

The Robert Jones and Agnes Hunt Orthopaedic Hospital



NHS Foundation Trust

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ANTIBIOTIC GUIDELINES FOR ADULTS IN SHROPSHIRE HOSPITALS

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Comments/suggested changes for consideration welcome. Send to stephanie.damoa-siakwan@sath.nhs.uk

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Consultant Microbiologists:

Dr Michael Brian

Dr Stephanie Damoa-Siakwan

Dr Graham Harvey

Dr Patricia O'Neill

Department of Microbiology for

Shrewsbury and Telford NHS Trust

Robert Jones and Agnes Hunt Orthopaedic Hospital Foundation Trust

Using antibiotics is a not a subject where every answer can be pre-defined. These guidelines describe first steps in common situations and are not comprehensive or applicable to patients with two infections. Organism resistance rates and cross-resistance are important. Empirical management will not deal with unexpected resistance, which means failure and changing antibiotics. If the situation you meet is not covered, consult a microbiologist.

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1. GUIDELINES

These should be used as the definitive antibiotic guidance that supplements other clinical guidelines on the intranet. If in doubt about antibiotic therapy, please discuss with Consultant Microbiologist ext. 1161 (RSH) or 76-1161 (PRH). Contact via switchboard out of hours. **Empirical guidelines** (section 1) apply when the organism and its susceptibility is not known. **Definitive preferences** for when the organism and its susceptibility is known are given separately in section 2.

These guidelines are intended for adults only. Different antibiotics may be needed for children.

NB Use of cephalosporins including cefuroxime, cefotaxime and ceftriaxone, quinolones, and carbapenems is being reduced, reflecting the need to reduce the provocation of *C.difficile*. Gentamicin is the preferred agent for Gram-negative "cover".

• General Principles

The general principles of antibiotic prescribing are summarised in figure 1

1. Antibiotics must be reviewed when microbiology results are available. Always review antibiotic use when results and/or clinical picture confirm, narrow or preclude a diagnosis of infection.
2. Always write the diagnosis of what infection is being treated in the notes and on the drug card. Avoid non-specific terms such as chest infection or sepsis.
3. Intravenous therapy must be reviewed by 48 hours & consider change to oral agents. Stop antibiotics altogether if there is no clear evidence of infection - to reduce the risk of *C.difficile*.
4. Oral follow on is not always necessary. Oral follow on after iv antibiotics should be dictated by microbiology results. Intravenous to oral switch after 48 hours is desirable if the intravenous line is removed to reduce the risk of line-associated infection and there is no broadening of the antibiotic spectrum used. There is no virtue in continuing antibiotics if they are not needed..
5. Use higher doses in patients weighing >70Kg, particularly if using flucloxacillin or other penicillins.
6. All doses quoted are for adults with normal renal function and weight.
7. Gentamicin and tobramycin dosing must be precise and is worked out on a basis of 7mg/Kg once daily. If a lower dose is given, and interpretations for 7mg/Kg applied, ototoxicity and nephrotoxicity may result because drug clearance will falsely be assumed to be normal. DO NOT USE 5mg/Kg. **Increase dose intervals for Gentamicin and Vancomycin in renal impairment.** Renal function must be checked within 24 hours of starting vancomycin or gentamicin and dose changed if abnormal. **Avoid use of vancomycin with gentamicin because of synergic nephrotoxicity.** Consultant microbiologists can advise on alternatives.
8. Metronidazole is unnecessary and undesirable with Co-amoxiclav, Piperacillin-tazobactam, Clindamycin, Meropenem or, Ertapenem as these all cover anaerobes.
9. Topical Mupirocin should be used only in accordance with the MRSA integrated care pathway.
10. Tetracyclines and quinolones. Avoid giving milk/antacids/iron which stop their absorption. Doxycycline is deliberately advised at 100mg bd because this regimen has proved effective in MRSA clearance and treatment, loading doses are often accidentally omitted and because it is a non-toxic dose in chlamydia infection and patients without established renal impairment. Intravenous doxycycline is a specially imported unlicensed preparation: use oral doxycycline whenever possible. Avoid tetracyclines (including doxycycline) during breast-feeding, or under the age of 12 years.

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11. In pregnancy avoid tetracyclines (e.g. doxycycline), quinolones (e.g. ciprofloxacin), aminoglycosides, mupirocin and high dose metronidazole. Avoid trimethoprim in the first trimester and nitrofurantoin at term.

• **Duration of treatment**

Give short courses of antibiotics where possible. Five days is normally adequate unless otherwise stated and automatic stop orders after 5 days are enforced unless other durations are specifically prescribed initially. Guidance is included on when longer courses are routinely justified. Reducing antibiotic use in hospital is important. Do not progress with repeat or new antibiotic courses after the first one for whatever indication without microbiological advice. This carries a high risk of C difficile.

• **Allergy**

Establish and record details of drug allergies prior to prescribing antimicrobial treatment. Some patients report they are allergic to agents but further questioning can reveal that they do not have a true allergy. Diarrhoea and nausea are features of intolerance not true allergy.

Pharmacists can help with queries and assist in obtaining information from the GP.

Patients with a history of anaphylaxis, laryngeal oedema, bronchospasm, hypotension, local swelling, urticaria or pruritic rash, occurring immediately after a penicillin are potentially at increased risk of immediate hypersensitivity to beta-lactams and should not be prescribed a beta-lactam antibiotic (e.g. penicillin, flucloxacillin, cephalosporins, carbapenems). Remember co-amoxiclav (augmentin) and piperacillin/tazobactam contain a penicillin. Patients with non-severe reaction to penicillin may receive cephalosporins or carbapenems. However, a percentage of patients with severe penicillin allergy (variously estimated as 2-10%) are allergic to cephalosporins and meropenem or ertapenem.

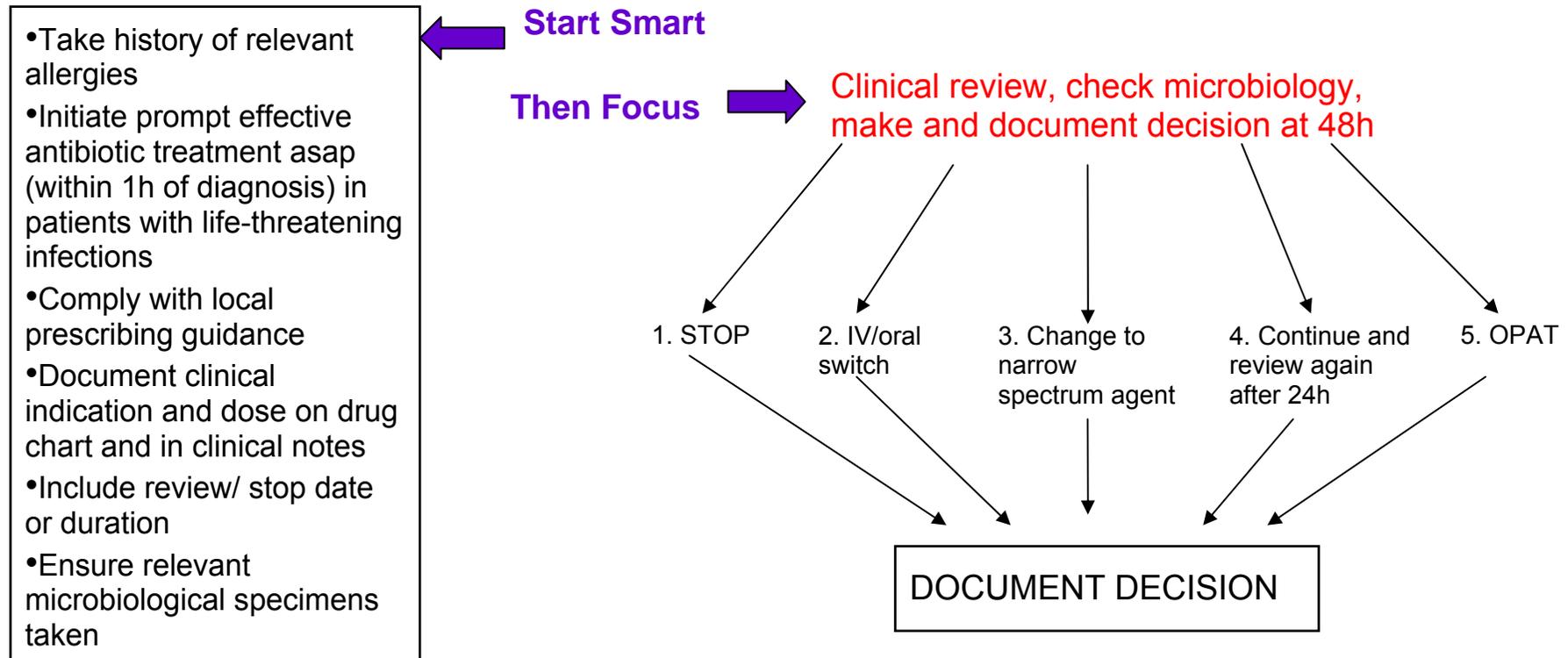
For further information see appendix 1.

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Figure 1

Antibiotic Stewardship

Right drug, Right dose Right time, Right duration....Every patient



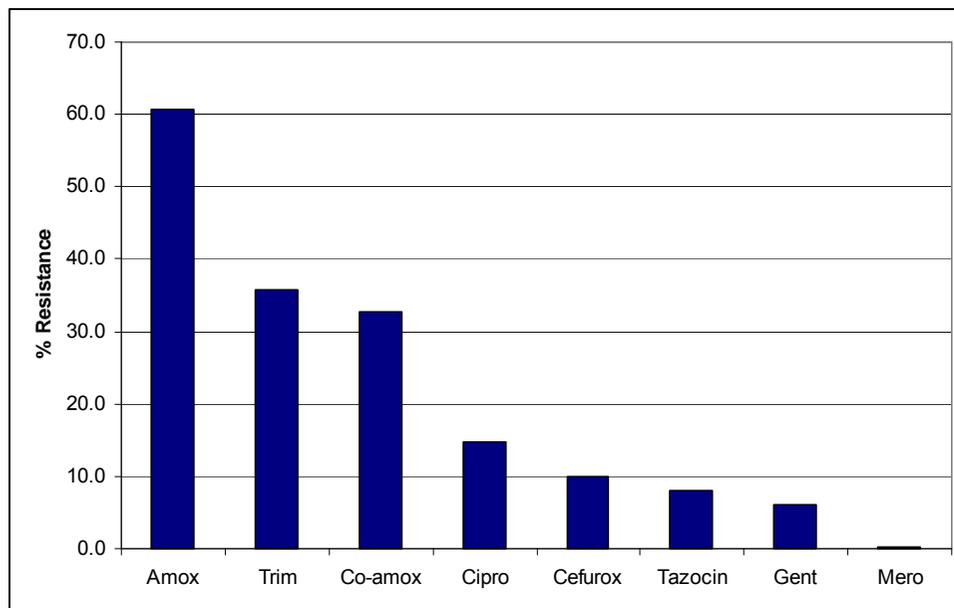
Department of Health Advisory Committee on Antimicrobial Resistance and Healthcare Associated Infection (ARHAI)

Antibiotic Resistance Rates in Shropshire

Antibiotic Resistance Rates of Common Organisms Jul 13-Jun 14

	Streptococcus pneumoniae	Haemophilus influenzae	Group A Streptococcus	S. aureus (excludes screens)
Amoxicillin	-	21.3	-	-
Co-amoxiclav	-	3.1	-	-
Trimethoprim	-	33.5	-	-
Penicillin	2.9	-	0	-
Doxycycline	12.1	1.0	4.0	8.7
Erythromycin	12.3	-	3.1	13.6
Flucloxacillin	-	-	0	7.1

Gram Negative Organism Resistance Rates in Blood Cultures Jan12-Jul13



2. Empirical Guidelines

Sepsis		
<p>Ensure that blood cultures, urine and other appropriate cultures are taken. All regimes are empirical and must be reviewed by 48h with results. See also Surviving Sepsis information on posters and intranet</p>		
<p>Septic shock/ Severe sepsis No obvious source</p>	<p>Flucloxacillin 1g qds iv (1.5g qds if >80Kg, 2g qds if >100kg) AND Gentamicin 7mg/kg iv od AND metronidazole 500mg iv tds Known renal impairment/suspected ARF Piperacillin/tazobactam 4.5g bd AND a single dose Gentamicin 2mg/kg Previous history MRSA Piperacillin-tazobactam 4.5g tds AND Vancomycin 1g bd iv Penicillin allergy or history ESBL Meropenem 1g tds Severe penicillin allergy Vancomycin 1g bd iv AND Aztreonam 1g tds AND metronidazole 500mg tds iv</p>	<p>For use in unwell patients with unclear source, otherwise treat primary site of infection.</p>
<p>Sepsis, not severe</p>	<p>Benzylpenicillin 1.8g qds and Gentamicin 7mg/kg iv Known renal impairment/suspected ARF Piperacillin/tazobactam 4.5g bd AND a single dose Gentamicin 2mg/kg Severe penicillin allergy Vancomycin 1g bd iv AND Aztreonam 1g tds AND metronidazole 500mg tds iv</p>	<p>For use in unwell patients with unclear source, otherwise treat primary site of infection.</p>
<p>Fever >38C in neutropenia Associated with shock or history of ESBL or penicillin allergy</p>	<p>Piperacillin/tazobactam 4.5g qds Meropenem 1g tds Severe penicillin allergy: Vancomycin 1g bd AND Aztreonam 1g tds AND Metronidazole 500mg tds</p>	<p>Add glycopeptide if history of MRSA or clinical features of line infection See also 'Policy for immediate management of febrile neutropenia in adult haematology and oncology patients'</p>

