	
Liver surgery	Amoxicillin 1g IV + gentamicin 3mg/kg IV + metronidazole 500mg IV	Teicoplanin 400mg IV + gentamicin 3mg/kg IV + metronidazole 500mg IV	
Liver biopsy	Prophylaxis not recommended		
Gall bladder surgery (open)	Flucloxacillin 1g IV + gentamicin 3mg/kg	Teicoplanin 400mg IV + gentamicin 3mg/kg IV	
Gall bladder surgery (laparoscopic)	Prophylaxis not recommended.		
Gall bladder surgery (laparoscopic) in high risk patients	gentamicin 3mg/kg IV	gentamicin 3mg/kg IV	High risk: intraoperative cholangiogram, bile spillage, conversion to laparotomy, acute cholecystitis/pancreatitis, jaundice, pregnancy, immunosuppression, insertion of prosthetic devices.
3.2.13 Uro-genital		**Penicillin allergy**	**comments**
Transrectal prostate biopsy	ciprofloxacin 750mg PO 2 hours before the procedure. If resistance/contraindication to ciprofloxacin give gentamicin 3mg/kg IV		
Shock wave lithotripsy	Pre-procedural antibiotics do not significantly reduce the risk of UTI and fever in patients undergoing ESWL, but should be considered in patients at high risk of infectious complications (i.e. patients with large stone burden, associated pyuria, history of pyelonephritis, and adjunctive operative procedure including stent, nephrostomy insertion, PCNL or ureteroscopy). For high risk patients give gentamicin 3mg/kg IV stat		
Routine cystoscopy	Prophylaxis not recommended		Check urine cultures especially if known/recurrent UTI. See BUI pathway here (link)
Traumatic cystoscopy/ ureteroscopy	Amoxicillin 1g IV + gentamicin 3mg/kg IV	Teicoplanin 400mg IV + gentamicin 3mg/kg IV	
Percutaneous nephrolithotomy	Amoxicillin 1g IV + gentamicin 3mg/kg IV	Teicoplanin 400mg IV + gentamicin 3mg/kg IV	
Endoscopic ureteric stone fragmentation/ removal	Amoxicillin 1g IV + gentamicin 3mg/kg IV	Teicoplanin 400mg IV + gentamicin 3mg/kg IV	
Transurethral resection of prostate	Amoxicillin 1g IV + gentamicin 3mg/kg IV	Teicoplanin 400mg IV + gentamicin 3mg/kg IV	
Transurethral resection of bladder tumours	Amoxicillin 1g IV + gentamicin 3mg/kg IV	Teicoplanin 400mg IV + gentamicin 3mg/kg IV	Prophylaxis not usually recommended but consider in high risk patients and large tumours.
Radical cystectomy	Amoxicillin 1g IV + gentamicin 3mg/kg IV + metronidazole 500mg IV	Teicoplanin 400mg IV + gentamicin 3mg/kg IV + metronidazole 500mg IV	
Open prostatectomy	Amoxicillin 1g IV + gentamicin 3mg/kg IV + metronidazole 500mg IV	Teicoplanin 400mg IV + gentamicin 3mg/kg IV + metronidazole 500mg IV	

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Formation of ileal conduit or neo-bladder	Amoxicillin 1g IV + gentamicin 3mg/kg IV + metronidazole 500mg IV	Teicoplanin 400mg IV + gentamicin 3mg/kg IV + metronidazole 500mg IV	
Circumcision	Prophylaxis not recommended.		
Insertion of an artificial urinary sphincter	Flucloxacillin 1g IV + gentamicin 3mg/kg IV + metronidazole 500mg IV	Teicoplanin 400mg IV + gentamicin 3mg/kg IV + metronidazole 500mg IV	
Insertion of urethroplasty	Amoxicillin 1g IV + gentamicin 3mg/kg IV	Teicoplanin 400mg IV + gentamicin 3mg/kg IV	
3.2.14 Gynaecological		**Penicillin allergy**	**comments**
Abdominal hysterectomy	Co-amoxiclav 1.2g IV	cefuroxime 1.5g IV + metronidazole 500mg IV	
Vaginal hysterectomy	Co-amoxiclav 1.2g IV	cefuroxime 1.5g IV + metronidazole 500mg IV	
Caesarean section	Cefuroxime 1.5g IV + metronidazole 1g PR		Give clindamycin 600mg IV if type 1 allergy. Give pre-skin incision
Assisted delivery	Co-amoxiclav 1.2g IV	Clindamycin 300mg IV	To be given as soon as possible after birth and definitely within 6 hours of birth
Third or fourth degree perineal tears	Cefuroxime 1.5g IV + metronidazole 500mg IV		Give clindamycin 600mg IV if type 1 allergy
Manual removal of the placenta	Cefuroxime 1.5g IV + metronidazole 500mg IV		Give clindamycin 600mg IV if type 1 allergy. Prophylaxis should be considered
Induced abortion	Co-amoxiclav 1.2g IV	cefuroxime 1.5g IV + metronidazole 1g PR	Give clindamycin 600mg IV if type 1 allergy
Evacuation of incomplete miscarriage	Prophylaxis not recommended		
Intrauterine contraceptive device insertion	Prophylaxis not recommended		
3.2.15 Orthopaedic surgery		**Penicillin allergy**	**comments**
Arthroscopy	Prophylaxis not recommended		
Arthroplasty	ceftriaxone 2g IV	Teicoplanin 400mg IV + gentamicin 5mg/kg IV	
Open fracture	ceftriaxone 2g IV	Teicoplanin 400mg IV + gentamicin 5mg/kg IV	Therapy should continue for a maximum of 72 hours or until soft tissue closure, whichever is sooner**.** Give IV antibiotics ASAP: time to antibiotics affects long term outcome in open fractures
Open surgery for closed fracture	ceftriaxone 2g IV	Teicoplanin 400mg IV + gentamicin 5mg/kg IV	
Hip fracture	ceftriaxone 2g IV	Teicoplanin 400mg IV + gentamicin 5mg/kg IV	
Orthopaedic surgery (without implant)	Prophylaxis not recommended		
Lower limb amputation including trauma	ceftriaxone 2g IV	Teicoplanin 400mg IV + gentamicin 3mg/kg IV + metronidazole 500mg IV	