Ear Nose and Throat		
Sore throats, simple coughs, colds are mostly viral.		
Quinsy or severe tonsillitis	Benzylpenicillin 1.2g qds if penicillin-allergic: Clarithromycin 500mg bd iv	Add metronidazole 500mg tds iv if not responding
Acute toxic suppurative otitis media and acute severe, or acute on chronic, maxillary sinusitis	Cefuroxime 1.5g tds iv followed by Co-amoxiclav 375mg (625mg if >100Kg) tds po If penicillin-allergic: Doxycycline 100mg bd po or iv.	Erythromycin and clarithromycin are less active against <i>Haemophilus influenzae</i> and are not recommended by the microbiologists
Acute frontal sinusitis or maxillary/ethmoid sinusitis with orbital complications	Cefuroxime 1.5g tds iv AND Metronidazole 500mg tds iv	Followed by co-amoxiclav 375 (625 mg if >100Kg) tds po as oral follow-on
Suspected CNS involvement in the sinusitis	Ceftriaxone 2G bd iv AND Metronidazole 500mg tds iv If severe penicillin allergy: Vancomycin 1G bd AND Metronidazole 500mg tds AND Ciprofloxacin 200mg bd iv	Discuss any need for oral follow-on with microbiologist
“Malignant” Otitis externa (necrotising osteitis)	Ciprofloxacin 400mg bd iv AND Gentamicin 7mg/Kg iv	Review when Pseudomonas susceptibilities available. If susceptible, oral ciprofloxacin 500-750 mg bd prolonged course (circa 3months).
Pyogenic infection of cervical nodes, cyst, or oesophago/tracheal related neck mass	Cefuroxime 1.5g tds iv AND Metronidazole 500mg tds iv If penicillin-allergic: Metronidazole 500mg tds iv AND Vancomycin 1G bd iv AND Ciprofloxacin 200mg bd iv.	
Functional Endoscopic Sinus Surgery	Post-op Co-amoxiclav 375 (625mg if >100Kg) mg tds po for 10 days. If penicillin-allergic, use Doxycycline 100mg bd po	

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Respiratory tract Infection		
Exacerbation COPD	<p>Not severe: Doxycycline 100mg po bd 5 days</p> <p>Severe: Doxycycline 100mg bd po or iv. Amoxicillin 1g tds iv if previous Doxycycline</p>	<p>Not all cases are due to bacterial infection, consider antibiotics only if there is a history of more purulent sputum production.</p> <p>If there are clinical or radiological signs of pneumonia present, follow pneumonia advice.</p>
Exacerbation of Bronchiectasis	<p>Doxycycline 100mg bd po/iv</p> <p>Severe Ceftazidime 2g iv tds AND Tobramycin 7mg/Kg/once daily</p> <p>14 day course standard</p>	<p><i>Haemophilus influenzae</i> common. Resistance to amoxicillin/co-amoxiclav is increasing Review with sensitivities</p> <p>Often associated with mucoid <i>Pseudomonas aeruginosa</i>. May require amendment according to previous results. When susceptibilities are available antibiotics may be changed to Ciprofloxacin 750mg po bd if susceptible. Frequent recurrent exacerbations may require nebulised use of inhaled Colistin or Tobramycin/Gentamicin as suppressive regimens</p>

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Community Acquired Pneumonia		
<p>Enquire about bird contact/recent travel. Organise a chest Xray. Urinary antigen detection will only be performed if there is radiological pneumonia.</p> <ol style="list-style-type: none"> 1. Always put the CURB65 score on urinary antigen requests. Score 1 each for age>65y, respiratory rate >30/min, diastolic BP <60 or systolic BP <90mmHg, urea >7mmol/l and acute confusion. 2. Send urine for pneumococcal antigen. If detected use benzyl-penicillin iv/ oral amoxicillin/doxycycline. Pneumococcal antigen is positive in 20% of CAP however a negative test does not rule out pneumococcal pneumonia. The test is unhelpful in COPD. 3. Request Legionella antigen if clinically suspected (travel history with overnight stay abroad or in the UK in last 18 days, leukaemia/lymphoma or transplant patient or known current outbreak) or if severe pneumonia (CURB65 score 2 or more at all ages or >3 aged 65 years, multilobar involvement, ITU/HDU admission). <p>Duration of treatment Five days treatment is proposed for mild/moderate pneumonia, 7-10 days treatment is proposed for undefined severe pneumonia. This should be extended to 14 to 21 days where <i>Staph aureus</i> or Gram-negative enteric bacilli (such as Klebsiella or Pseudomonas) pneumonia is confirmed and 6 weeks treatment may be needed for lung abscesses.</p> <p>IN AN UNWELL PATIENT WITH AN UNCERTAIN DIAGNOSIS, gentamicin 7mg/kg (stat dose of 2mg/kg if impaired renal function) can be added until the diagnosis is clearer.</p>		
Mild (CURB65 score less than 2)	Amoxicillin 500mg tds (If >80kg double dose) OR Doxycycline 100mg bd 5 days po or iv	Use po if possible. If previous amoxicillin treatment failure use doxycycline and vice versa
Moderate or Severe (CURB65 score >2 if <65y, >3 if >65y) No COPD With underlying COPD	Use Benzylpenicillin 1.8G qds AND Clarithromycin 500mg bd iv/po. Doxycycline 100mg bd po/iv unless definite pneumonia and previous doxycycline then Piperacillin/tazobactam 4.5g tds and Clarithromycin 500mg bd po/iv	If pneumococcal urinary antigen positive use Benzylpenicillin alone. Stop macrolide if no risk factors for legionella pneumonia or negative legionella urinary antigen Up to 30% may be viral even outside 'winter viral season' and may account for lack of response to antibacterials
Penicillin allergy Severe pneumonia with severe allergy to penicillin (breathing difficulties or collapse) and needs iv treatment	Doxycycline 100mg bd iv/po, Cefuroxime 1.5g tds and Clarithromycin 500mg bd po/iv if previous Doxycycline Vancomycin 1g bd iv AND Ciprofloxacin 500mg bd po/400mg bd iv	Use of clarithromycin (or erythromycin) alone is unsafe in pneumonia because of high incidence of resistance in pneumococci.

<p>Severe pneumonia requiring HDU/ITU or outreach review</p>	<p>Piperacillin/tazobactam 4.5g tds AND Clarithromycin 500mg bd Cefuroxime 1.5g tds AND Clarithromycin 500mg bd if non-severe penicillin allergy Vancomycin 1g bd iv AND Ciprofloxacin 500mg bd po/400mg bd iv if severe penicillin allergy</p>	<p>Consider adding linezolid especially if recent multiple courses of antibiotics</p>
<p>Confirmed Legionella: Positive urinary antigen test:</p>	<p>Low/Moderate severity: Ciprofloxacin 750mg bd po or Clarithromycin 500mg bd iv/po</p> <p>Severe/Life-threatening: Ciprofloxacin 750mg bd po or 400mg bd iv. Add a 2nd agent for the first few days - Clarithromycin 500mg bd po/iv OR Rifampicin 600mg bd iv/po.</p>	<p>Send sputum and/or pleural fluid for legionella culture. This is essential to tracing the origin of the case.</p> <p>Clinicians should be alert to the potential small risk of cardiac electrophysiological abnormalities with quinolone-macrolide combinations</p> <p>Treat for minimum 7-10 days, can be extended to 14 or 21 days depending on clinical judgement</p>
<p>Aspiration pneumonia</p>	<p>Treat according to severity with guidelines above for “<i>Community Acquired Pneumonia</i>”.</p>	<p>Often is chemical pneumonitis and need for metronidazole not well established. Consult microbiologist if no response to treatment. Avoid cephalosporin use as this increases the risk of C.difficile</p>

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Treatment of influenza and associated respiratory tract infections in an influenza outbreak		
<p>Infection control advice and guidance as to which samples to take are detailed in other policies available on the intranet.</p> <p><u>Clinical diagnosis of influenza</u> Fever >38C or History of fever AND 2 or more of the following: Cough (NOT just sore throat) or painful Tracheitis (85%), Rhinorrhea or blocked nose (60%), Limb muscle or joint pain (53%) or severe tiredness (80%), Headache (65%), Chills (70%), loss of appetite (60%), sore throat (50%). Diarrhoea and vomiting has been reported in US cases but significance is uncertain.</p>		
<p>Antiviral Treatment For patients clinically suspected or confirmed influenza on testing</p>	<p>Adult (inc pregnant women) - Oseltamivir (Tamiflu) 75mg bd orally for 5 days for those aged >13 years old. Renal impairment - Zanamivir (Relenza) by inhalation 10mg bd for 5 days. If unable to use zanamivir then reduce dose of Oseltamivir if eGFR <30 ml/min (30mg od if eGFR is 10-30ml/minute, If <10ml/min or dialysis consult renal team or pharmacist) Severe immunosuppression - Zanamivir (Relenza) by inhalation 10mg bd for 5 days. If unable to take inhaled Zanamivir, Oseltamivir can be given.</p>	<p>Antivirals not required in previously healthy individuals with uncomplicated influenza If required, ideally should be administered within 12-48h of onset of symptoms but can be started later if patient requires ITU admission or has complicated influenza. Treatment after 48 hours is an off-label use of oseltamivir and clinical judgement should be used. The commonest adverse effect of oseltamivir is nausea in about 10% of patients. This can be managed with anti-emetic medication.</p> <p>Previous influenza immunisation does not exclude influenza</p>
<p>Post exposure prophylaxis</p>	<p>Adult (inc pregnant women) – Oseltamivir 75mg od for 10 days Renal impairment – Zanamivir 10mg od by inhalation for 10 days or Oseltamivir 30mg alternate days if creatinine clearance is 10-30ml/minute, <10ml/min or dialysis consult pharmacist or renal team. Severe immunosuppression – Zanamivir 10mg od by inhalation for 10 days.</p>	<p>Not routinely recommended unless high risk group. Only use if can be started within 48h of last contact (36h for Zanamivir) unless specifically advised</p>

Urinary tract Infection		
<p>It is essential to send a urine sample as antibiotic resistance is common If urinary bacteriology performed in last week, treatment should be based on most recent susceptibilities NEVER use penicillin alone for the empiric treatment of severe UTI</p>		
<p>Mild community acquired UTI</p>	<p>Lower UTI: Nitrofurantoin 50mg qds 7 days OR Trimethoprim 200mg bd 3 days OR Pivmecillinam 400mg tds 3 days</p> <p>Upper UTI: Trimethoprim 200mg bd 5 days OR if Trimethoprim resistant, Ciprofloxacin 500mg bd 5 days.</p>	<p>Nitrofurantoin is not recommended in patients with renal impairment (eGFR<60ml/min) as there is increased risk of treatment failure due to inadequate urine concentration. Nitrofurantoin is ineffective in upper UTIs Review with urine results</p>
<p>Pregnant Oral</p>	<p>Cephalexin 500mg qds 10 days Or Amoxicillin 500mg tds 10 days if known to be susceptible</p>	<p>If penicillin-allergic and post 1st trimester can use Trimethoprim 200mg bd. Nitrofurantoin should be avoided at term (>36/40)</p>
<p>Severe or parenteral therapy required</p>	<p>Cefuroxime 1.5g tds iv until able to take oral drugs Severe penicillin allergy – discuss with microbiology</p>	<p>ESBL organisms rare in this group of patients</p>
<p>Severe urinary infections (? septicaemia or T>38.5)</p>	<p>Benzylpenicillin 1.2g qds iv AND Gentamicin 7mg/kg Penicillin-allergic use Gentamicin 7mg/Kg alone</p>	<p>Do not routinely use ciprofloxacin or cephalosporins. Modify treatment to orals when susceptibilities available.</p>
<p>Renal impairment – GFR<40ml/min</p>	<p>Piperacillin-tazobactam 4.5g tds (bd if <20ml/min) Penicillin allergic: Ertapenem 500mg od Severe penicillin allergy: Aztreonam eGFR 10-30ml/min - 1g then 500mg tds eGFR <10ml/min – 1g then 250mg tds</p>	
<p>Known/History ESBL (Check PAS/EPR)</p>	<p>Gentamicin 7mg/kg od If gentamicin resistant strain - Ertapenem 1g od iv.</p>	<p>Pivmecillinam 400mg tds plus co-amoxiclav 375mg tds 5 days is an oral option for mild infections if susceptible (check urine result)</p>

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Post operative infection after cystectomy	Flucloxacillin 1g qds AND gentamicin 7mg/kg If there is a history of ESBL or MRSA use Ertapenem 1g od AND Vancomycin 1g bd iv	
Epididymo-orchitis	<40y Doxycycline 100mg bd AND Ciprofloxacin 500mg bd po for 14 days >40y Ciprofloxacin 500mg bd po for 14 days	Acquired via ascending infection so always send an MSU and in sexually active men <40y also send sample for Chlamydia. Orchitis is usually viral so consider mumps.
Acute Prostatitis	Ciprofloxacin 500mg bd for 28 days OR Trimethoprim 200mg bd for 28 days. If iv treatment required: Benzylpenicillin 1.2g qds iv AND Gentamicin 7mg/kg,	When clinically improved adjust therapy according to sensitivities.

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Skin and Soft Tissue Infections		
<ul style="list-style-type: none"> • <u>Flucloxacillin will cover streptococci as well as staphylococci</u>– no need to add Benzylpenicillin or Amoxicillin. Always consult microbiologist if neutropenic (re clostridial sepsis). • <u>Remember to treat</u> co-existing eczema or tinea to reduce risk of recurrence. • <u>Patients with a past history of MRSA colonisation</u> should be commenced on vancomycin empirically pending culture results. • <u>Anaerobic cellulitis</u> is common around ulcers on legs, sebaceous cysts, deep pressure sores or on the abdominal wall and will require Metronidazole addition if the patient does not initially respond. • <u>Limb-threatening infections in diabetics with foot ulceration</u> involves any of: cellulitis, lymphangitis, deep ulcer with purulent discharge, fever or rigors. • <u>Bilateral leg cellulitis is RARE</u>. Lipodermatosclerosis can be misdiagnosed as cellulitis as legs can be red, warm and tender. However patient is not usually unwell and it does not respond to antibiotics. Consider dermatology advice. • <u>Duration and location of treatment:</u> Treat for 7 to 14 days. High dose therapy for >7 days may be necessary to achieve adequate levels. It is possible to manage selected patients with cellulitis with daily parenteral antibiotics at home or as outpatients. Such home regimens are not suitable for hospital use because of heightened risk of C.difficile (ceftriaxone) or expense (teicoplanin). Intravenous vancomycin should not be administered at home. 		
Mild wound infection/cellulitis	Flucloxacillin 500mg qds po (1g qds if weight >70Kg, 1.5g qds if >100kg) 7days OR, if penicillin allergic: Doxycycline 100mg bd po 7 days.	Use Doxycycline if history of MRSA.
Severe wound infection/cellulitis	Flucloxacillin 1g qds iv (1.5g qds if >70Kg, 2g qds if >100kg). If penicillin allergic: Vancomycin 1g bd iv Consult microbiologist if poor response after 72 hours	For iv management out of hospital: Ceftriaxone 2g iv once daily - do NOT use in hospital because of the risk of C.difficile. If penicillin allergic teicoplanin 800mg loading dose then 400mg iv od Review patients after 72 hours for oral follow on with oral flucloxacillin 1-1.5 g qds or doxycycline 100mg bd to finish 7-14 day course.