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3.2.16 Vascular surgery		Penicillin allergy	comments
Abdominal and lower limb arterial reconstruction	Flucloxacillin 1g IV + gentamicin 3mg/kg IV	Teicoplanin 400mg IV + gentamicin 3mg/kg IV	Add metronidazole 500mg IV if aortic aneurysm repair.
Lower limb amputation	See above		
Renal transplantation	See kidney transplant protocol		
Tenchkoff insertion	See guidelines for peritoneal dialysis		
3.2.17 Breast surgery		**Penicillin allergy**	**comments**
Breast cancer surgery	Flucloxacillin 1g IV + gentamicin 3mg/kg IV	Teicoplanin 400mg IV + gentamicin 3mg/kg IV	
Breast reshaping procedures	Flucloxacillin 1g IV + gentamicin 3mg/kg IV	Teicoplanin 400mg IV + gentamicin 3mg/kg IV	
Breast surgery with implant	Flucloxacillin 1g IV + gentamicin 3mg/kg IV	Teicoplanin 400mg IV + gentamicin 3mg/kg IV	
3.2.18 Plastic surgery		**Penicillin allergy**	**comments**
Plastic surgery	Flucloxaxillin 1g IV + gentamicin 3mg/kg IV	Teicoplanin 400mg IV + gentamicin 3mg/kg IV	
Prevention of infection during leech therapy	ciprofloxacin 500mg BD PO for duration of contact		
Open fracture	Flucloxacillin 1g QDS IV + gentamicin 5mg/kg IV OD.	Teicoplanin 400mg IV + gentamicin 5mg/kg IV	Therapy should continue for a maximum of 72 hours or until soft tissue closure, whichever is sooner. Give IV antibiotics ASAP: time to antibiotics affects long term outcome in open fractures
3.2.20 Trauma surgery		**Penicillin allergy**	**comments**
Penetrating trauma to CNS (cranio-cerebral)	Ceftriaxone 2g IV + metronidazole	Discuss with a medical microbiologist	If gross spillage from a viscus that may include non-purulent material, dirty traumatic wounds, faecal contamination, foreign body, de-vitalised viscus or pus encountered from any source during surgery then give a 5 day treatment course
Maxillofacial	ceftriaxone 2g IV	Teicoplanin 400mg IV + gentamicin 3mg/kg IV	
Thoracic	ceftriaxone 2g IV	Teicoplanin 400mg IV + gentamicin 3mg/kg IV	
Abdominal (with peritonitis)	ceftriaxone 2g IV metronidazole 500mg IV	Teicoplanin 400mg IV + gentamicin 3mg/kg IV + metronidazole 500mgIV	
Limbs	ceftriaxone 2g IV metronidazole 500mg IV	Teicoplanin 400mg IV + gentamicin 3mg/kg IV + metronidazole 500mg IV	
3.2.21 Cardiac implantable electronic device		**Penicillin allergy**	**comments**
Insertion of cardiac implantable electronic device	Flucloxacillin 1g IV	Teicoplanin 400mg IV	

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References

- BSAC/HIS/ICNA WP recommendations - JHI, 2006, 63 Suppl S3-4 – *Guidelines for MRSA in healthcare facilities: Screening.*
- Local experience/root cause analysis findings re higher risk of MRSA in CSU from patients with long term catheters.
- Start Smart then Focus. Advisory committee on antimicrobial resistance and healthcare associated infection (ARHAI), November 2011
- NICE clinical guideline 74. Surgical site infection, October 2008
- NICE clinical guideline 132. Caesarean section, November 2011
- SIGN antibiotic prophylaxis in surgery, July 2008
- Peterson & Waterman 2011, Exp Rev Anti Infect Ther: 9(1) 181-96

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4.1 Guidelines for the Treatment of *Clostridium Difficile*

See also the NBT Infection Control Clostridium Difficile policy

Background

Patients prescribed an antibiotic will often experience transient episodes of diarrhoea. The majority are not caused by *Clostridium difficile*. However, *C. difficile* associated colitis can cause considerable morbidity and mortality.

Action on suspicion of a case of *C. difficile* diarrhoea

- Before starting treatment send a sample of faeces for detection of *C. difficile* toxin.
- Treatment should not be delayed awaiting results. Commence treatment empirically if suspicion is high.
- Isolate symptomatic patients in a side-room or cohort ward and implement infection control measures. When isolation is not possible, discuss with Infection Control regarding best placement for the patient.
- Refer to Trust Management Pack for *C. difficile* outbreaks
- Discontinue all other antibiotics as soon as possible. Discuss with a microbiologist if an alternative agent required.
- Critically review the ongoing need for proton pump inhibitors (PPI) or H2 antagonists. Aim to stop if possible.
- Replace fluid losses and correct electrolyte imbalance.
- Avoid antimotility agents, e.g. loperamide, codeine, etc.
- Use thorough hand-washing techniques with soap and water. Gloves and apron should be worn when caring for patients with CDAD – please refer to the infection control policy on *C difficile* for further details.
- Observe closely for signs of worsening condition or toxic megacolon.

Treatment of the first episodes of *C. difficile* associated diarrhoea (CDAD)

The following severity assessment score should be used and documented in the patient's notes.

Any of the following indicates severe disease:

- temperature > 38.5°C
- WBC >15.0 x 10^9/L
- acutely rising blood creatinine (>50% increase over baseline)
- evidence of severe colitis (abdominal signs, radiology)

Severe cases: vancomycin 125mg QDS PO for 10 days.

Non severe cases: metronidazole 400mg TDS PO for 10 days

Metronidazole is available as a suspension which must be given on an empty stomach; where patients are being fed enterally, metronidazole tablets should be crushed and administered via an NG/PEG tube rather than using the suspension.

If *C. difficile* toxin is not detected, discontinue treatment.

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In severe cases not responding to vancomycin 125mg QDS PO by 7 days, use high dose vancomycin 500mg QDS PO +/- metronidazole 500mg TDS IV. The addition of oral rifampicin 300mg BD or immunoglobulin 400mg/kg may also be considered or a change of therapy to fidaxomicin 200mg BD for 10 days. These options must be discussed with a Medical Microbiologist or ID physician before being prescribed.

Treatment of recurrent or relapsed *C. difficile* infection

20% to 30% of patients with *C. difficile* associated diarrhoea relapse or have re-infection. These patients should be discussed with a microbiologist or ID physician and treated with fidaxomicin 200mg BD for 10 days.

Tapering followed by pulsed doses of vancomycin may be of value and the following regimen has been used: vancomycin orally 125mg QDS 1 week; 125mg TDS 1 week, 125mg BD 1 week, 125mg OD 1 week; 125mg on alternate days 1 week; 125mg every third day for 2 weeks – total duration of course 6 weeks.

The addition of rifaximin 550mg BD for 20 days immediately after finishing a standard antibiotic treatment course may decrease the incidence of recurrent diarrhoea.

Severe disease, other treatments

For patients with life-threatening disease, those who require surgery and those who do not respond to initial therapy, please consult a Medical Microbiologist.

There is a range of additional therapies available to treat *C. difficile* which include biotherapeutic, immunotherapy, use of combination antimicrobials intravenously or orally and pulsed antibiotics. There is no strong evidence to support the superiority of one approach over another but they may be of use in an individual patient.

The best approach to *C. difficile* diarrhoea is prevention.
Controlled antibiotic prescribing and stopping unnecessary PPIs and H2 Antagonists is essential.

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4.2 Guidelines for the Antimicrobial Management of Patients with Methicillin Resistant Staphylococcus aureus (MRSA) Infection

See also the NBT Infection Control MRSA policy

Introduction

In North Bristol NHS Trust, MRSA infection is relatively rare – only patients known to be MRSA colonised or those with prior infection require empiric therapy.

Antibiotics used in the therapy of MRSA

Vancomycin (see section 6.3 for dosing) for IV therapy

Doxycycline (100mg BD PO) for oral therapy

Duration of therapy

For non severe infection, 5 days of therapy is satisfactory. For cellulitis 5-14 days therapy may be required depending on severity and response rates. A bacteraemia with no evidence of deep infection, infective endocarditis or prosthesis associated infection should be treated for 14 days with vancomycin, particularly if IV line associated and the line is removed. For complicated bacteraemia, a longer duration will be required.

If there is doubt about therapy duration, discuss with a medical microbiologist.

4.3 Invasive Fungal Infection

Please discuss all potential invasive fungal infections with a Medical Microbiologist.

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5.1 ANTIBIOTIC GUIDELINES FOR NEUROSURGERY

5.1.1 Prophylaxis

		Penicillin allergy	comments
Clean non implant or minor implants (titanium mini plate, Brantigan cage, odontoid screw)	Flucloxacillin 1g IV + gentamicin 3mg/kg IV	Teicoplanin 400mg IV+ gentamicin 3mg/kg IV	
Major non shunt implants (acrylic/titanium cranioplasty, major spinal implants)	Flucloxacillin 1g IV + gentamicin 3mg/kg IV	Teicoplanin 400mg IV + gentamicin 3mg/kg IV	
Clean contaminated (one or more cranial air sinuses, crossed or access via nasopharynx or oropharynx)	Co-trimoxazole 960mg IV + metronidazole 500mg IV		
Shunt implant or revision	flucloxacillin 1g IV + gentamicin 3mg/kg IV + intraventricular vancomycin 10mg + intraventricular gentamicin 3mg	Teicoplanin 400mg IV + gentamicin 3mg/kg IV + intraventricular vancomycin 10mg + intraventricular gentamicin 3mg	
Implant of an Ommaya reservoir	intraventricular vancomycin 10mg + intraventricular gentamicin 3mg		
CSF leak (rhinorrhoea or otorrhoea)	Prophylaxis not required		
Penetrating cranio-cerebral injuries (gunshot wounds, other causes)	ceftriaxone 2g IV + metronidazole 500mg IV	Discuss with a medical microbiologist	If contaminated give a 5 day treatment course

All doses are single dose unless specified.
For prolonged operative procedures (> 6 hours and/or major blood loss), additional intra-operative doses of 50% of the initial dose should be administered every 4 hours (every 8 hours for gentamicin for the duration of the procedure)

For patients known to be MRSA positive or who have other risk factors (3.2.1) replace flucloxacillin with teicoplanin 400mg IV (unless giving co-trimoxazole).

In patients with impaired renal function a reduced dose of gentamicin should be given as per the table below.

creatine clearance (eGFR)	dose
>80ml/min	3mg/kg
40-80ml/min	2mg/kg
<40ml/min	1mg/kg

- In obese patients (BMI ≥30kg/m^2), use ideal body weight to calculate dose

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5.1.2 Protocol for patients whose EVDs are to be removed or who are to undergo shunt implantation

Three days before removal of an EVD/shunt implantation obtain a sample of CSF and submit to the Microbiology Department for Gram's film and culture.

Instil vancomycin 10mg and gentamicin 3mg (15mg and 4mg respectively for patients with very large ventricles) into the ventricles after the sample has been obtained.

The frequency of subsequent doses will depend on the volume of CSF drainage and must be assessed daily, at 24-hour intervals after the previous dose.

<50 mL	no further doses (except 1 intraoperative dose at the time of shunt implantation)
50-100 mL daily	a second dose on the third day (+ 1 intraoperative dose at the time of shunt implantation)
100-150 mL daily	a daily dose (+ 1 intraoperative dose at the time of shunt implantation)
150-250 mL daily	daily doses of vancomycin 15mg and gentamicin 4mg (+ 1 intraoperative dose at the time of shunt implantation)

NB For patients undergoing shunt implantation administer systemic prophylaxis according to prophylaxis guidelines (page 27)

Before EVD removal

If the final report on the sample of CSF (usually available 3 days after it was obtained) confirms that it is sterile remove the EVD.

If a Gram's stain of the sample of CSF (performed on receipt of the specimen) indicates the presence of bacteria, send a second sample for confirmation and continue vancomycin ± gentamicin (depending on isolate) for a further 4 days (5 days in total) according to the dosing frequency described above and then remove the EVD. If the Gram's stain suggests that the sample is sterile, but culture yields a bacterium (usually after 2-3 days) send a second sample for confirmation and continue the antibiotic(s) for a further 2-3 days (5 days in total) according to the dosing frequency described above and then remove the EVD.

Before shunting

If the CSF is reported to be sterile (usually 3 days after it was obtained) no further doses should be given following implantation of the shunt.

If a Gram's stain of the CSF indicates infection, send a second sample for confirmation. The consultant can then decide whether to continue giving the antibiotic(s) according to the dosing frequency described above until the shunt has been implanted and then to give vancomycin ± gentamicin (depending on the bacterium) via an Ommaya reservoir **daily** for 5-7 days following implantation **OR** to delay shunting until the patient has received vancomycin ± gentamicin (depending on the bacterium) for a total of 5 days according to the dosing frequency described above.

If the Gram's stain suggests that the sample is sterile, but culture yields a bacterium (usually after 2-3 days) send a second sample for confirmation. The consultant can then decide whether to give vancomycin ± gentamicin (depending on the bacterium) via an Ommaya reservoir **daily** for 5-7 days following implantation **OR** to delay shunting until the patient has received vancomycin ± gentamicin (depending on the bacterium) for a total of 5 days according to the dosing frequency described above.

5.1.3 CSF shunt infections

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Treatment is administered on an individual basis according to recommendations provided by the Medical Microbiologists.

5.1.4 Pyrexia in patients with blood in the ventricles

Patients with blood in their ventricles often have fevers. In such patients **who have no obvious foci of infection**, the initial investigation should be a CRP. If this is <100, no further investigations or empirical antibiotic treatment is indicated as the fever is almost certainly 'central' in origin. If the CRP is >100, an infection screen should be undertaken and, where appropriate, empirical therapy started.

5.1.5 Treatment of External Ventricular Drain (EVD) associated ventriculitis

If a Gram's film or culture result suggests that a patient has EVD-associated ventriculitis a second sample should be obtained as soon as possible. The diagnosis is confirmed by isolation of the same bacterium from two consecutive specimens. However, antibiotic(s) can be initiated immediately after the second sample has been obtained. If this sample is subsequently shown to be sterile, treatment should be discontinued.

The antibiotic(s) given will depend on the nature and susceptibility of the pathogen. However, usually only vancomycin and gentamicin are administered by the intraventricular route, and patients will receive one or more of these drugs. A minority of patients will also require systemic therapy.

Please consult the table below for guidance on appropriate dosing regimens. Treatment will be guided by a Medical Microbiologist on an individual patient basis.

NB It is clear that the criteria for choosing the dosages of vancomycin and gentamicin are largely subjective. However, if these regimens are followed, the likelihood of either underdosing or, owing to the excellent safety record of the drugs, overdosing will be minimal; toxicity associated with intraventricular administration of vancomycin has never been reported. It will be exceptional for a patient to receive >25mg of vancomycin or >5mg of gentamicin.

5.1.6 Postoperative patients with the clinical signs and/or symptoms of meningitis

A small percentage of neurosurgical patients will, in the postoperative period, develop signs and/or symptoms consistent with a diagnosis of meningitis; this may present one month or more after the surgery. In the majority (70%) of such cases, the meningitis is not of infective aetiology. However, there are no clinical criteria which can be used to reliably differentiate between those who do and those who do not have bacterial meningitis.

Investigations: Examination of CSF, including glucose concentration; simultaneous blood glucose determination; full blood count and CRP.

Management: Commence treatment with ceftriaxone 2g BD IV. If no bacterium is isolated after 3 days of incubation and the patient has made a rapid clinical response (usually within 24 h), discontinue treatment.

If a bacterium which is considered to be a true pathogen is isolated, further treatment should be discussed with a Medical Microbiologist.

5.1.7 Postoperative wound infections

The results of culture of the wound, if available, should be used to guide antibiotic treatment. If the results are not available and empirical therapy is required, flucloxacillin (1g QDS IV/ 500mg QDS PO), or clindamycin 600mg QDS IV / 300mg PO in patients who are allergic to penicillin, would be appropriate.

5.1.8 Brain abscess

Empirical therapy of patients with brain abscesses should be based on the site of the abscess and predisposing

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infectious processes, if they can be identified; an urgent Gram stain of pus obtained at the time of surgery might also be helpful. CRP should be used to monitor response to treatment.

Abscesses (usually frontal) which are sinugenic, odontogenic or of unknown origin:
ceftriaxone 2g BD IV + metronidazole 500mg TDS IV.