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<p>Severe with history of MRSA colonisation</p>	<p>Vancomycin 1g bd iv (or teicoplanin 400mg iv od with 800mg loading dose for management at home). Use doxycycline 100mg bd as oral follow on if susceptible strain. 5 to 14 days total duration.</p>	<p>If doxycycline-resistant strain, linezolid may be used for oral follow-on. If cultures negative for MRSA and not penicillin allergic can convert to Flucloxacillin 1g qds (1.5g qds if >80Kg, 2g qds if >100kg).</p>
<p>Diabetic Foot Ulcer Non-limb threatening</p> <p>Sepsis or Limb-threatening (Extending cellulitis > 2cm, lymphangitis, deep ulcer with purulent discharge, suspected abscess)</p>	<p>Flucloxacillin 500mg po qds (1g qds if >70kg) or Doxycycline 100mg bd AND metronidazole 400mg po tds</p> <p>Vancomycin 1g bd iv AND Metronidazole 500mg tds iv AND Ciprofloxacin 750mg bd po (or 400mg bd iv)</p>	<p>Use Doxycycline if history of MRSA. Review with culture results</p> <p>MRSA rates are decreasing. Review with culture results and consider switching vancomycin to flucloxacillin if appropriate.</p>
<p>Abdominal wound/leg ulcers/deep pressure sores as source of cellulitis</p> <p>If penicillin allergic or History MRSA</p>	<p>Metronidazole (500mg tds iv or 400mg tds po) AND Flucloxacillin 1g qds iv (1.5g qds if >70Kg, 2g qds if >100kg).</p> <p>Vancomycin 1g bd iv AND Metronidazole (500mg tds iv or 400mg tds po).</p>	<p>Add Gentamicin for non-diabetic abdominal wounds not responding to standard regimes but caution re toxicity from vancomycin and gentamicin combination (Consult microbiologist for alternatives).</p>
<p>Necrotising fasciitis</p>	<p>In Group A streptococcal necrotising fasciitis give 600-900mg tds iv Clindamycin AND Benzylpenicillin 1.2-2.4g qds AND normal human Immunoglobulin (2g/kg single dose).</p>	<p>If necrotising fasciitis suspected or abdominal wall cellulitis, consult microbiologist. In order to supply immunoglobulin the pharmacist will require a clinician request form to be signed by the consultant/SpR. Forms can be obtained from the pharmacist.</p>
<p>Fournier's Gangrene</p>	<p>Meropenem 1g tds iv AND Clindamycin 600-900mg tds iv</p>	<p>Radical surgical debridement is essential</p>

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Animal or Human Bites, Deep/dirty Wounds		
<p>Includes Animal or human bites or extensive scratches on face or upper limb, deep dirty punctures, farmyard/garden injuries, closed oral wounds, perineal or perianal wounds, after debridement: Antibiotics after animal bites are given to prevent anaerobic, staphylococcal & Pasteurella infection. This is pre-emptive therapy rather than true prophylaxis. 5 days antibiotics are usual. Remember to give Tetanus immunoprophylaxis using tetanus toxoid +/- immunoglobulin as appropriate</p>		
<p>Not requiring admission</p>	<p>Co-amoxiclav 375-625 mg tds po</p>	
<p>Penicillin allergic</p>	<ul style="list-style-type: none"> • animal bites: oral Metronidazole 400mg tds AND Doxycycline 100mg bd; • deep dirty punctures and oral wounds: oral Metronidazole 400mg tds AND Doxycycline 100mg bd • perianal and perineal wounds: Metronidazole 400mg tds alone. 	
<p>If parenteral treatment required for severe animal bites and scratches or oral wound:</p>	<p>Metronidazole 500mg tds AND 1.5g Cefuroxime tds, (not iv co-amoxiclav). If penicillin-allergic: Metronidazole 500mg tds AND Doxycycline 100 mg bd iv</p>	
<p>If parenteral treatment required for punctures, severe perianal and perineal wounds</p>	<p>Benzylpenicillin 1.2g qds, Metronidazole 500mg tds and Gentamicin 7mg/Kg od iv. If penicillin-allergic: Metronidazole 500mg tds AND Doxycycline 100 mg bd iv</p>	
<p>Bat bites from anywhere and animal bites from overseas</p>	<p>Discuss rabies prophylaxis with on-call virologist at Heart of England Hospital, Birmingham</p>	
<p>Human bites</p>	<p>As for animal bites</p>	<p>Also consider Blood-borne virus prophylaxis (See Infection control policy on exposure to blood borne viruses).</p>
<p>Limb Trauma</p>	<p>See Orthopaedic prophylaxis section</p>	

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Septic Arthritis/Osteomyelitis		
Septic arthritis - native joint	<p>Flucloxacillin 1.5 - 2g qds iv alone. If penicillin allergic, Vancomycin 1g bd iv AND Sodium fusidate 500mg tds po.</p> <p>In diabetics/patients with rheumatoid arthritis where Gram negative septic arthritis is more likely, add gentamicin to flucloxacillin initially until culture results available & ertapenem to vancomycin and fucidin.</p>	<p>Continue iv flucloxacillin or vancomycin therapy for at least 10 days. Sodium fusidate is better given po and is not normally required if flucloxacillin is used Consult microbiologist re duration and oral follow-on. Six weeks therapy is recommended for septic arthritis with S.aureus.</p>
Infected joint replacement	<p>Vancomycin 1g bd iv until two weeks after implant removed if coagulase-negative Staph infection or culture negative histological positive infection. If infection with other organisms (e.g. S aureus, Enterococcus, Gram negative species) at least 6/52 treatment is required post joint removal and the antibiotic regime should be discussed with a Consultant Microbiologist</p>	<p>If implant is conserved in situ infection is unlikely to resolve but consult microbiologist re antibiotic choice for 6-12 months suppressive therapy.</p>
Foot osteomyelitis or ulceration in diabetics.	<p>Flucloxacillin 1g qds (1.5g qds if >80Kg, 2g qds if >100Kg) AND Metronidazole 400mg tds AND Ciprofloxacin 500mg bd. If penicillin allergic or MRSA positive, Use iv Vancomycin instead of flucloxacillin</p>	<p>Deep culture is more reliable and will permit rationalisation of initial therapy.</p>
Acute osteomyelitis	<p>If staphylococcal, treat as for native joint septic arthritis</p>	<p>A microbial diagnosis from deep samples is normally advisable. Spinal, post traumatic, or chronic osteomyelitis may not be staphylococcal: consult microbiologist.</p>

Line Associated Infections		
Investigation for complications, e.g. infective endocarditis, and longer treatment courses may be required if there is persistent bacteraemia/fungaemia after the line has been removed.		
S. aureus	Empirically use vancomycin 1g bd iv (prolong dose interval in renal impairment). Flucloxacillin po or iv should be substituted if a susceptible Staph aureus is grown.	Line must be removed and treatment continued for 2 weeks minimum
Coagulase-negative staphylococci	Line removal without antibiotics is usually sufficient. Short courses of vancomycin (7-10 days) can be used if a coagulase-negative staphylococcus is isolated from blood cultures and the line is technically irreplaceable.	
Gram negative bacilli	Remove catheter and treat with systemic antibiotic for 7-14 days. Discuss with microbiology	
Yeast	Line must be removed then treat with anti-fungals for at least 2 weeks after the first negative blood culture following line removal.	

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Abdominal Sepsis		
Biliary sepsis	<p>Benzyl penicillin 1.2 g qds iv AND Gentamicin once daily 7mg/kg iv</p> <p>If penicillin allergic and <u>no</u> stent or T tube present: Gentamicin 7mg/Kg iv as sole antibiotic.</p> <p>If penicillin allergic and stent or T tube <u>is</u> present: 800mg Teicoplanin iv AND Gentamicin 7mg/Kg iv initially followed by 400mg Teicoplanin once daily AND Gentamicin.</p>	If patient is being discharged to complete antibiotic course then oral Ciprofloxacin 750mg bd can be prescribed on the TTOs.
Lower abdominal sepsis/post op colon surgery or severely ill	<p>Benzylpenicillin 1.2g qds iv AND Gentamicin 7mg/kg iv AND Metronidazole 500mg tds iv for 5 days.</p> <p>Renal impairment GFR <40ml/min Piperacillin-tazobactam 4.5g tds iv (bd if <20ml/min)</p> <p>Penicillin allergy Vancomycin 1g bd iv AND Ciprofloxacin 400mg bd iv AND Metronidazole 500mg tds iv</p> <p>ITU/HDU Piperacillin/tazobactam 4.5g tds if admitted from community OR Meropenem 1g tds if penicillin allergic or re-operation/previous antibiotics</p>	<p>NEVER use penicillin and metronidazole without gentamicin in the empiric treatment of abdominal sepsis</p> <p>Oral follow on is not usually required. If oral antibiotics are thought necessary, contact microbiology. Do not prescribe penicillinV + metronidazole alone</p> <p>Reduce meropenem and piperacillin/tazobactam doses in impaired renal function</p>
Diverticulitis	IV treatment required – treat as for lower abdominal sepsis	Not severe/oral follow-on: Metronidazole alone often sufficient Alternatively Coamoxiclav 375mg tds or Metronidazole +Ciprofloxacin 500mg bd for 7 days
Pancreatitis with CT evidence of pancreatic necrosis	<p>Meropenem 500mg tds iv for 10-14 days</p> <p>If antibiotics prolonged for >10 days, give antifungal prophylaxis with Fluconazole (loading dose of 400mg then 200mg od iv/po).</p>	Antibiotics only recommended with >30% necrosis and signs suggestive of infection. Gentamicin & vancomycin penetrate pseudocyst fluid and fat necrosis poorly and should not be used unless there are other sites of infection.

Meningitis and other CNS Infections		
<p>Remember to Notify Public Health Physician on call if suspected bacterial meningitis: 0344 225 3560 (option 2) daytime, via switchboard out of hours. Prophylaxis is dealt with by the Public Health team. The guidance used is available on the Health Protection Agency website (Guidance for public health management of meningococcal disease in the UK)</p>		
<p>Bacterial Meningitis associated with polymorphs in CSF</p>	<p>Empirical therapy: Ceftriaxone 2g bd iv If aged >55 years ADD Amoxicillin 2g qds to cover Listeria Also consider adding Amoxicillin if pregnant</p> <p>Severe penicillin allergy: Vancomycin 1g bd iv AND Rifampicin 600mg bd po/iv AND Ciprofloxacin 400mg bd iv</p> <p>Immunocompromised: Consult microbiologist</p>	<p>Remember to give dexamethasone 0.15mg/kg qds started with or before antibiotic especially if suspected pneumococcal meningitis. Continue for 4 days if confirmed pneumococcal meningitis</p> <p>Review therapy with culture results Minimum duration of treatment: Meningococcal: 7 days Pneumococcal 10-14 days Listeria: 21 days Organism not identified – 7-14 days Immunocompromised: discuss with microbiology</p>
<p>Viral Meningitis</p>	<p>Antivirals not required</p>	
<p>HSV Encephalitis</p>	<p>Aciclovir 10mg/kg iv tds for 14 days minimum Repeat LP at ~14d to confirm HSV PCR negative</p>	<p>Maintain good hydration and monitor renal function Oral acyclovir does not achieve adequate levels to treat CSF infection</p>

Clostridium difficile		
<p>(See also Medical Management of C.difficile and Infection Prevention and Control guidelines available on the intranet) Stop all antibiotics if possible. If not, or patient has severe systemic features/megacolon, consult microbiologist re optimal choice. Assess severity regularly and escalate therapy if necessary. Treat as indicated in table for 10-14 days.</p>		
<p>Mild disease Less than 3 type 5-7 stools/day Normal wbc and temp</p>	<p>Metronidazole 400mg tds po</p>	<p>Treatment not necessary if no diarrhoea Stop earlier if asymptomatic for 72h</p>
<p>Moderate disease 3-5 type 5-7 stools/day WBC 10-15, temp 37.3-38.5°C No tachycardia or hypotension</p>	<p>Metronidazole 400mg tds po</p>	<p>Daily review of stool chart, FBC, U+Es and severity assessment.</p>
<p>Severe disease Any of: WBC>15, temp >38.5°C, acute rising creatinine (above 50% baseline)</p>	<p>Uncomplicated Vancomycin 125mg qds po Complicated Vancomycin 500mg qds po/ng AND Metronidazole 500mg tds iv</p>	<p>Complicated = any of: hypotension, tachycardia, ileus, abdominal tenderness, colonic distension >10cm, thumb printing, colonic wall thickening If partial ileus, or hypotension, use liquid vancomycin - if necessary by nasogastric tube. If complete ileus or megacolon increase dose to 500mg qds orally and give by rectal tube</p>
<p>Relapse</p>	<p>1st relapse Metronidazole 400mg tds po or Vancomycin 125mg qds according to severity 2nd relapse Fidaxomicin 200mg bd on consultant microbiology advice</p>	<p>If diarrhoea continues, a tapering of vancomycin course may offer control whilst the normal flora recovers. Consult a gastroenterologist. Normal human immunoglobulin can also be considered. In order to supply immunoglobulin the pharmacist will require a clinician request form to be signed by the consultant/SpR. Forms can be obtained from the pharmacist.</p>
<p>1. Intravenous vancomycin does NOT reach the colon in adequate concentrations. 2. Antibiotic assays are NOT required with oral vancomycin. 3. Vancomycin injection is licensed for oral use. It is cheaper than the capsules and easier to swallow/administer ng. (Oral doses can be made from the injection vial by adding 10 ml of sterile Water for Injections BP to a 500 mg vial of Vancomycin Hydrochloride. After initial reconstitution of the vial, 125 mg (2.5 ml) may be diluted in 30 ml of water and given to the patient to drink or administered by a ng tube. 4. Do NOT use <u>oral</u> metronidazole and <u>oral</u> vancomycin together. There is no evidence for this and it may affect reestablishment of normal colonic flora.</p>		

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Gynaecological and Obstetric infection.		
Higher doses may be required in pregnancy reflecting increased volume of distribution		
Post-operative pelvic cellulitis, vault haematoma and fever	Flucloxacillin 500 mg qds po/iv (1.5g qds, if weight >80Kg, 2G qds if >100kg) AND Metronidazole 400mg tds (or 500mg tds iv). If penicillin allergic, Clindamycin 600mg tds iv OR 300mg qds po alone.	
Chorioamnionitis or intrapartum fever	Benzylpenicillin 1.2g qds AND Gentamicin 5mg/Kg od AND Metronidazole 500mg tds If penicillin allergic, Clindamycin 600mg qds AND 5mg/Kg Gentamicin od	Discuss repeat dose gentamicin with microbiologist. If on this regime and requires C-section then additional antibiotics are not required There is usually no requirement for oral follow-on post delivery.
Pelvic abscess, Septic abortion	Benzylpenicillin 1.2g qds AND Metronidazole 500mg tds AND Gentamicin 7mg/Kg once daily. If penicillin allergic, Clindamycin 600mg tds AND Gentamicin 7mg/Kg once daily.	
Pelvic inflammatory disease and salpingitis	Acute with fever and/or abdominal signs Ceftriaxone 250mg (single dose), AND Gentamicin 7mg/kg od AND Metronidazole 500mg tds AND Doxycycline 100mg bd all iv until improved for 24 hrs followed by continuation of oral Metronidazole AND Doxycycline to complete 14 days. Recurrent & No fever and/or abdominal signs Doxycycline 100mg bd AND Metronidazole 400mg tds	Ceftriaxone is included only for therapy of potential gonococcal infection. Other agents are unreliable for this, without susceptibility tests. If severe penicillin-allergic patient consider omitting Ceftriaxone and give single dose of 200mg Ciprofloxacin iv (NB 10% resistance in gonococcus).
Post partum fever/infection	Mild: Co-amoxiclav 375mg tds (625mg if >100Kg) mg tds po OR Clindamycin 300mg qds po(450mg qds if >100kg) Severe: Cefuroxime 1.5g tds iv AND Metronidazole 500mg tds Severe penicillin allergy: Clindamycin 600mg qds AND Gentamicin 5mg/Kg once daily.	
Infected Caesarian wounds/perineal tear/epesiotomy	Co-amoxiclav 375mg tds (625mg if >100Kg) OR Clindamycin 300mg qds (450mg qds if >100kg)	

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Infective Endocarditis		
<p>All suspected cases of endocarditis must be discussed with a Consultant Microbiologist when starting treatment. Take blood cultures 20ml x3 before starting antibiotics. If necessary all can be taken within 2 hours but separate venepunctures are essential. These are empirical guidelines, when bacteriology results available discuss definitive treatment with microbiologist. If patient is clinically stable wait for the results of blood cultures before starting antibiotics. If culture negative, investigate for Coxiella and Bartonella Vancomycin monotherapy is inadequate for endocarditis. Gentamicin and Vancomycin doses must be modified according to renal function and levels</p>		
Indolent presentation	Benzyl penicillin 1.2g iv 4 hourly AND Gentamicin 80mg (1mg/kg) tds iv	Amoxicillin 2g 4hourly can be used instead of benzyl penicillin
Acute presentation	Flucloxacillin 2g qds iv AND Gentamicin 80mg (1mg/kg) tds iv History of MRSA or Penicillin allergy: Vancomycin 1g bd iv AND Gentamicin 80mg (1mg/kg) tds iv History of ESBL: Vancomycin 1g bd iv AND Meropenem 2g tds iv	Increase dose of flucloxacillin to 2g 4hourly if weight>85kg
Prosthetic Valve or Intracardiac device	Vancomycin 1g bd AND Gentamicin 80mg (1mg/kg) tds AND Rifampicin 600mg bd po/iv	

Liver		
<p>Patients with liver failure are at risk of renal failure and biochemical markers of this may not be reliable. They may be infected with a wide range of organisms and re-infection is not uncommon. In the presence of ascites, samples should be taken to assess if spontaneous bacterial peritonitis is present. Use of quinolone prophylaxis against spontaneous bacterial peritonitis is known to select for MRSA and may select for multiple resistant E coli and Klebsiella. Defined localised infections e.g. pneumonia should be treated with the antibiotic regimen usually used. Otherwise:</p>		
<p>Liver failure with signs of non-localised systemic infection</p>	<p>Piperacillin/tazobactam 4.5g tds or Meropenem 500mg tds if penicillin allergic</p> <p>In acute hepatic failure where liver transplantation may be planned ADD Fluconazole 400mg od.</p>	<p>Add Vancomycin 1G bd if the patient is on ciprofloxacin, or has signs of soft tissue sepsis.</p>
<p>Spontaneous bacterial peritonitis</p>	<p>If bowel sounds normal and “well”: Ciprofloxacin 750mg bd po If ill or obtunded: Piperacillin/tazobactam 4.5G tds iv or Meropenem 500mg tds iv until susceptibilities available when rationalise (usually to ciprofloxacin 750mg bd po). If culture negative at 72hrs stop</p>	<p>After a verified episode of SBP give prophylaxis – see prophylaxis section</p>
<p>Hepatic encephalopathy (established, or incipient after gastrointestinal bleed)</p>	<p>Antibiotic prophylaxis in this situation is not recommended. Use antibiotics only for features of sepsis.</p>	

Malaria

Malaria should always be managed in consultation with someone experienced in managing the disease. Advice can be sought from the on-call infectious disease SpR at Birmingham Heartlands Hospital (via switchboard). See also [UK Malaria Treatment Guidelines](#)

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3. DEFINITIVE TREATMENT

– switching from empirical treatment once susceptibilities are reported.

THE NARROWING OF SPECTRUM AT THIS STAGE IS THE KEY ACTIVITY IN REDUCING SELECTION FOR MULTI-RESISTANCE AND A KEY PART OF HOSPITAL ANTIBIOTIC POLICY.

Remember **START SMART, THEN FOCUS**

ORAL FOLLOW ON TREATMENT IS NOT ALWAYS NECESSARY AND PROLONGS ANTIBIOTIC RESISTANCE SELECTION. THERE IS NO NEED TO SWITCH TO THE SAME AGENT ORALLY OR FINISH “COURSES”.

Infections Commonly Requiring >5 DAYS Antibiotic Prescription

• **Eradicating MRSA carriage and infection**

Patients with mupirocin-susceptible MRSA in their nose should start nasal mupirocin for 5 days. If the patient has a tetracycline susceptible MRSA in a soft tissue lesion as well, they require not only mupirocin but also, if susceptible, oral doxycycline (100mg bd.) for 10 days. With mupirocin resistant MRSA a combination of 2 antibiotics to which the strain is susceptible should be used in all cases for 10 days. As first choice for nasal carriage combine topical neomycin (Naseptin) with either iv vancomycin or oral doxycycline. (Alternative agents if the strain is resistant should be discussed with the microbiologist but will also require 10-14 days therapy).

• **Skin and musculoskeletal infection**

Line Associated Infections

NB If infected with Staph. aureus, line **MUST** be removed and treatment continued for 2 weeks minimum. Short courses of vancomycin (5-7 days) can be used if a coagulase-negative staphylococcus is isolated from blood cultures and the line is technically irreplaceable.

Cellulitis:

Should be treated for 7 to 14 days according to severity and speed of response

Septic arthritis/Osteomyelitis

Need iv Flucloxacillin or Vancomycin therapy for at least 10 days. Consult microbiologist re duration and oral follow-on. Six weeks therapy is recommended for septic arthritis with S.aureus and a similar duration or longer may be needed in foot osteomyelitis in diabetics. 2 weeks therapy post implant removal is all that is required for coagulase-negative staphylococcal infection in a prosthetic joint infection.

Erysipelas:

Benzylpenicillin 1.2g qds 7-10 days OR if penicillin allergic, Clarithromycin 500mg bd iv 7-10 days.

• **Chlamydial infection**

14 days therapy with doxycycline or erythromycin/clarithromycin is recommended.

In acute pelvic inflammatory disease/ salpingitis, metronidazole with the doxycycline is also usually continued for 14 days. A single dose of azithromycin is a satisfactory substitute.

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• **Bacterial Meningitis**

See section in empirical guidelines for appropriate agents.

Normal adult, no organism seen in CSF or meningococcal: 7days iv.

Pneumococcal: 10 days iv.

Listeria: 21 days

Immunocompromised – consult microbiologist

• **Infective Endocarditis**

In any endocarditis 2-6 weeks therapy may be indicated depending on organism. In general 6 weeks therapy is required for prosthetic valve endocarditis, removal of an infected pacemaker, or those with enterococcal endocarditis and clinical symptoms for more than 3 months. Two-week regimens are suitable for patients with viridans or “bovis” streptococcal strains with penicillin MIC= \leq 0.1mg/l and neither emboli nor cardiac abscesses. Use of 2 weeks aminoglycoside is recommended for all penicillin susceptible streptococci except group A streptococci and pneumococci. Longer aminoglycoside treatment may be required for enterococci, nutritionally variant streptococci and prosthetic endocarditis with streptococci with MIC $>$ 0.1mg/l.

• **Gastrointestinal infections**

Typhoid, paratyphoid and systemic salmonella infection.

More than 5 days therapy and prolonged iv antibiotics are usually required. Consult microbiology.

Clostridium difficile.

10-14 days therapy with oral metronidazole or vancomycin is recommended for first C difficile infections unless the patients diarrhoea and illness has settled earlier. Prolonged therapy may be needed in recurrence (see antibiotic guidelines)

• **Infections in neutropenia**

Intravenous treatment is required until the patient has been afebrile for 48-72 hours.

• **Urinary Tract Infection in pregnancy**

Amoxicillin 500mg tds 10 days OR, if resistant, Cephalexin 500mg qds 10 days, if not severe.

Oral Follow-on

Oral follow on is not always necessary. Sometimes iv therapy should just be followed by no oral antibiotics. Intravenous therapy is necessary if the patient will not absorb oral therapy e.g. is nil by mouth. If the patient can absorb oral drugs and there is no broadening of the antibiotic spectrum used, intravenous to oral switch after 48 hours is desirable especially if the intravenous line is removed to reduce the risk of line-associated infection.

If there is no microbiological evidence of infection at 48 hours and the patient had not been partially treated earlier antibiotics should be stopped. If significant organisms are antibiotic resistant treatment should be changed. There is no virtue in continuing antibiotics if they are not needed.

Stopping IV therapy

Patients on IV antibiotics must be reviewed DAILY and consider stopping when:

- Clinical improvement
 - E.g. afebrile >24h, no unexplained tachycardia, improving WCC
- Able to take medication by mouth/NG/PEG
 - Considerations: e.g. vomiting, NBM, unconscious, malabsorption
- No specific indications for long-term IV antibiotics
 - Endocarditis
 - Meningitis / encephalitis / brain abscess
 - Osteomyelitis/ septic arthritis/ bone or joint infection; infected implants/prostheses/graft tissue
 - Complex skin and soft tissue infection, deep abscesses
 - Bronchiectasis, cystic fibrosis, empyema
 - Bacteraemia due to organisms requiring long-term IV therapy, e.g. *S. aureus*, (MSSA or MRSA), *Candida* spp
 - Immunocompromised patients (e.g. HIV, neutropenia, immunosuppressants or cytotoxics)
 - Patients receiving IV therapy on specific Microbiology advice

ADVICE ON AGENTS OF CHOICE FOR FOLLOW-ON IN ADULTS

Certain antibiotics have restrictions on their use within the trust. A list is provided in appendix 2.

Abdominal/biliary infections:

Usually no oral follow on required.

Staphylococcal infection:

Use flucloxacillin if the strain is susceptible and the patient is not allergic to penicillin. If anaerobes are present, and the infection is minor, oral co-amoxiclav will cover both staphylococci and anaerobes. Erythromycin resistance is commoner than tetracycline resistance so doxycycline is preferred to erythromycin/clarithromycin.

Pneumococcal infection:

Use oral amoxicillin if possible and stop cephalosporins or erythromycin/clarithromycin. Doxycycline is more likely to be active than clarithromycin if the diagnosis rests on urinary antigen detection without antibiotic susceptibilities, or the patient is penicillin allergic.

Streptococci:

Outside the throat Amoxicillin is a better choice than penicillin V for oral therapy as it is more reliably absorbed.

Haemophilus:

Amoxicillin resistance is becoming more common so review sensitivity results. Increasing numbers of Haemophilus are resistant not only to amoxicillin (by beta-lactamase) production but also to co-amoxiclav and cephalosporins (by a change in the antibiotic target site). Doxycycline resistance is rarer than co-amoxiclav and cefuroxime resistance. Erythromycin has no activity, and Clarithromycin dubious activity against Haemophilus.

Gram-negative infection (coliforms, E coli, Klebsiella, Enterobacter, Citrobacter, Serratia, Pseudomonas).

In order of preferred choice of oral agent, if Gram-negative organism reported susceptible, Use:

- Amoxicillin
- Trimethoprim.
- Nitrofurantoin (urines only)
- Pivmecillinam +/- Co-amoxiclav
- Cephalexin
- Ciprofloxacin

If no microbiology available:

Oral cephalosporins should be AVOIDED in respiratory tract infections. Oral cefuroxime axetil produces a higher incidence of C.difficile diarrhoea. Cephalexin has a narrower spectrum than cefuroxime and is only useful in UTI. Amoxicillin or doxycycline alone is the appropriate usual follow-on in RTIs that need antibiotics. Clarithromycin or erythromycin resistance is commoner than doxycycline resistance in pneumococci, and clarithromycin should only be used if Legionella infection is diagnosed by urinary antigen tests. For suspected Mycoplasma infection send nose and throat swabs in viral transport medium for Mycoplasma PCR and use doxycycline.

Oral co-amoxiclav has a similar spectrum to iv cefuroxime and metronidazole but should not be used indiscriminately – outbreaks of C difficile associated with over-use are recorded. Metronidazole is not required if this agent is being used. It occasionally is useful as a single antibiotic for oral follow-on where mixed faecal flora or mixtures of Staph. aureus (not MRSA), streptococci and anaerobes are causing infection. It may also be useful as an alternative to doxycycline in Haemophilus infections confirmed as resistant to amoxicillin.

Flucloxacillin or, in penicillin allergy, doxycycline are useful for wound infections/cellulitis infections. Erythromycin resistance is now commoner than tetracycline resistance. It is not necessary to give penicillin with flucloxacillin, as flucloxacillin will cover streptococci.

Remember to avoid giving milk/antacids/iron with doxycycline or ciprofloxacin.