Abscesses (usually temporal) which are otogenic:
ceftazidime 2g TDS IV + amoxicillin 1g TDS IV + metronidazole 500mg TDS IV.

5.1.9 Subdural empyema

Empirical therapy of patients with subdural empyemata should be based on predisposing infectious processes and a Gram stain of pus obtained at the time of surgery. CRP should be used to monitor response to treatment.

Empirical antibiotic treatment: ceftriaxone 2g OD IV + metronidazole 500mg TDS IV

5.1.10 Antibiotic treatment regimens for patients with EVD-associated ventriculitis

Dosage according to CSF volume of distribution (baseline dosage)

Antibiotic	**<normal**	**normal**	**moderately >normal**	**markedly >normal**
vancomycin	5 mg	10 mg	15 mg	20 mg
gentamicin	2 mg	3 mg	4 mg	5 mg

Frequency of baseline dosage (according to CSF drainage since previous dose)

Antibiotic	**<50 ml over 3 days**	**50-100 ml over 2 days**	**100-150 ml in 24 hours**	**>150 ml in 24 hours**
vancomycin	every third day	alternate days	daily	daily + 5 mg for each 50 ml, or part thereof, >150 ml
gentamicin	every third day	alternate days	daily	daily + 1 mg for each 50 ml, or part thereof, >150 ml

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5.2 Empirical antibiotic therapy for Burn patients with A) Burn wound infection and B) presumed septic shock.

A. Burn Wound Infection

Time since injury occurred	Previous antibiotic therapy	Treatment
≤5 days	No	flucloxacillin 2g QDS IV Penicillin allergy: clindamycin 600mg QDS IV
≤5 days	Yes	amoxicillin 1g TDS IV + co-trimoxazole 960mg BD IV Penicillin allergy: co-trimoxazole 960mg BD IV + IV vancomycin
6-9 days	No	amoxicillin 1g TDS + co-trimoxazole 960mg BD IV Penicillin allergy: co-trimoxazole 960mg BD IV + IV vancomycin
6-9 days	Yes	piperacillin/tazobactam 4.5g TDS IV Penicillin allergy (non-type 1, non-severe): ceftazidime 2g TDS IV plus IV vancomycin Penicillin allergy (type 1 allergy/severe reaction): ciprofloxacin 500mg BD PO/400mg BD IV+ IV vancomycin
≥10 days	Yes or No	piperacillin/tazobactam 4.5g TDS IV or discuss with medical microbiology Penicillin allergy (non-type 1, non-severe): ceftazidime 2g TDS IV plus IV vancomycin Penicillin allergy (type 1 allergy/severe reaction): ciprofloxacin 500mg BD PO/400mg BD IV+ IV vancomycin

If a patient with clinical infection is:

- colonised with MRSA - add vancomycin
- colonised with *Pseudomonas aeruginosa* – use piperacillin/tazobactam at a dose of 4.5g QDS IV. If using ciprofloxacin as part of the 'penicillin allergy' regimens above, use a dose of 750mg BD PO/400mg TDS IV
- colonised with an MDR Gram-negative rod or has been transferred from another hospital which has a high incidence of MDR organisms – consultant a Medical Microbiologist

Duration of therapy: 5 days if pathogen isolated from burn wound; 3 days if no pathogen isolated. Review therapy at 48hrs.

Please note that patients with severe burns may develop pyrexia in the first few days after the injury even without sepsis.

B. Sepsis in a burns patient

The American Burn Association diagnosis of sepsis in burns patient is made after establishing the existence of an infection (documented by clinical response to antibiotics, pathological analysis of tissues from the wound or positive cultures) and at least three of the following criteria:

1. Temperature >39° or <36.5°C
3. Progressive tachycardia (>110 beats per min)
4. Progressive tachypnea (>25 breaths per minute not ventilated or minute ventilation >12l/min ventilated)
5. Thrombocytopenia <100 x10^9/l (will not apply until 3 days after initial resuscitation)
6. Hyperglycaemia, in the absence of pre-existing diabetes mellitus (untreated plasma glucose >11 mmol/l or >7 units of insulin/h intravenous drip or significant resistance to insulin, >25% increase in insulin requirement over 24h)
7. Inability to continue enteral feedings >24 h (abdominal distension or high gastric residuals, residuals two times feeding rate or uncontrollable diarrhoea, >2500 ml/day).

In addition to patients who fit the above criteria for sepsis, this antibiotic protocol should also be used in patients who are at high risk of sepsis including:

- Burns patients who are in ITU with inhalational injury
- Immunosuppressed patients with large open wounds

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The antimicrobial therapy is:

Piperacillin/tazobactam 4.5g QDS IV

If patient is:

- colonised with MRSA - add vancomycin
- colonised with an MDR Gram-negative rod or has been transferred from another hospital which has a high incidence of MDR organisms – consultant a Medical Microbiologist
- penicillin allergic - consult a Medical Microbiologist.

Patients should be deescalated to narrow spectrum therapy when culture results are available (48hr review).

5.2.2 Plastic surgery

		Penicillin allergy	**comments**
Cellulitis/ erysipelas	Flucloxacillin 2g QDS IV for 5-14 days oral switch: 500mg QDS	Clindamycin 600mg QDS IV for 5-14 days Oral switch: 300mg QDS	
Limb Abscess	Flucloxacillin 2g QDS IV for 7-14 days oral switch: 500mg QDS	Clindamycin 600mg QDS IV for 7-14 days Oral switch: 300mg QDS	
Animal and human bites	Co- amoxiclav 1.2g IV TDS or 625mg PO TDS for 5 days	Clindamycin 300mg IV (450mg IV) QDS +/- Ciprofloxacin 750mg BD PO for 7 days **Discuss with a Microbiologist.**	
Wound infection following clean surgery	Flucloxacillin 2g QDS IV for 5 days oral switch: 500mg QDS	Clindamycin 450mg QDS IV for 5 days Oral switch: 300mg QDS	Send MRSA Swabs
Cellulitis at a cannula site	Flucloxacillin 2g QDS IV for 5 days oral switch: 500mg QDS	Clindamycin 450mg QDS IV for 5 days Oral switch: 300mg QDS	
Cellulitis in a current injecting drug user	Flucloxacillin 2g QDS IV for 5 days oral switch: 500mg QDS	Clindamycin 450mg QDS IV for 5 days Oral switch: 300mg QDS	If known to be colonised with MRSA give vancomycin (see section 6.3 for dosing)
Mastitis and breast abscesses	Flucloxacillin 2g QDS IV for 5 days oral switch: 500mg QDS	Clindamycin 450mg QDS IV for 5 days Oral switch: 300mg QDS	
Necrotising fasciitis	Piperacillin-tazobactam 4.5g IV TDS plus clindamycin 600mg IV QDS If the patient is colonised with MRSA, has risk factors for MRSA, or is an IVDU – add vancomycin (see section 6.2 for dosing)	penicillin allergy – consult a Medical Microbiologist	Discuss treatment with a Medical Microbiologist as soon as diagnosis is made, early appropriate therapy is imperative. Consider the use of IVIG, especially in patients in whom Group A streptococcal infection seems likely.
Perianal infection	Co-trimoxazole 960mg BD IV and metronidazole 500mg TDS IV for 5 days Oral switch: co-trimoxazole 960mg BD + metronidazole		

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	400mg TDS		
Open fractures	Flucloxacillin 1g IV QDS + gentamicin IV	Teicoplanin 400mg IV OD + gentamicin IV	Therapy should continue for a maximum of 72 hours or until soft tissue closure, whichever is sooner. Give IV antibiotics ASAP: time to antibiotics affects long term outcome in open fractures

5.3 Richard Bright Renal Unit. Use of Antibiotics – Standards and Audit Measures

Complications resulting from Chronic Kidney Disease result in a high level of antibiotic use in Renal Units. This encourages antibiotic resistant bacteria and healthcare acquired infection such as C difficile diarrhoea. Antibiotics must only be used when necessary and an appropriate antibiotic must be used following necessary investigations. All decision making relating to use of antibiotics must be recorded.