Nitrofurantoin is useful for lower UTI ONLY. Trimethoprim resistance is increasing especially in elderly medical patients so the sending of samples is essential. Ciprofloxacin is useful in upper UTI in the presence of trimethoprim resistance and when intravenous antibiotics are no longer indicated.

Specific Organisms

MRSA carriage and infection:

For serious infection vancomycin is the usual acute treatment but may require supplementation with other agents in skin and soft tissue infection and cannot be relied on for clearance. Linezolid is an oral option, available only with the agreement of a Consultant Microbiologist and again cannot be relied on for clearance.

For clearance regimes, consult MRSA IPC policy. Prior to clean surgery, patients with mupirocin-susceptible MRSA in their nose may be cleared prior to surgery with nasal mupirocin for 5 days and then starting a week after this 3 nasal swabs each taken a week apart. If the patient has an MRSA in a soft tissue lesion as well as nasal carriage they require concurrent oral antibiotics, usually Doxycycline (100mg bd) for 10-14 days if the strain is susceptible. This procedure could be shortened in patients who only have nasal mupirocin-susceptible MRSA by giving vancomycin prophylaxis at the time of surgery and starting nasal mupirocin for 5 days from the night before surgery.

Eradicating carriage in patients with high-level mupirocin (Bactroban) resistant strains is more complex. Patients carrying such strains MUST be isolated. With mupirocin resistant strains, a combination of 2 agents to which the strain is susceptible should be used in all cases including nasal carriage. Two of topical neomycin (Naseptin), doxycycline, erythromycin, clindamycin, trimethoprim, rifampicin or sodium fusidate may be used and specific microbiological advice should be taken. 10-14 days treatment is recommended.

All patients with a history of MRSA undergoing procedures where antibiotic prophylaxis is required should have Vancomycin 1g prophylaxis. This includes patients who have had successful MRSA clearance regimes.

ESBL (Extended Spectrum B lactamase) producing coliforms e.g. E. coli.

These Gram-negative organisms are usually resistant to all cephalosporins and penicillins, usually also to quinolones, trimethoprim and sometimes gentamicin. Urinary infections and colonisation of catheters that are minor should be suppressed with nitrofurantoin 50mg qds. Recurrent infection is frequent and often involves the upper urinary tract. Prolonged faecal carriage (often for years) is the source of these recurrences and cannot be cleared. Infection requires treatment with either Gentamicin (if susceptible) or ertapenem 1g od or meropenem 500mg tds. Incorrectly treated these organisms carry a higher mortality than other Gram negative infections except Pseudomonas.

Oral regimes available if strain resistant to trimethoprim and ciprofloxacin:

- Nitrofurantoin 50mg qds for 10 days (only suitable for lower UTIs)
- 400mg tds pivmecillinam **plus** 375mg tds co-amoxiclav for 5 days
- Fosfomycin 3g stat dose in women, in men give a 2nd 3g dose 3 days later

Enterococci:

Except for infections of blood, urine and prosthetic material, enterococci seldom require treatment. Enterococcus faecalis susceptible to Amoxicillin is also sensitive to high dose benzylpenicillin, particularly in combination with gentamicin.

High-level gentamicin resistant strains are resistant to the synergic bactericidal action of penicillin and gentamicin, in such circumstances gentamicin then has no benefit in endocarditis. Vancomycin and teicoplanin have activity against enterococci but are only bacteristatic and ineffective alone for treatment of endocarditis. Daptomycin is bactericidal and synergic with rifampicin.

Vancomycin-resistant enterococcal infections are difficult to treat and require consultant microbiologist advice. They are commoner in haematology. Appropriate agents will be reported including linezolid or daptomycin according to the site of infection.

4. Prophylaxis Guidelines

Antibiotic prophylaxis should be single dose unless otherwise specified. After that it becomes treatment for an established infection. Prophylaxis at surgery should be given intravenously (unless otherwise specified) at or shortly after induction or intraoperatively after cultures are taken in the case of prosthetic infection. Prophylaxis after surgery is usually ineffective. If oral prophylaxis is used it should be given at least 1.5 hours before the procedure.

Cephalosporin and quinolone use is reduced to avoid selection for resistant organisms especially new strains of ESBL, E coli, MRSA & C difficile. Gentamicin causes less C.difficile infection than cephalosporins, quinolones or ertapenem.

PROPHYLAXIS in medical conditions

Bacterial Endocarditis

Preventive dentistry to treat existing dental sepsis should always be undertaken when a new diagnosis of cardiac congenital or valvular disease is made and before insertion of orthopaedic or other prostheses and is the single most important action in prevention of endocarditis. Indeed, **the importance of maintaining good oral health** should be emphasised for all patients.

Current NICE guidelines (2008) state that antibiotic prophylaxis against infective endocarditis is **not** recommended:

- for people undergoing dental procedures
- for people undergoing non-dental procedures at the following sites:
 - upper and lower gastrointestinal tract
 - genitourinary tract; this includes urological, gynaecological and obstetric procedures, and childbirth
 - upper and lower respiratory tract; this includes ear, nose and throat procedures and bronchoscopy.

The evidence is poor for prophylaxis in many conditions where prophylaxis has been the standard of care for 50 years and if the incidence of bacteraemia is low, the risks of prophylaxis in superinfection and allergy may outweigh theoretical and observed risks of endocarditis.

However, the risk of endocarditis is increased if there is suspected infection at the site of the procedure at the time of operation. If elective urological procedures are to be undertaken, a urine culture should be sent preoperatively. If any culture is positive, seek microbiologist advice on treatment and operative prophylaxis as cephalosporins, quinolones, trimethoprim and nitrofurantoin are unreliable in prophylaxis against enterococci. Combination treatment of the infection which covers endocarditis organisms as well as those grown may be advisable e.g. benzylpenicillin 1.2g qds and gentamicin 7mg/kg od if susceptible.

The following are regarded as being at risk of infective endocarditis (NICE 2008)

- acquired valvular heart disease with stenosis or regurgitation
- valve replacement
- structural congenital heart disease, including surgically corrected or palliated structural conditions, but

	<p>excluding isolated atrial septal defect, fully repaired ventricular septal defect or fully repaired patent ductus arteriosus, and closure devices that are judged to be endothelialised</p> <ul style="list-style-type: none"> ○ previous infective endocarditis ○ hypertrophic cardiomyopathy. <p>Any episodes of infection in people at risk of infective endocarditis should be investigated and treated promptly to reduce the risk of endocarditis developing. Patients should be made aware of the symptoms that may indicate infective endocarditis and when to seek expert advice as well as the risks of undergoing invasive procedures, including non-medical procedures such as body piercing or tattooing.</p>	
Prosthetic Joints	<p>Comparable to the changes in guidance concerning dental procedures and risk of infective endocarditis, there is no evidence of benefit and antibiotic prophylaxis is not routinely recommended for patients with joint prostheses. However, it is important to maintain good oral hygiene and to avoid dental sepsis.</p>	
Neutropenia: to prevent bacteraemia	<p>Ciprofloxacin 250mg bd (with microbiological monitoring of rectal swab for ciprofloxacin resistant Gram negatives). Ciprofloxacin prophylaxis should be stopped when the patients WBC rises to $0.5 \times 10^9/l$. Antifungal prophylaxis will also be required – discuss with haematologist, oncologist or microbiologist</p>	
Variceal bleeding	<p>Ciprofloxacin 500mg bd for 7 days</p>	<p>Antibiotic therapy should be commenced in patients with chronic liver disease who present with acute upper gastrointestinal haemorrhage to reduce the risk of SBP.</p>
Spontaneous bacterial peritonitis	<p>Ciprofloxacin 500mg od</p> <p>Consult microbiologist if breakthrough on this regime</p>	<p>Use after first confirmed episode to reduce incidence of recurrence. It can also be used in patients with severe liver disease and no prior history of SPB if ascitic fluid albumin content is $<10g/l$.</p>

PROPHYLAXIS in endoscopy		
Prevention of infective endocarditis following diagnostic or therapeutic endoscopy	<p>Not recommended</p> <p>Patients with ongoing cholangitis (or other infections for which therapeutic endoscopy is indicated as part of their management plan) should already be on antibiotics. Additional doses are not required.</p>	<p>The possibility of infective endocarditis should be considered in patients with known cardiac risk factors who develop symptoms and signs of infection during the weeks following an endoscopic procedure. Such patients should undergo prompt investigation and appropriate treatment.</p>
Cholangitis and bacteraemia prophylaxis in ERCP	<p>Benzylpenicillin 1.2g AND Gentamicin 120mg (single dose) If penicillin allergic, Gentamicin alone.</p> <p>Ciprofloxacin 750mg orally 1.5 hours pre-procedure and with follow-on for 48-72 hours is occasionally useful but resistance rates to ciprofloxacin are now 20% more than when these regimens were first advocated.</p>	<p>Routine prophylaxis for ERCP is not necessary, but is recommended: when complete biliary drainage unlikely to be achieved (eg, sclerosing cholangitis and/or hilar cholangiocarcinoma patients with a history of liver transplantation; patients with pancreatic pseudocyst; patients with severe neutropenia ($<0.56 \times 10^9/l$) and/or advanced haematological malignancy).</p>
PEG insertion	<p>Flucloxacillin 1G AND Metronidazole 500mg iv at induction of anaesthesia pre-insertion.</p> <p>Penicillin allergy other than angiooedema or urticaria: Cefuroxime 1.5G AND Metronidazole 500mg iv.</p> <p>Severe penicillin allergy (angioedema or urticaria) or MRSA: Vancomycin 1g (or Teicoplanin 400mg) AND 500mg Metronidazole iv.</p>	<p>To prevent insertion site sepsis. Only single doses are required.</p>

Prophylaxis in Surgery

Antibiotics should commence within 1h before incision (2h for vancomycin) and are most effective when given ≤ 30 minutes before skin is incised. Antibiotic prophylaxis should be single dose unless otherwise specified. Continuing antibiotics until all drains or catheters are removed has not been shown to be of any benefit. Intra-operative doses should be considered if there is blood loss >1500 ml or procedure lasts more than 4h (not required with vancomycin). Establish and record details of drug allergies prior to prescribing antimicrobial treatment. Patients with a history of severe penicillin allergy should not receive prophylaxis with a beta-lactam antibiotic (e.g. penicillin, flucloxacillin, cephalosporins). Patients with non-severe reaction to penicillin may receive cefuroxime. (see [allergy section](#))

MRSA

All patients with a history of MRSA undergoing procedures where antibiotic prophylaxis is required should have Vancomycin 1g prophylaxis. This includes patients who have had successful MRSA clearance regimes.

Patients undergoing elective surgery (including day cases) are required to have nose and skin-lesion swabs screened for MRSA.

Clearance processes for mupirocin-susceptible strains.

Even if clearance is successful the use of vancomycin 1G prophylaxis at surgery is recommended.

Nasal mupirocin-susceptible MRSA can be treated prior to surgery with intranasal mupirocin 2-3x daily for 5 days. Starting a week later, 3 nasal swabs a week apart may be taken to check clearance. If the patient has MRSA in a soft tissue lesion they require oral doxycycline 100mg bd (if susceptible) for 10-14 days together with nasal mupirocin.

This procedure could be shortened in patients who only have nasal mupirocin-susceptible MRSA, by starting nasal mupirocin for 5 days from the night before surgery and giving vancomycin prophylaxis at the time of surgery (Leeds regimen). The same procedure can be adopted for urgent surgery in patients who have previously been MRSA positive. If Gentamicin is also indicated, consult microbiologist for alternatives to avoid the nephrotoxic combination of Vancomycin and Gentamicin

Mupirocin-resistant strains

Patients with mupirocin-resistant strains undergoing surgery should be pre-booked where possible. For mupirocin-resistant strains a combination of 2 antibiotics to which the strain is susceptible should be used for 14 days to attempt clearance (difficult). Seek microbiology advice. Two of topical neomycin (Naseptin), tetracyclines, erythromycin, clindamycin, trimethoprim, rifampicin or fucidin may be used. Some MRSA strains are resistance to all clearance regimes. Do NOT use single antibiotics or persist with mupirocin (Bactroban). We have most experience with the use of naseptin qds AND oral doxycycline 100mg bd. Vancomycin 1g prophylaxis at surgery is recommended.

Abdominal surgery		
Gastric or unobstructed small intestinal surgery or biliary surgery	<p>Benzylpenicillin 1.2g AND Gentamicin 2mg/kg (to nearest 20mg) single doses. If penicillin-allergic omit Benzylpenicillin and give Gentamicin 2mg/kg (to nearest 20mg) single dose alone.</p>	For bariatric surgery increase benzylpenicillin dose to 2.4g
Colorectal or obstructed small intestinal surgery:	<p>Benzylpenicillin 1.2g AND Gentamicin 2mg/kg (to nearest 20mg) mg AND Metronidazole 500mg. If peritonitis is present at operation because of perforation maintain the benzylpenicillin and metronidazole but give an evening dose of 7mg/kg gentamicin daily and continue all therapy for up to 5 days (see therapy section).</p> <p>Penicillin-allergy: EITHER just omit the Benzylpenicillin from the colorectal regimen (preferred) OR Substitute Clindamycin 600mg for Benzylpenicillin and Metronidazole Omission of the benzylpenicillin means that enterococcal or group F streptococcal systemic infection is not covered but these are rare.</p>	To prevent bacteraemia and abdominal abscess.
Appendicectomy:	Benzylpenicillin 1.2g AND Gentamicin 2mg/kg (to nearest 20mg) mg AND Metronidazole 500mg.	To prevent abdominal abscess. For complicated cases/ significant lower abdominal sepsis see therapy section
Pancreatitis	Meropenem 500mg tds iv for 10-14 days If penicillin allergic, Ciprofloxacin 400mg bd iv	Only recommended with >30% necrosis
Herniorrhaphy with mesh insertion	Benzylpenicillin 1.2g AND Gentamicin 2mg/kg (to nearest 20mg) If penicillin-allergic, omit benzylpenicillin	To prevent local sepsis:

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Vascular Surgery		
Aortic surgery	To prevent staphylococcal infection: Vancomycin 1g. If vascular access for this infusion is difficult due to emergency transfusion, then Teicoplanin 400mg as a bolus can be given instead. Add Ertapenem 1g if gut ischaemia a possibility to prevent coliforms or anaerobic infection.	

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Urological Surgery		
Antibiotics are not given routinely on catheter removal even in the presence of a prosthetic implant.		
Endoscopic surgery (TURP or TURBT), retropubic prostatectomy, DVU, Cystoscopy with biopsy - procedures causing a urothelial breach or TVT insertion	Gentamicin 120-160mg	To prevent Gram-negative bacteraemia:
Upper tract endoscopic surgery	Gentamicin 120-160mg AND Amoxicillin 1g. If penicillin allergic: and no enterococci in urine, omit amoxicillin: if enterococci in urine, Gentamicin 120mg AND Teicoplanin 400mg.	To prevent Gram-negative and enterococcal bacteraemia
ESWL	Trimethoprim 200mg or Gentamicin 120-160mg AND Amoxicillin 1g. See above for penicillin allergy	Routine prophylaxis is not recommended however should be considered in complicated cases e.g. internal stent, nephrostomy, infected stones
Nephrectomy or Pyeloplasty	Gentamicin 120-160mg	To prevent Gram-negative bacteraemia
Open urological surgery involving opening bowel inc. ileal conduit and enterocystoplasty or in patients with MRSA	Vancomycin 1g AND Meropenem 500mg.	To prevent bacteraemia and abdominal abscess (Meropenem is used instead of Ertapenem to cover Pseudomonas and enterococci in addition which are more likely in these patients.)
Transrectal prostatic biopsy	Gentamicin 7mg/kg* iv and Metronidazole 1g pr Ciprofloxacin 500mg bd po for 4d, 1 st dose prior to procedure *if eGFR<30ml/min give 2mg/kg	Contact microbiology if known ciprofloxacin resistant organism in urine. If admitted with sepsis post-procedure, give Meropenem 1g tds pending culture results
Transrectal prostate injection	Gentamicin 3mg/kg iv (rounded to nearest 20mg	

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Urology		
Urodynamics	<p>Not routinely required if no growth from pre-op urine</p> <p>Spinal injuries: Gentamicin 5mg/kg single dose</p> <p>Non-spinal injuries patients with history of repeated UTI or significant voiding dysfunction: Gentamicin 7mg/kg.</p> <p>If ESBL producing organism currently or in past: Gentamicin 7mg/kg iv or Ertapenem 1g iv if resistant</p> <p>If pre-operative urine indicates gentamicin resistance, contact microbiology.</p>	<p>Oral Trimethoprim 200mg or Ciprofloxacin 500mg, depending on previous susceptibility, are alternatives but are less likely to be reliable.</p> <p>Routine prophylaxis for endocarditis is not recommended in the current NICE guidelines, however, the risk of endocarditis is increased in at-risk patients if there is established urosepsis at the time of procedure</p>
Traumatic catheterisation	<p>History of MRSA : 1g bd Vancomycin iv</p> <p>History of ESBL in urine: 7mg/kg Gentamicin iv or if gentamicin resistant 1g od Ertapenem iv</p> <p>Other Gram-negative organism in urine: 7mg/kg Gentamicin, unless organisms resistant</p>	<p>IF any one of:</p> <ul style="list-style-type: none"> •more than 2 attempts at catheterisation •instrumentation •resultant ongoing haematuria •removal of catheter with balloon inflated send a urine for culture and give antibiotic until cultures available and treatment can be rationalised.

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Gynaecological Surgery		
Cystoscopy	See urological surgery	
Hysterectomy (abdominal or vaginal), laparotomy, prolapse repair with mesh	Metronidazole 500mg iv at induction AND Gentamicin 2mg/kg (to nearest 20mg) AND benzylpenicillin 1.2g at induction. If penicillin-allergic, OMIT Benzylpenicillin with NO substitution i.e. use Metronidazole AND Gentamicin	To prevent bacteraemia and abdominal abscess
Vaginal surgery	Metronidazole 500mg iv at induction	To prevent anaerobic infection
Termination of pregnancy	Metronidazole 500mg iv at induction AND Azithromycin 1g po post-op. Azithromycin can be omitted if patient is chlamydia negative by NAT testing.	To prevent anaerobic infection and chlamydial spread
Obstetrics		
Caesarean section	Cefuroxime 1.5g AND Metronidazole 500mg iv If penicillin-allergic, Erythromycin 500mg AND Metronidazole 500mg iv	To prevent wound infection and post-partum fever If already on antibiotics for chorioamnionitis or intrapartum fever, additional agents are not required
To prevent Group B streptococcal neonatal infection at onset of established labour	Benzylpenicillin 3g in 100ml saline over 30 minutes & then 1.2g four hourly until delivery. If penicillin allergic, Clindamycin 900mg in 150mls saline over 1 hour, repeated every 8 hours until delivery. Add gentamicin 5mg/kg od if intrapartum fever $\geq 38^{\circ}\text{C}$ or suspected chorioamnionitis. In planned caesarean section with intact membranes, antibiotics as for Caesarean section	a) Past history of Group B streptococcal infection in previous neonate b) UTI or positive genital culture in this pregnancy with Group B streptococcus
Manual removal of placenta or 3rd and 4th degree tear	Cefuroxime 1.5g AND Metronidazole 500mg iv Single dose. For 3 rd and 4 th degree tears continue with Co-amoxiclav 375mg (625mg if >100Kg) tds po 48 hours. If penicillin allergic, oral follow on with Erythromycin 500mg tds AND Metronidazole 400mg tds	To prevent local infection

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Orthopaedic Surgery		
Up to 24 hours of antibiotic prophylaxis can be considered for arthroplasty		
Clean Surgery without implant	Antibiotic prophylaxis is not recommended	
Above knee surgery (inc. amputation)	Benzylopicillin 600mg iv OR Metronidazole 500mg iv History of MRSA: Vancomycin 1g iv.	To prevent gas gangrene. For up to 5 days
Hemiarthroplasty or internal fixation of closed fracture	From own home: Cefuroxime 1.5g iv single dose Known past or current MRSA or from nursing/residential home: Vancomycin 1g iv	To prevent prosthetic infection
Primary total joint replacement	MRSA negative: Cefuroxime 1.5g iv single dose. History of MRSA: Vancomycin 1g	To prevent prosthetic infection, Screen for MRSA in nose and skin breaks.
Excision or revision (1 or 2 stage insertion) arthroplasty	AT EACH STAGE: Vancomycin 1g	To prevent secondary infection
Spinal surgery	MRSA negative: Cefuroxime 1.5g Repeat dose every 6hours in prolonged surgery. Maximum of 3 doses. History of MRSA: Vancomycin 1g.	
Percutaneous Achilles tendon repair	Flucloxacillin 1g iv History of MRSA or penicillin allergy: Vancomycin 1g iv	

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Trauma		
Remember to give Tetanus immunoprophylaxis using tetanus toxoid +/- immunoglobulin as appropriate		
Extensive contaminated wound with devitalised tissue inc. high velocity gunshot & open fracture	Flucloxacillin 1g iv, Metronidazole 500mg iv AND Gentamicin 120mg* Penicillin allergy: Clindamycin 600mg iv and gentamicin 120mg* If head gunshot or head severe trauma: 2g ceftriaxone bd AND Metronidazole 500mg.	To prevent local infection, at surgery * If more than one dose is likely to be required, give gentamicin 7mg/kg
Animal and human bites or extensive scratches on face or upper limb, deep dirty punctures, closed oral wounds, perineal or perianal wounds, after debridement	If not requiring admission: Oral Co-amoxiclav 375mg (625mg if >100Kg) tds. <i>If penicillin allergic:</i> • animal bites: oral Metronidazole 400mg tds AND Doxycycline 100mg bd; • deep dirty punctures and oral wounds: oral Metronidazole 400mg tds AND Doxycycline 100mg bd • perianal and perineal wounds: Metronidazole 400mg tds alone. If parenteral treatment required for SEVERE animal bites and scratches 500mg tds Metronidazole AND 1.5G Cefuroxime tds. If penicillin-allergic: Metronidazole 400mg tds AND Doxycycline 100 mg bd	To prevent anaerobic, staphylococcal & Pasteurella infection Bat bites and bites from overseas: Discuss rabies prophylaxis with on-call virologists at Heart of England Hospital, Birmingham. Human bites: consider Blood-borne virus prophylaxis (See Infection control policy on exposure to blood borne viruses).
Trauma - without heavy contamination or devitalised tissue, that exposes joint, or tendon - in limb affected by lymphoedema - in limb with prosthesis on same side - and diabetes	Flucloxacillin 500mg qds (1g qds if >70Kg, 1.5g qds if >100kg) If penicillin allergic: Doxycycline 100mg bd.	To prevent local infection

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Miscellaneous		
Insertion of internal cardiac pacemaker, cardioverter defibrillator or loop recorder or other non-joint prosthesis	1G iv Vancomycin over 90 minutes. If patient is vancomycin intolerant 400mg Teicoplanin can be used.	Use of 200mg teicoplanin in 10 mls into the pocket to receive the implantable cardiac device is an optional addition but Vancomycin should NOT be used locally. There is no evidence for prolonged prophylaxis.
Breast		SIGN guidelines recommend antibiotic prophylaxis for breast surgery with implant and to consider it in cancer surgery and reshaping
Cataract		Antibiotic prophylaxis is strongly recommended.
Oesophageal surgery	Flucloxacillin 1G AND Metronidazole 500mg AND Gentamicin 120mg.	To prevent resection site sepsis and mediastinitis.
Pharyngo-laryngeal surgery	Benzympenicillin 1.2g AND Metronidazole 500mg AND Gentamicin 7mg/Kg single dose. Penicillin allergic: Clindamycin 600mg AND Gentamicin 7mg/Kg single dose. If MRSA positive or gentamicin-resistant Gram-negative organism present: Meropenem 500mg AND Vancomycin 1g. If penicillin allergic, consult microbiologist.	
Dental surgery in patients receiving bisphosphonates	Not penicillin allergic. Amoxicillin 3G po single dose and Metronidazole 400mg repeated every 8 hours for 24 hours total Penicillin allergic Clindamycin 600mg po repeated every 8 hours for 24 hours total.	The bacterial aetiology of extensive necrosis in this situation is unknown. Previous endocarditis guidelines are probably inappropriate alone as there is no evidence this is due to viridans streptococci.

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Prophylaxis Post-Splenectomy		
The following is a summary.		
Antibiotic prophylaxis	<p>Not penicillin allergic Advise penicillin V continuously from hospital discharge until at least 16 years old or at least 2 years post splenectomy for patients >16y. Adult dose is 500mg bd.</p> <p>Penicillin allergic The evidence of benefit is less good. Adults – consider no prophylaxis, or erythromycin 500mg bd Children – consider erythromycin.</p> <p>All patients should carry a supply of appropriate antibiotics for emergency use and advised to seek urgent medical advice if develop symptoms and/or signs of infection</p>	<p>Life long prophylactic antibiotics should be offered to patients considered at continued high risk of pneumococcal infection (aged <16 years or > 50 years, inadequate serological response to pneumococcal vaccination, a history of previous invasive pneumococcal disease, and splenectomy for underlying haematological malignancy particularly in the context of on-going immunosuppression)</p> <p>Patients not at high risk should be counselled regarding the risks and benefits of lifelong antibiotics and may choose to continue or discontinue prophylaxis.</p>
Immunisation	<p>The following are recommended (irrespective of age) see 'Immunisation against infectious disease (DoH)' for full details (green book)</p> <p>Pneumococcal Hib/MenC Meningococcal ACWY conjugate vaccine Influenza.</p>	<p>Ideally patients should be vaccinated four to six weeks before elective splenectomy. Where this is not possible, they can be given up to two weeks before surgery. If it is not possible to vaccinate at least two weeks before surgery, or a patient has an emergency splenectomy, vaccination should be delayed until at least two weeks after the operation to obtain a better response.</p>
Other advice	<ul style="list-style-type: none"> • Take appropriate precautions to avoid malaria • Note risk of multiresistant pneumococci abroad eg Spain • Antibiotic prophylaxis for animal bites • Take precautions to avoid tick bites in areas where babesiosis endemic e.g. North America • Carry a medic-alert disc 	

5. Antibiotic Dosing and Levels

General instructions: all assays

Please use the red-topped clotted tubes.

When requesting assays, if not ordered electronically, write the following minimum information on a blue BACTERIOLOGY form:

Time the level was taken e.g. 01/02/06 9.30a.m.

Time the last dose was given e.g. 31/1/06 2200

Prescribed regimen e.g. 1G bd.

Patient details.

Without this information the assay will not normally be done as it cannot be safely interpreted. Information on the form will be reported. If this is inaccurate the interpretation may be incorrect and further advice should be sought from a consultant bacteriologist.

Getting the assays to the laboratory in time for the assay run:

- There is no antibiotic assay facility at Telford or Oswestry: it is in Shrewsbury. Careful attention to transport times is essential. On weekdays two batches of assays are carried out morning and afternoon. Afternoon results may not be available until 8pm. DO NOT ring the BMS or duty consultant microbiologist unless they are not on the results reporter/EPR by 9pm. At Oswestry sometimes results fail to reach the EPR because the computer link between the sites fails and the IT staff on call must be contacted to restore the link.
- On Saturdays and Sundays samples are picked up from the Telford laboratory for transport to Shrewsbury twice a day (morning and early afternoon). At Oswestry a single taxi to take levels from all wards should be arranged.

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Adult Vancomycin Use and Dosing

Why Use Vancomycin

Vancomycin's spectrum includes almost all common Gram-positive organisms including Staphylococci, Streptococci and Enterococci. cocci except vancomycin-resistant enterococci. Teicoplanin's spectrum does not reliably include Staph. haemolyticus the second commonest coagulase- negative staphylococcus. The kinetics of Teicoplanin are less predictable and the assay is not available at SATH therefore monitoring adequate treatment is better with vancomycin. Ototoxicity with both compounds is very rare. Vancomycin nephrotoxicity is commoner than with teicoplanin but only if other nephrotoxic agents (e.g. gentamicin) are used in combination.

Recommended target pre-dose concentration:

- 10–15 mg/L for standard infection
- 15–20 mg/L for deep-seated infections (e.g. osteomyelitis, endocarditis or pneumonia due to *Staphylococcus aureus*)

Dosage:

Check the patient's plasma creatinine and weight before administering vancomycin.

Once the patient is on vancomycin, plasma creatinine MUST be measured at least twice weekly.

Vancomycin must be administered slowly (no faster than 10mg/min) to prevent infusion-related toxicities e.g. Red man syndrome (flushing, erythema, pruritis and less frequently, hypotension, angioedema, chest pain). It is related to the release of histamine and is not a true allergic reaction.