5.3.1 Recording decisions

Standard	Audit measure
The clinical indication for each prescription for antibiotics must be recorded in the medical record for inpatients. For outpatient prescriptions, the indication must either be recorded in the notes or on the Proton summary screen.	Clinical indication recorded
48h after initiating antibiotics, there should be a review recorded in the medical record (or Proton summary screen for outpatients) that should include the results of culture and sensitivity and a decision on whether or not to continue therapy or to amend therapy as a result of reported culture and sensitivity	Written entry in the medical record or Proton summary screen 2 days after initiation of antibiotics that summarises laboratory results, advice from microbiologists, and decision on further antibiotic treatment
All prescriptions for antibiotics should include the intended duration of therapy	Prescriptions on drug charts for antibiotics should include 'for xx days'. Stop date on Proton prescriptions
All patients on four or more antibiotics should be discussed with a medical microbiologist, and the discussion recorded in the medical record	Record of discussion with microbiologists in all patients whose drug charts contain concurrent prescriptions for 4 or more antibiotics
All phone calls from medical microbiologists on specific patients should be recorded in the medical record, including at weekends.	Entry in the medical relating to each phone call made by microbiologist.

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5.3.2 Investigation of suspected infection

Standard	Audit measure
Intravenous antibiotics should never be prescribed before at least one set of blood cultures have been taken (other than in emergency treatment of suspected bacterial meningitis). In patients with a dialysis catheter, one set of cultures should be taken through the catheter, and one set taken peripherally.	Blood cultures received by laboratory
Oral antibiotics should never be prescribed for suspected urinary tract infection without first obtaining a bladder urine specimen for culture.	MSU, CSU, or suprapubic aspirate received by laboratory
Suspected community-acquired lower respiratory tract infection should be investigated according to the Trust policy. The full policy is available on the Trust intranet under Microbiology.	i. CXR performed and appearances recorded ii. Record of whether the patient is being treated as having an acute exacerbation of chronic obstructive airways disease or community-acquired pneumonia iii. Sputum culture sent prior to antibiotic treatment if the patient is recorded as having a productive cough at presentation.
Antibiotics for suspected soft tissue infection related to a vascular catheter, graft, or fistula should never be prescribed before blood cultures have been taken.	Blood cultures received by laboratory
Antibiotics for suspected CAPD-related peritonitis should never be prescribed without first sending PD effluent samples to the laboratory	50ml PD effluent sample received in laboratory

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5.3.3 Appropriate antibiotic choice

Before prescribing antibiotics patients should always be asked if they have any specific allergies. If allergic to the antibiotic advised in this guideline then the case should be discussed with microbiologist.
NO ANTIBIOTIC SHOULD BE PRESCRIBED FOR MORE THAN 5-7 DAYS UNLESS SPECIFICALLY ADVISED BY MICROBIOLOGY (name of advising microbiologist to be recorded in the notes)

Standard	Audit measure
Lower respiratory tract infection Antibiotics for suspected community-acquired lower respiratory tract infection should be prescribed according to the Trust policy. The full policy is available on the Trust intranet under Microbiology.	Appropriate antibiotics prescribed
Suspected bacteraemia related to vascular catheters should be treated with vancomycin IV. If confirmed by blood culture, the catheter should be removed, unless there are compelling clinical reasons for not doing so.	i. Vancomycin prescribed in patients with suspected 'line infection' ii. Record of Consultant level decision not to remove the catheter when there is a vascular catheter present and a positive blood culture
Soft tissue infection e.g. cellulitis IV flucloxacillin is first line treatment unless there is clinical reason (e.g. previous cultures) to suspect MRSA. If MRSA infection is suspected, vancomycin is first line treatment, with monitoring of vancomycin levels. If MSSA is confirmed on culture, patients on vancomycin should be changed to flucloxacillin. Dose of penicillins may need to be adjusted in renal impairment	Appropriate antibiotic prescribed
CAPD-related peritonitis should be treated according to the Renal Unit peritonitis policy.	Appropriate antibiotics prescribed
Suspected bacterial meningitis should be treated with intravenous ceftriaxone 2g BD IV; Amoxicillin should be added to cover *Listeria spp* if the patient is immunosuppressed	Appropriate antibiotics prescribed
Suspected urinary tract infection (in non-transplant patients) should be treated for 3 days unless there are clinical reasons for a longer course	i. Appropriate antibiotic prescribed ii. Duration of treatment 3 days OR reason for longer course recorded
Suspected gram-negative bacteraemia (from urinary tract or gastrointestinal disease) should be treated with piperacillin/tazobactam (4.5g TDS IV, adjusted if necessary for renal function).	Appropriate antibiotic prescribed
Infected renal cyst guidelines are available here	

For information on the use of antimicrobial line locks see the renal department guidelines.

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5.4. Hot Orthopaedics and Trauma Post Operative Wound Infection

Most post-operative wound infections in emergency related Orthopaedic Surgery in patients without prosthetic joints are cause by *S. aureus*. The drug of choice is flucloxacillin. If the patient is known to be MRSA-positive, the drug of choice is vancomycin (see section 6.2 for dosing). The regimen should be altered, if appropriate, in the light of culture results. Infections in patients with prosthetic joint infection are more complex, and these guidelines do not apply in these situations.

5.4.1 Septic arthritis

The predominant aetiological agent is *S. aureus*, followed by β-haemolytic streptococci. However, as almost any bacterium can be implicated, it is important to identify the pathogen.

Investigations:	blood cultures x 2, joint aspirate (including urgent Gram stain), CRP (and repeat every 5-7 days to monitor response to therapy)
Empirical therapy:	flucloxacillin 2g QDS IV otherwise, according to Gram stain results of joint aspirate
Definitive therapy: *S. aureus*	 flucloxacillin 2g QDS IV
Duration:	4 weeks in total (5-7 days IV, remainder PO)

5.4.2 Acute Osteomyelitis – not related to prosthetic joints

The predominant aetiological agent is *S. aureus.* However, the range of potential pathogens is extensive. Elderly patients in particular may be infected by unusual organisms. In patients (usually diabetics) with infected foot ulcers, multiple bacterial species may be implicated. It is **ESSENTIAL** therefore to identify the microbiological cause(s).

Investigations:	bone biopsy/aspirate (including urgent Gram stain), blood culture x 2, CRP (and repeat every 5-7 days to monitor response to therapy) Do not rely on the results of superficial swabs of ulcers to identify the cause(s) of the bone infection
Empirical therapy:	flucloxacillin 2g QDS IV
Definitive therapy: *S. aureus* other pathogens	 flucloxacillin 2g QDS IV discuss with Medical Microbiologist
Duration:	minimum 6 weeks in total (5-10 days IV, remainder PO)

5.4.3 Acute infections in patients with metalwork *in situ*, but where the metalwork cannot be removed until the fracture has united

seek advice from a Medical Microbiologist
NB. It must be assumed that the bone is infected

5.4.4 Open Fractures

Flucloxacillin 1g QDS IV + gentamicin 5mg/kg IV OD.

In patients with a penicillin allergy: teicoplanin 400mg IV + gentamicin 5mg/kg IV
Therapy should continue for a maximum of 72 hours or until soft tissue closure, whichever is sooner.
Give IV antibiotics ASAP: time to antibiotics affects long term outcome in open fractures.

5.4.5 Spinal abscesses/infection

All patients with a proven or presumed spinal infection should be discussed with the Microbiology or ID teams.

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5.5. Obstetrics and Gynacology

The following relevant guidelines can be found on the Maternity homepage:

http://sharepoint/sites/wch/teamsite/maternity/GuidelinesHomepage/AZList/Forms/AZ.aspx

- Group B Streptococcal (GBS) Care in pregnancy and labour
- Sepsis (and empirical treatment of common perinatal infections)
- UTI in Pregnancy
- Management of Pre Term pre labour rupture of membranes 24-37 Weeks

5.5.1 Pelvic Inflammatory Disease

Outpatient in mild/moderate PID has equivalent outcomes to inpatient treatment. However antibiotics should be started as soon as PID is suspected as delay may increase the severity of infection and the risk of long term sequelae.

The RCOG recommended regimes for outpatient treatment of PID are:

- ofloxacin 400mg BD PO + metronidazole 400mg BD PO for 14 days.

OR

- Stat dose of ceftriaxone 500mg IM followed by doxycyline 100mg BD PO + metronidazole 400mg BD PO for 14 days.

Ofloxacin should be avoided in patients at high risk of gonococcal infection (e.g. partner has GC) and metronidazole may be discontinued in patients with mild/moderate PID if they are intolerant.

Inpatient treatment is indicated in patients with severe PID, pregnant patients, non-response or intolerance of oral treatment, suspected tubo-ovarian abscess or where urgent surgical treatment may be necessary.

The RCOG recommended regimes for inpatient treatment of PID are:

- ceftriaxone 2g OD IV + doxycycline 100mg BD PO (oral switch: doxycycline 100mg BD PO + metronidazole 400mg BD PO) for 14 days total.

OR

- clindamycin 900mg TDS IV + gentamicin IV (see section 6.1 for dosing), followed by either:
  - clindamycin 450mg QDS PO to complete 14 day course
  - doxycycline 100mg BD PO + metronidazole 400mg BD PO to complete 14 day course.

IV antibiotics should be continued until 24 hours after clinical improvement and followed by oral therapy.

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6. DOSING OF GENTAMICIN, AMIKACIN AND VANCOMYCIN

Antibiotic Assays – Gentamicin, Amikacin and Vancomycin

To ensure the medical microbiologist can provide timely and accurate advice on antibiotic assays, the following data is required:-

- antibiotic to be assayed
- last dose (mg)
- when last dose given (hour, date)
- whether dose pre/post dose level
- the dose size (mg) and the time of dose (hour, date) and time of assay (hour, date)

Failure to provide this information may result in the assay not being performed.

6.1. Gentamicin

(a) Therapy

As gentamicin does not penetrate into adipose tissue significantly, **obese patients (BMI ≥30kg/m^2) should be dosed based on their ideal body weight** which is calculated as:

Male: ideal body weight = 50 + (2.3 x height in inches over 5ft)
Female: ideal body weight = 45 + (2.3 x height in inches over 5ft)

Creatinine clearance	gentamicin dose	dose frequency
>80ml/min	7mg/kg	24 hours
40-80ml/min	5mg/kg	24 hours
20-40ml/min	5mg/kg	48 hours
<20ml/min (discuss use with a medical microbiologist)	5mg/kg	measure level at 48h and await the result before giving next dose

The maximum dose of gentamicin should not exceed **560mg** daily.

Creatinine clearance should be used instead of eGFR. This can be calculated using the Cockcroft-Gault formula which can be found here or the gentamicin calculator on the Microbiology homepage.

A pre-dose gentamicin level should be measured before the second dose and should be ≤1mg/L. Take pre-dose assays immediately before the dose is due – do not wait for the result before giving the next dose unless advised.

Provided the pre-dose level before the second dose is ≤1mg/L, then gentamicin should be re-assayed twice in the following week. Renal function should be monitored **daily** while a patient is on gentamicin.

If the pre-dose level is >1mg/L, dosing modification or use of an alternative agent may be required. This should be discussed with a medical microbiologist.

Once-a-day dosing regimens have only been validated for patients with normal renal function (creatinine clearance >80ml/min) and therefore some caution is required in patients with renal impairment. Once-daily dosing is not appropriate for treating endocarditis. See BSAC guidelines for further information.

Gentamicin is excreted by the kidney, and accumulation may result in nephrotoxicity and ototoxicity. Those at special risk include the elderly, hypotensive patients and those with existing renal impairment. Prescribers who have concerns about the dose to use and its frequency should discuss with a medical microbiologist or infection pharmacist.

No patient should receive gentamicin for more than 7 days without clinical advice from a medical microbiologist.

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When gentamicin is being used as monotherapy in the therapy of aerobic Gram-negative rods (coliforms or Pseudomonas spp), a peak concentration 1hr after the dose should be taken. This should be ≥7mg/L.

(b) Prophylaxis

Where gentamicin is used as prophylaxis (see Section 3.2), then the following guide should be used.

creatine clearance (eGFR)	Dose (depending on procedure)	
>80ml/min	5mg/kg	3mg/kg
40-80ml/min	3.5mg/kg	2mg/kg
<40ml/min	2mg/kg	1mg/kg

- 5mg/kg dose is used for prophylaxis in orthopaedic surgery, except lower limb amputation
- obese patient BMI ≥30kg/m^2, use ideal body weight (see above) to calculate dose

6.2. Amikacin

As amikacin does not penetrate into adipose tissue significantly, **obese patients (BMI ≥30) should be dosed based on their ideal body weight** which is calculated as:-

Male: ideal body weight = 50 + (2.3 x height in inches over 5ft)
Female: ideal body weight = 45.5 + (2.3 x height in inches over 5ft)

Creatinine clearance	amikacin dose	dose frequency
>80ml/min	15mg/kg	24 hours
40-80ml/min	10mg/kg	24 hours
20-40ml/min	10mg/kg	48 hours
<20ml/min (discuss use with a medical microbiologist)	10mg/kg	measure level at 48h and await the result before giving next dose

Creatinine clearance should be used instead of eGFR. This can be calculated using the Cockcroft-Gault formula which can be found here.

A pre-dose amikacin level should be measured before the second dose and should be ≤5mg/L. Take pre-dose assays immediately before the dose is due – do not wait for the result before giving the next dose unless advised.

Provided the pre-dose level before the second dose is ≤5mg/L, then amikacin should be re-assayed twice in the following week. Renal function should be monitored **daily** while a patient is on amikacin.

If the pre-dose level is >5mg/L, dosing modification or use of an alternative agent may be required. This should be discussed with a medical microbiologist.

Once-a-day dosing regimens have only been validated for patients with normal renal function (creatinine clearance >80ml/min) and therefore some caution is required in patients with renal impairment. Amikacin should not be used to treat endocarditis.

Amikacin is excreted by the kidney, and accumulation may result in nephrotoxicity and ototoxicity. Those at special risk include the elderly, hypotensive patients and those with existing renal impairment. Prescribers who have concerns about the dose to use and its frequency should discuss with a medical microbiologist or infection pharmacist.

No patient should receive amikacin for more than 7 days without clinical advice from a medical microbiologist.

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Amikacin is only used in these guidelines for the therapy of hospital acquired complicated UTI and peak concentrations assays are not required.

6.3 Vancomycin

Vancomycin is dosed twice a day and serum levels are monitored to reduce the risk of significant accumulation and nephrotoxicity. Vancomycin is administered in a volume of 100-250ml by slow infusion (10mg/min) to avoid red man syndrome. Vancomycin is excreted almost entirely via the kidney.