Loading dose

Actual body weight	Less than 60kg or eGFR <50ml/min	60-90kg	More than 90kg
Loading Dose	1g	1.5g	2g
Fluid	250ml	500ml	500ml
Infusion period	120min	180min	210min

Maintenance dose

eGFR >50ml/min: 15mg/kg rounded to nearest 250mg twice daily

eGFR is 30-50ml/min: give an initial dose of 1g then continue at 500mg bd. Check level pre 3rd /4th dose

eGFR <30ml/min (not on dialysis)– give 1g stat then check level the following day and wait for the result. Give next dose when level <15mg/l or according to microbiology advice. Dosage interval can vary from daily to every 5 days.

Timing of doses and levels:

Trough vancomycin levels are used to check that dosing is adequate. Peak levels can be predicted from trough levels if the dosage is known, and are unnecessary. **Vancomycin doses should not be held back waiting for levels** to be reported unless recommended by the microbiologist in advance because of previous toxic levels. Patients are at risk of inadequate antibiotic dosing and poor outcome of their infection if nursing or medical staff hold back doses and the risk of toxicity with vancomycin is minimal unlike gentamicin. Bacteria start regrowing quickly if the level falls below 5mg/l.

With normal renal function, take the blood into a red-capped tube as a trough level immediately before the third or fourth dose is given.

Remember to use electronic ordering which prompts you for information or fill in a blue (NOT purple) form.

For twice daily dosage schedules it is critical that the blood is taken after the normal interval between doses i.e. 12 hours. It is best to organise doses once the patient has received an initial dose on a 10am/10pm schedule so that bloods are not taken inadvertently after a dose by phlebotomists.

With bd dosing it is safe to advance doses by up to 6 hours to bring them into line with a 10pm/10 am dosing schedule but DO NOT send levels before such a brought-forward dose. **If the patient is on a 12hourly dosage, levels must not be taken <10hrs after the last dose, or if on 24 hourly dosage less than 20.5 hours after the last dose.**

Trough level Results:

Result	Action
<10mg/l or <15mg/l for deep-seated infection	<ul style="list-style-type: none"> • Check that previous doses have been given as prescribed. Low levels can result from samples being taken too late or doses missed • If timing and sample are correct then increase dose/reduce dosing interval as advised by microbiology on the result
10-15mg/l or 15-20mg/l for deep-seated infection	<ul style="list-style-type: none"> • Continue current therapy
>15mg/l or >20mg/l for deep-seated infection	<ul style="list-style-type: none"> • Check that the dose prescribed and timing of the level are correct. High levels can result from samples being taken too early • Check where the sample was taken from. Falsely high levels may occur as a result of taking blood from the line vancomycin was given through • If timing and sampling are correct then omit dose/reduce dose/increase interval as advised by microbiology on the result

Progressively rising vancomycin levels may indicate renal impairment even with normal plasma creatinine and in this instance the microbiologists may recommend that the dosage interval or dose is changed even if the level is in range.

Low levels may select for vancomycin hetero-resistance in Staphylococcus aureus with Minimum Inhibitory Concentrations above 1mg/l.

This resistance is associated with treatment failure in serious infection and alternative antibiotics are indicated. Blood and joint isolates have their MICs tested.

Gentamicin use, dosing and levels in adults

Why use Gentamicin?

- Gentamicin offers a good spectrum of activity for abdominal and urinary infection and prophylaxis with no risk of C difficile, unlike quinolones, carbapenems and cephalosporins. A minority of MRSA are gentamicin resistant and unlike cephalosporins and quinolones there is no evidence that gentamicin selects for MRSA. Gentamicin is not useful for chest infection –follow medical guidelines. Cefuroxime cannot be relied on for empirical coverage of Gram-negative infection so gentamicin use with penicillin or amoxicillin is preferred.

Tobramycin is twice as active against *Pseudomonas aeruginosa* but half as active against other organisms and inactive against many enterococci with penicillins. Specific susceptibility tests are necessary because antibiotic resistance mechanisms affect both drugs in different and unpredictable ways. In general we only recommend tobramycin use in treatment of pseudomonas in bronchiectasis. In general tobramycin is less nephrotoxic than gentamicin and the Hartford nomogram can be used to ensure dosage is not excessive.

- Once daily dosing with gentamicin 7mg/Kg is more effective (lower mortality), convenient and safer (less nephrotoxicity and ototoxicity) than multiple dose regimens (1-1.5mg/Kg tds), if there are no contraindications to its use (see below). **Do not use doses of 3 to 5mg/Kg** as with these regimes there are no validated methods for interpreting levels and nephrotoxicity is not less.

- Because a single level taken any time between 6 and 14 hours after a single daily is all that is required for dosing at 7mg/Kg, it is easier for surgical and medical staff to manage patients on single dose gentamicin. On multiple dose regimens a pre-dose and a 1 hour post dose level are required.

Contraindications to once daily Gentamicin dosing and reason for this

Lower dose required:

- Endocarditis (Guidelines suggest 80mg tds).
Aim for a pre-dose level <1mg/l and a post-dose of 3-5mg/l.

Changed volume of distribution

- Major burns (>20%)-Use tds schedule
- Ascites (Use tds schedule at augmented dose).

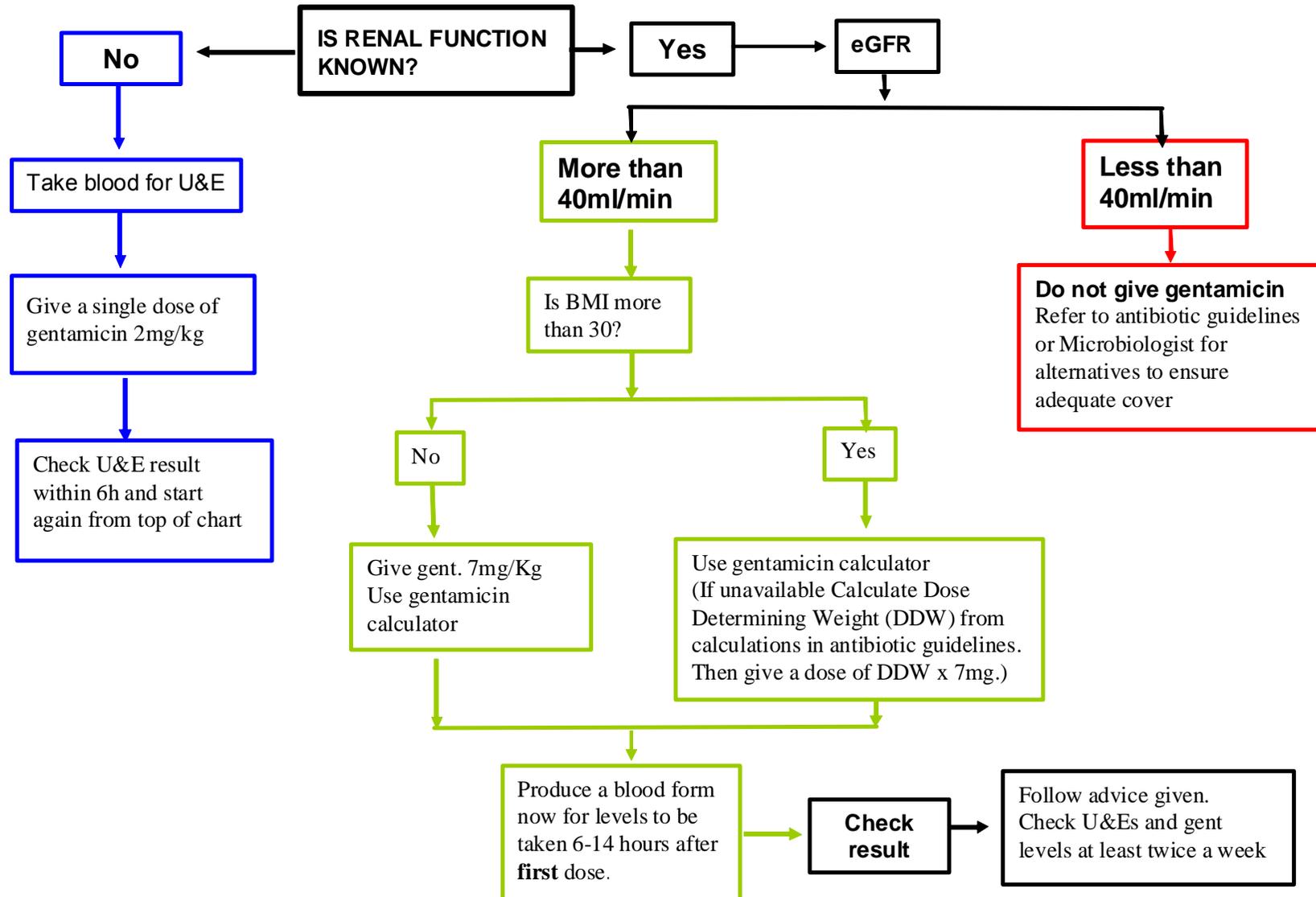
Risks of ototoxicity increased

- Neutropenia - Avoid or use tds schedule. Problem relates to prolonged duration of treatment and repetitive use (see J Antimicrob. Chemother 2000;45:383)
- Established renal failure and haemodialysis patients (Avoid if possible)

Insufficient information

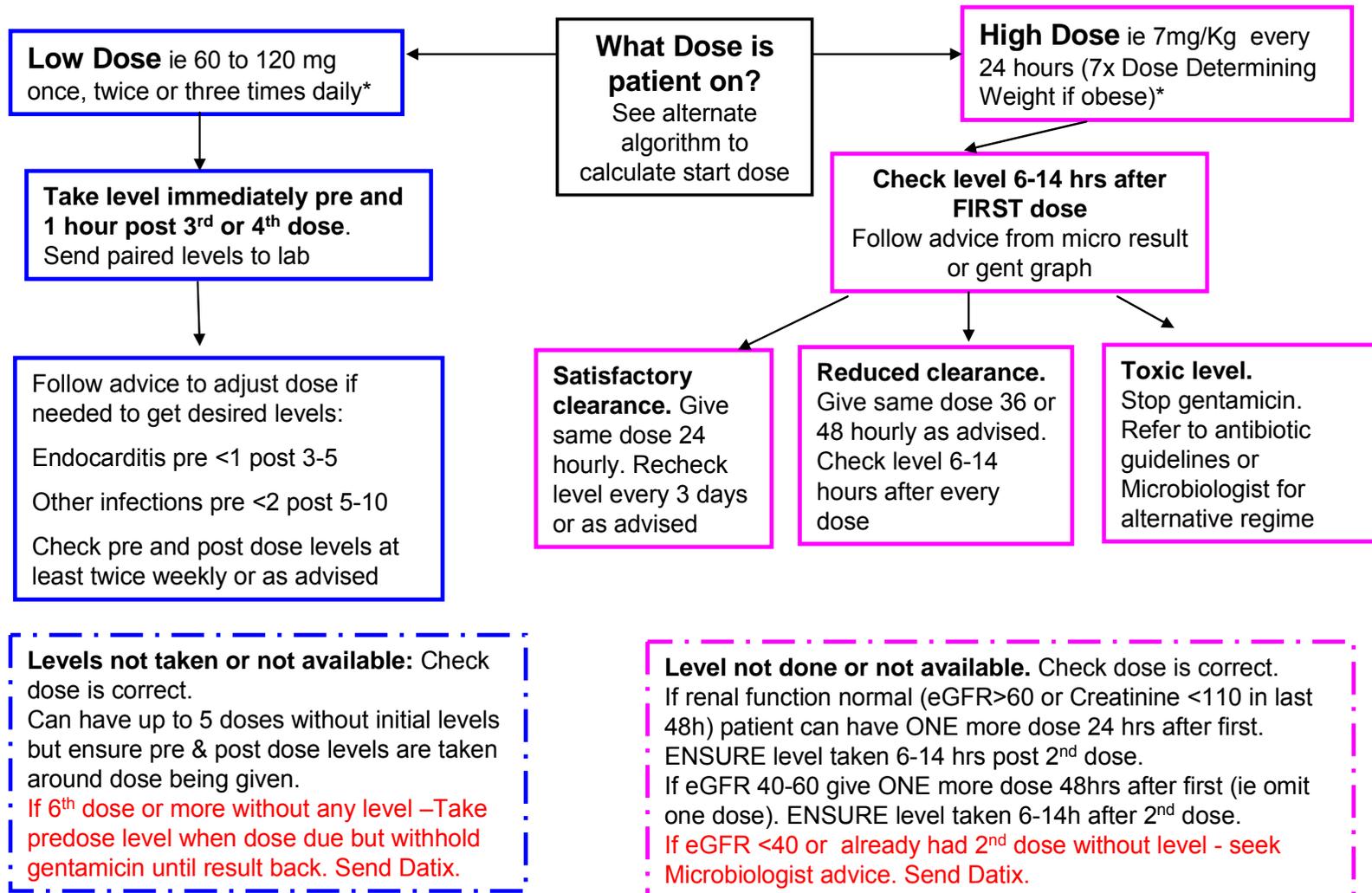
- Pregnancy or breast-feeding
- Meningitis
- Information on use of once daily dosing in children is limited and dosing should be based on paediatric guidance.

How to calculate correct initial gentamicin dose regimen*



Gentamicin in Adults 2 – ongoing management and monitoring

See Antibiotic Guidelines for detailed advice and alternate algorithm for calculating start dose



***Individual doses of 200mg or more must NEVER be given more than once daily**

Monitor renal function at least 2x weekly if patient on gentamicin.

Avoid giving with other nephrotoxic drugs.

Prolonged courses increase the risk of ototoxicity

Version 3 Feb 2014
Shrewsbury & Telford Hospital

Prescribing gentamicin

A gentamicin calculator is available on the SATH intranet to aid in calculating the first dose of gentamicin ([see app list](#) on home page). If it is not available then the following advice should be followed. See figures 2 and 3 for summary flowcharts.

• **Doctors must check the patient's recent plasma creatinine before prescribing Gentamicin.** Avoid gentamicin if the creatinine is >150mmol/l or eGFR <40ml/min). NB eGFR may be unreliable in emaciated patients and in the elderly and creatinine clearance may need to be calculated.

• **Check what other drugs the patient is on. Gentamicin nephrotoxicity is associated with concomitant use of vancomycin, loop diuretics, NSAIDs and ACE inhibitors.** If the patient is receiving these, gentamicin may not be the best choice. Consult either the antibiotic guidelines or a microbiologist for alternative antibiotics.