Vancomycin pre-dose levels should be measured at the 3rd or 4th dose as convenient. Pre-dose assays should be taken immediately before the dose is given. Do not delay the dose until the result is available. The pre-dose vancomycin level should be in the range 5-15mg/L. If this is the case, a further pre-dose should be measured once per week plus a serum creatinine over the duration of therapy.

In obese patients, total body weight should be used to determine initial dosing using a dose of 15mg/kg every 12 hrs.

The following dosing guide should be used:-

creatinine clearance	vancomycin dose	dose frequency
>80ml/min	1000mg	12hrly
40-80ml/min	750mg	12hrly
20-40ml/min	500mg	12hrly
<20ml/min	1000mg	measure level at 48h and await the result before giving the next dose

eGFR is an normally an acceptable estimate of creatinine clearance. In patients with extremes of bodyweight or who are over 75 years old, creatinine clearance should be calculated using the Cockcroft-Gault formula which can be found here.

For patients with creatinine clearances of <20ml/min not under the care of a renal physician, please discuss the dosing with a medical microbiologist or infection pharmacist.

Alternatively, if the serum creatinine is <110µmol/L, then the following guide can be simpler based on age.

Age (years)	vancomycin dose	Dose frequency
<60	1000mg	12hrly
60-75	750mg	12hrly
>75	500mg	12hrly

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7. ASSESSMENT OF PENICILLIN ALLERGY

Many patients claim to be allergic to penicillin, however only 10-25% of these are truly penicillin allergic. It needs to be established if they are truly allergic (type 1 allergy), this allergy would be characterised by:-

- urticaria
- itching, lumpy rash
- lip swelling
- tongue/laryngeal swelling
- bronchospasm
- hypotension

These features usually occur within 72 hours of receiving penicillin.

Nausea, vomiting, sore throat, diarrhoea, are not manifestations of penicillin allergy.

Patients with a type 1 allergy should not receive βlactams (penicillins, cephalosporins, and carbapenems).
Patients who do not have a type 1 allergy can safely receive cephalosporins or carbapenems.

Penicillin containing drugs	**Other βlactams (not penicillins)**
amoxicillin	cefradine
co-amoxiclav (Augmentin)	cefalexin
benzyl penicillin	cefuroxime
phenoxymethyl penicillin	cefotaxime
flucloxacillin	ceftriaxone
piperacillin-tazobactam (Tazocin)	ceftazidime
pivmecillinam	cefixime
	ertapenem
	meropenem

Reference

Pegler S, Healy B. In patients allergic to penicillin, consider second and third generation cephalosporins for life threatening infections. BMJ; 335; 991.

8. FURTHER INFORMATION/ REFERENCES

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British National Formulary – 66, March 2015

British National Formulary for Children, 2015

BSR & BHPR, BOA, RCGP and BSAC guidelines for management of the hot swollen joint in adults
Rheumatology 2006, 45, 1039-41, or www.bsac.org.uk/resource_library.cfm

Guidelines for the prevention of endocarditis: report of the Working Party of the British Society for Antimicrobial Chemotherapy
www.bsac.org.uk/resource_library.cfm

Guidelines for the prophylaxis and treatment of MRSA infection
www.bsac.org.uk/resource_library.cfm

National Institute for Clinical Excellence
Chronic obstructive pulmonary diseases
Management of COPD in adults in primary and secondary care
www.nice.org.uk/pdf/CG012_niceguideline.pdf

British Thoracic Society
Guidelines for the Management of Community acquired pneumonia in adults
Thorax 2001; 56 (Suppl IV) or
www.brit-thoracic.org.uk/bts_guidelines_pneumonia_html

Guidelines for Management of CAP in adults, 2004 update
www.brit-thoracic.org.uk

Glossary

BNF	British national formulary
CAP	Community-acquired pneumonia
CAPD	Continuous ambulatory peritoneal dialysis
CCDC CDAD	Consultant in Communicable Disease Control Clostridium Difficile Associated Infection
CMV	Cytomegalovirus
CRP	C-reactive protein
CSF	Cerebrospinal fluid
CSU	Catheter stream urine
CXR	Chest X-ray
EVD	Extra-ventricular drain
FBC	Full blood count
HAP	Hospital-acquired pneumonia
HSV	Herpes Simplex virus
MRSA	Methicillin Resistance Staphylococcus Aureus
MSU	Mid-stream urine
VZV	Varicella Zoster virus

Appendix A. Guideline for Vaccinations and Prophylactic Antibiotics required for Adult Patients Undergoing Emergency or Elective Splenectomy

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Patients who have had a splenectomy are at risk of overwhelming infection from certain microorganisms such as *Streptococcus pneumoniae*, *Haemophilus influenzae* type B and *Neisseria meningitidis*. These guidelines also apply to patients with non-functioning spleens.

Vaccinations

The Department of Health recommends the following vaccinations in patients who have had or are going to have a splenectomy.

- **Haemophilus Influenzae type b**
- **Meningococcal A, C W135 and Y conjugate**
- **Meningococcal B**
- **Pneumococcal**
- **Influenza**

Where possible, vaccines should be administered at least two weeks prior to **elective surgery**. Ideally this should be carried out by the GP prior to the hospital admission. If patient is not vaccinated beforehand then surgery should not be delayed.

In the case of **emergency splenectomy** current guidance is to wait 2 weeks before giving vaccinations. However immunisation should not be delayed if this is likely to result in failure to vaccinate. The clinician may prefer to vaccinate the patient before discharge to ensure that it has been done.

Schedule- Applies to adults only regardless of previous vaccination status

Vaccine	Timing
Hib/MenC Combined vaccine	**Elective splenectomy-** GP to vaccinate at least 2 weeks prior to admission. **Emergency splenectomy**- 2 weeks post- surgery or before discharge.
Pneumococcal polysaccharide Vaccine (PPV)	**Elective splenectomy**- GP to vaccinate at least 2 weeks prior to admission. **Emergency splenectomy**- 2 weeks post- surgery or before discharge. Booster dose every 5 years in asplenic patients
Meningitis B Vaccine (Bexsero)	**Elective splenectomy –** GP to vaccinate prior to admission. Two doses needed 1 month apart. The second dose should be at least 2 weeks prior to admission. **Emergency splenectomy –** First dose 2 weeks post-surgery or prior to discharge. Second dose one month after initial vaccines.
MenACWY conjugate	**One month after initial vaccines** **Inform GP to give**
Seasonal Influenza	**Inform GP to give as soon as practical. Should be given annually.**

DETAILS OF VACCINATIONS GIVEN MUST BE CLEARLY DOCUMENTED IN THE PATIENTS NOTES AND ON THE DISCHARGE LETTER. PLEASE INFORM GP TO FOLLOW UP ON VACCINES NOT GIVEN.

Cautions

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Vaccinations should be delayed if the patient has signs of significant febrile illness.
Please seek specialist advice if patient undergoing chemotherapy or radiotherapy as the pneumococcal vaccine may have to be delayed.
Patients with immunosuppression or HIV may not make a full antibody response to pneumococcal vaccine. Please seek specialist advice.

Prophylactic antibiotics

- Phenoxymethylpenicillin 250mg PO BD or amoxicillin 250mg PO OD
- Erythromycin 500mg PO BD in penicillin allergic patients

Lifelong prophylactic antibiotics should be offered to patients considered at continued high risk of pneumococcal infection. See current British Journal of Haematology guidelines for further information. Antibiotic prophylaxis is **essential** in the first 2 years after the operation.

http://www.bcshguidelines.com/documents/Review_of_guidelines_absent_or_dysfunctional_spleen_2012.pdf

Additional points

Patients are to be advised to seek medical attention immediately if they are ill. Especially if they experience symptoms such as fever, sore throat severe headache or abdominal pain.

Patients are to be advised to get treatment for any bites (especially dog)

Patients are to be advised to seek advice on malaria prophylaxis and extra vaccinations if travelling abroad.

All Patients must be given a copy of "Splenectomy information for patients" available from pharmacy.

References-

Davies JM, Lewis MPN, Wimperis J, Rafi I, Ladhani S, Bolton-Maggs PHB. Review of guidelines for the prevention and treatment of infection in patients with an absent or dysfunctional spleen:
Prepared on behalf of the BCSH by a Working Party of the Haemato-Oncology task Force. British
Journal of Haematology,2011; 155: 308-317.
http://www.bcshguidelines.com/documents/Review_of_guidelines_absent_or_dysfunctional_spleen_2012.pdf

Department of Health. Immunisation Against Infectious Diseases 1996 – "The Green Book". Updated version available online:
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BNF 66 September 2014.Pharmaceutical Press.

Appendix B. Guidelines for antibiotic dosing in patients with impaired kidney function

These guidelines aim to provide information on suitable dose adjustments for frequently prescribed antibiotics in hospital inpatients with impaired renal function. These guidelines do not aim to provide information on all

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antibiotics and complex patients should be discussed with microbiology and/or a member of the renal pharmacy team. Information produced by manufacturers on antibiotics not included in this document can be found online at **http://emc.medicines.org.uk** or alternatively individual cases can be discussed with a member of the renal pharmacy team.

Recommendations are based on the patient's current creatinine clearance (CrCl), which is used as an estimate of kidney function. eGFR is an normally an acceptable estimate of creatinine clearance. In patients with extremes of bodyweight creatinine clearance should be calculated using the Cockcroft-Gault formula which can be found here.

Anuric and oliguric (<500ml/day) patients can be assumed to have a CrCl <10ml/min (severe renal impairment). Patients receiving renal replacement therapy with intermittent haemodialysis or peritoneal dialysis should be dosed the same as patients with a CrCl of less than 10ml/min unless otherwise stated.

Patients receiving continuous hemofiltration or haemodiafiltration are beyond the scope of this document.

Dosing regimens suggested reflect local practice for hospital inpatients and may be outside the scope of the product licence. Unlicensed doses are indicated in ***bold italics.*** The decision to prescribe an unlicensed dose should be considered along with the patient's clinical condition and infection being treated when choosing a dosing regimen. Patients should be closely monitored for signs of treatment efficacy and toxicity.

Antibiotics that are removed by haemodialysis should be administered post dialysis where possible. This is particularly important where doses are administered once daily.

Table 1. Antibiotic doses in renal impairment

Bold italic text indicates that the dose is outside the product licence.

	Creatinine Clearance (CrCl)	Dose recommended	Comments
IV / Oral amoxicillin	>30 ml/min	Standard doses[1]	Higher doses may be required for treatment of endocarditis discuss with microbiology. Dialysed
	<30ml/min	***500mg - 1g TDS***[2]	
IV benzylpenicillin	>20ml/min	***Standard doses***[2]	Monitor for neurotoxicity at high doses. Dialysed
	10-20ml/min	600mg – ***2.4g*** *QDS*[2]	
	<10ml/min	600mg - ***1.2g*** *QDS*[2]	
Oral cefalexin	>20ml/min	500mg – ***1g*** TDS[1,2]	Dialysed
	10–20 ml/min	***500mg TDS***[2]	
	<10ml/min	***250mg - 500mg TDS***[2]	
IV ceftazidime	>50ml/min	Standard doses[1]	Higher doses have been used discuss with microbiology / pharmacy. Monitor for neurological side effects, consider levels. Dialysed
	31-50ml/min	1 - ***2g*** every 12 hours[2]	
	16-30mlmin	1 - ***2g*** every 24 hours[2]	
	6-15ml/min Inc. CAPD	500mg - ***1g*** every 24 hours[2]	
	<5ml/min	500mg - ***1g*** every 48 hours[2]	
	Haemodialysis	1g after each dialysis session[3]	
IV ceftriaxone	>10ml/min	Standard doses[1]	
	<10ml/min	1 - 2g OD[1]	
IV cefuroxime	20-50ml/min	Standard doses[1]	Dialysed
	10-20ml/min	750mg BD[1]-***1.5g TDS***[2]	
	<10ml/min	***750mg - 1.5g BD***[2]	
Oral ciprofloxacin	>60ml/min	Standard doses[1]	Higher doses of 750mg BD may be

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	<60ml/min	500mg BD[1]	considered at all levels of renal function. Discuss with microbiology. Monitor for tendinitis with long courses. Dialysed
IV ciprofloxacin	>60ml/min	Standard doses[1]	Dialysed
	<60ml/min	400mg BD[1]	
IV / Oral clarithromycin	>30ml/min	Standard doses[1]	Care! Check for significant interactions with transplant medication
	10-30ml/min	***Standard doses[2]***	
	<10ml/min	***Standard doses [2] High doses may cause vomiting.***	
Oral clindamycin	>10ml/min	Standard doses[1]	Care! Half-life is prolonged in severe renal impairment but clinical significance unknown.
	<10ml/min	Doses up to 450mg QDS[2]	
IV clindamycin	>10ml/min	Standard doses[1]	
	<10ml/min	Doses up to 1.2g QDS[2]	
Oral co-amoxiclav	>30ml/min	Standard doses[1]	Care! With prolonged courses, clavulanic acid accumulates monitor LFTs Dialysed
	<30ml/min	***Standard doses[2]***	
IV co-amoxiclav	>30ml/min	1.2 g TDS[1]	
	<30ml/min	***1.2g BD[2]***	
IV / Oral co-trimoxazole	>30ml/min	960mg BD[1]	Monitor FBC Higher doses may be required for treatment of PCP discuss with microbiology/ pharmacy.
	<30ml/min	480mg BD[1]	
Oral doxycycline	All levels of renal function	Standard doses[1]	
IV / Oral erythromycin	>20ml/min	Standard doses[1]	Care! Check for significant interactions with transplant medication.
	10ml-20ml/min	Up to 1g QDS[2]	
	<10ml/min	Up to 500mg QDS[2]	
IV flucloxacillin	>10ml/min	Standard doses[1]	Consider levels if high doses required, monitor LFTs
	<10ml/min	Doses up to 1g QDS[2]	
IV / Oral metronidazole	All levels of renal function	Standard doses[1]	Dialysed
IV Meropenem	>50ml/min	**500mg QDS**	Dialysed
	26-50ml/min	***500mg TDS***	
	10-25ml/min	**500mg BD[1]**	
	<10ml/min	**500mg-1g OD[1]**	
Oral minocycline	All levels of renal function	Standard doses[2]	
Oral nitrofurantoin	>30ml/min	Standard doses[4]	
	<30ml/min	Avoid[3]	
Oral penicillin V	All levels of renal function	Standard doses	
IV piperacillin / tazobactam	>20ml/min	4.5g TDS[1]	Higher doses may be used in neutropenic sepsis discuss with microbiology/ pharmacy.
	<20ml/min	4.5g BD[1]	
IV/ Oral rifampicin	>10ml/min	Standard doses[2]	Check for significant interactions with transplant medication. Monitor LFTs. May colour PD fluid. Higher doses may be required for management of meningitis discuss with microbiology/ pharmacy.
	<10ml/min	600mg daily[2]	
Oral trimethoprim	All levels of renal	Standard doses[1] for short	Serum creatinine may rise. Consider

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	function	courses. Discuss with microbiology/ pharmacy if prolonged treatment doses required.	folic acid supplementation if prolonged treatment doses required.

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