• **Weigh the patient, calculate the dose** by multiplying by 7 then round dose to nearest 20mg

If unfit to be weighed, determine ideal body weight (IBW) from the height using table below or the following formulae:

$$\text{Males: IBW(kg)} = (0.9 \times \text{height in cm}) - 88$$

$$\text{Females: IBW(kg)} = (0.9 \times \text{height in cm}) - 92$$

If obese (i.e. wt >20% above IBW), use the following to calculate the dose-determining weight (DDW)

$$\text{DDW} = \text{IBW} + 0.4(\text{ABW} - \text{IBW})$$

(ABW=actual body weight)

If emaciated the patient must be weighed.

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Height (feet)	Height (cm)	MALE		FEMALE	
		IBW (kg)	Obese if wt >(kg)	IBW (kg)	Obese if wt >(kg)
4"11	150	47.0	56.4	43.0	51.6
5"0	152.5	49.3	59.1	45.3	54.3
5"1	155	51.5	61.8	47.5	57.0
5"2	157.5	53.8	64.5	49.8	59.7
5"3	160	56.0	67.2	52.0	62.4
5"4	162.5	58.3	69.9	54.3	65.1
5"5	165	60.5	72.6	56.5	67.8
5"6	167.5	62.8	75.3	58.8	70.5
5"7	170	65.0	78.0	61.0	73.2
5"8	172.5	67.3	80.7	63.3	75.9
5"9	175	69.5	83.4	65.5	78.6
5"10	178	72.2	86.6	68.2	81.8
5"11	180.5	74.5	89.3	70.5	84.5
6"0	183	76.7	92.0	72.7	87.2
6"1	185.5	79.0	94.7	75.0	89.9
6"2	188	81.2	97.4	77.2	92.6
6"3	190.5	83.5	100.1	79.5	95.3
6"4	193	85.7	102.8	81.7	98.0
6"5	195.5	88.0	105.5	84.0	100.7
6"6	198	90.2	108.2	86.2	103.4

• A dose of 7mg/kg must be used for patients on once daily dosing. Check the dose is correct for the patient weight. This dose must be given in 100ml saline or dextrose by iv infusion over 1 hour. The evidence base for a) interpretation of levels and use of the Hartford nomogram and b) improved efficacy and reduced toxicity is only available for this regimen.

Measuring gentamicin (or tobramycin) serum levels

- **Take levels usually after the first dose of 7mg/kg gentamicin or tobramycin.** If the patient has had intermediate lower doses of gentamicin e.g. surgical prophylaxis then antibiotic will last some 6 hours before a 7mg/Kg dose can be given. Levels should be postponed to after the first 7mg/Kg dose. It is more convenient to give once daily gentamicin at 10pm to facilitate checking levels. However if gentamicin is required earlier in the day in an unwell patient, do not delay giving the dose. You must ensure that arrangements are in place to take levels at the appropriate time.
- **Take a single blood for gentamicin or tobramycin levels (5ml clotted - red-capped tube) 6- 14 hours after start of 7mg/Kg infusion. Do not take blood via a cannula or from the arm where the drug has been infused.**
- **Write the time the last dose** of gentamicin or tobramycin was given on the request form and give dosage details of regimen. **Also record on the request form the time the sample was taken.** Avoid writing ambiguous terms (e.g. 1200) and use the 24h clock i.e. 2359, 1150. The laboratory may also query apparently low doses for weight so if the weight is low also include this. If information is incomplete on the form, the assay may not be performed as the microbiologist might give wrong advice based on insufficient information.
- Tobramycin Levels taken pre dose and 1 hour post dose have been used in paediatrics in cystic fibrosis on once daily dosing with 7-10mg/Kg. These reports cannot be relied on to guide therapy in adults or children. Trough levels of less than 1mg/l are outside the linear part of the calibrated assay and therefore such results cannot be reported as reliably as they need to be to detect slight drug accumulation when assayed at 24 hours. Peak levels vary in their timing and although levels around 1 hour approximate to peak, they may not be actual peak and levels measured at 6-14 hours after the dose are more reliable and less vulnerable to timing errors. In cystic fibrosis, the high volume of distribution means that doses more than 7mg/kg are commonly given and the Hartford nomogram cannot then be used.

Using the assay results.

- The following procedure is used by the microbiologist to interpret the result and can be used by other staff
- Use reported level and time interval from dose to level measurement, to plot on graph below. This plot advises dosage frequency. If result falls above upper limit for 48hour dosage abandon once daily regimen and check antibiotic policy for alternative antibiotic.
- If assay result is not available within 24hrs, look up eGFR or measure plasma creatinine and calculate creatinine clearance from formula below (if not obese).

Males: Creatinine clearance = $1.23 \times ((140 - \text{Age}) \times \text{Weight}(\text{kg})) / \text{Serum creatinine}(\mu\text{mol/l})$

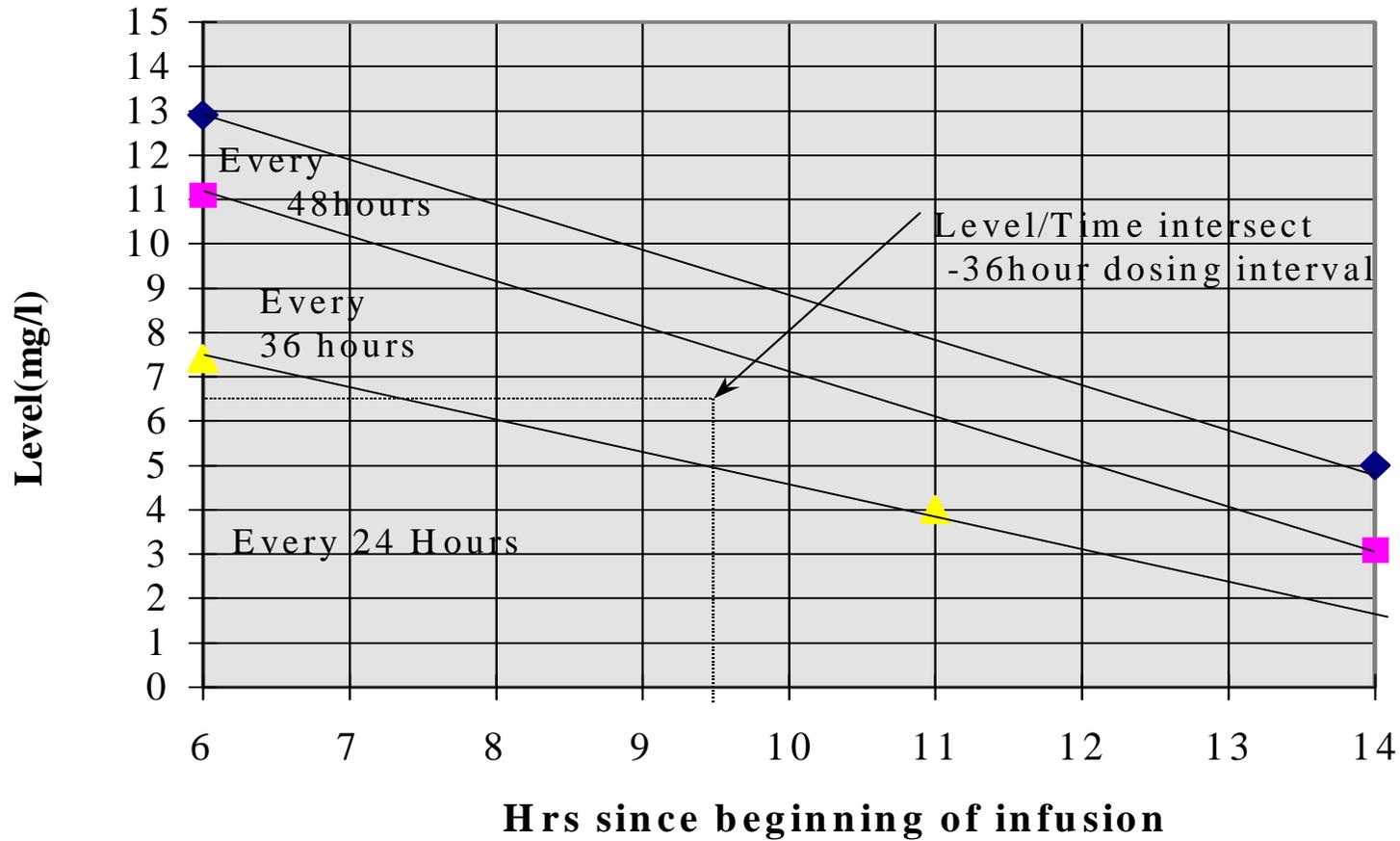
Females: Creatinine clearance = $1.03 \times ((140 - \text{Age}) \times \text{Weight}(\text{kg})) / \text{Serum creatinine}(\mu\text{mol/l})$

If renal function normal (eGFR >60ml/min or Cr <110 $\mu\text{mol/l}$) give a further dose after 24h. **Ensure that levels are taken after the 2nd dose.**

If eGFR 40-60 ml/min give dose after 48h. **Ensure that levels are taken after the 2nd dose.**

If eGFR <40ml/min or has had a 2nd dose without levels then seek microbiology advice

Hartford nomogram for 7mg/Kg/day gentamicin dosage



Nicolau et al. Antimicrob.Ag.Chemother (1995) 39:650-5

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Assays should be taken at least once every 3 days or daily if renal function changes or the dose is changed. Plasma creatinine must be measured minimum twice weekly. The microbiologist will advise on assays that are abnormal and will often recommend when to take the next level on assay reports.

Prolonged courses of gentamicin are associated with an increased risk of side-effects. Courses should generally be limited to 5 days unless advised by a microbiologist.

Prescribing gentamicin at 1mg/kg bd/tds.

Sepsis: Courses no longer routinely advised. Use 7mg/kg regime if normal renal function. If renal impairment check antibiotic policy for alternative regimen or contact microbiology. May occasionally be advised by the microbiologists if no other options available. Give 2 doses then take a level pre-3rd dose and 1h after the dose has been given. Aim for a pre-dose of <2mg/l and a post-dose of 5-10mg/l (in severe infections aim for at least 8mg/l). The microbiologist will normally suggest if any dosage adjustment is required.

Infective endocarditis: Current BSAC guidelines recommend an initial dose to 80mg tds (1mg/kg tds) however 80mg bd is usually sufficient in elderly patients. Target pre-dose level is lower at 1mg/l and recommended 1 hour post dose level is between 3 and 5mg/l. Caution is needed in the second week and subsequently as gentamicin toxicity associated with renal impairment is not uncommon.

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Teicoplanin assays

The pharmacokinetics of teicoplanin are less predictable than vancomycin.

Contrary to the manufacturers view, professional microbiology guidelines in the UK recommend that antibiotic assays for treatment of severe infection should always be performed.

A loading period is essential in the first 24 hours of therapy to ensure adequate levels and should not be forgotten. The manufacturers recommend that three doses of 400mg are given 12 hours apart and thereafter 400mg is given every 24hrs. An alternative is to give an initial dose of 800mg followed by 400mg every 24 hours.

No local assay service is available and samples are sent away which normally gives a 48 –72 hour turnaround for results. Sending assays on Friday and Saturday should be avoided.

Use in renal failure is not recommended as no local assay service is available and the delay in sending samples away compromises correct dosing.

The spectrum of coagulase negative staphylococci covered by teicoplanin is less than vancomycin.

Vancomycin is recommended instead of teicoplanin for inpatient use except when gentamicin is being used, when evidence of less nephrotoxicity related to the combination of teicoplanin and gentamicin as against vancomycin and gentamicin may mean teicoplanin use is preferred but please always consult microbiology before prescribing teicoplanin.

Trough levels of teicoplanin should be measured once the patient has had 2 teicoplanin doses 24 hours apart. Use a plain red topped tube, Pre-dose blood levels exceeding 10mg/l are associated with good outcomes in general infections but special situations warrant higher levels. Levels of >20mg/l are required for good prognosis in endocarditis and we would recommend similar levels are achieved when treating prosthetic joint infection.

Itraconazole and voriconazole levels

It seems likely that different fungal infection in different sites require different therapeutic levels and expert external advice is required on interpretation. When these drugs are used orally for prophylaxis or treatment of life threatening invasive mycoses, particularly aspergillosis, antibiotic levels should be routinely monitored to ensure absorption is adequate.

Itraconazole should not be given with cyclophosphamide regimens as the drug induces production of toxic cyclophosphamide metabolites. Grapefruit juice may increase serum levels of Itraconazole in some species but this is not clearly known in man. Itraconazole has potent effects on P450 cytochrome enzymes and levels are affected by other p450 cytochrome enzyme inducers. Take care re drug interactions!

Voriconazole induces falls in cyclosporin A levels and other interactions associated with drug metabolising enzymes are to be expected. Voriconazole levels are affected by genetic heterogeneity in drug metabolising enzymes.

No local service is provided and these assays are sent away and batched so a 48 hour to 7 day delay in reporting assays is usual.

Trough therapeutic levels of itraconazole should be maintained above 0.5ug/l.(500-1000ng/ml).

Voriconazole trough levels in the 1-5mg/l range are to be expected.

Other antibiotic assays

These may be possible to arrange via the Department of Microbiology, Southmead Hospital, Bristol if there is a good case for them. Please discuss with a consultant microbiologist.

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Appendix 1

PENICILLIN ALLERGY ALERT

TRUE penicillin allergy includes anaphylaxis, urticaria or rash immediately after penicillin administration.

In cases of **INTOLERANCE** to penicillin (e.g. gastrointestinal upset) or a rash occurring >72 hours after administration, penicillins/related antibiotics should not be withheld unnecessarily in severe infection but the patient must be monitored closely after administration.

Remember

Record allergies carefully in the notes and on the drug chart.

Check with the patient and the allergy section of the drug chart prior to all drug administration.

In **TRUE** penicillin allergy* **ALL** penicillins, cephalosporins and other beta-lactam antibiotics should be avoided.

Contraindicated (In severe infection seek pharmacy or microbiology advice)

Amoxicillin	HeliClear® (contains amoxicillin)
Benzylpenicillin	Penicillin V (phenoxymethylpenicillin)
Co-Amoxiclav	Piperacillin/tazobactam (Tazocin®)
Co-Fluampicil	Ticarcillin (Timentin®)
Flucloxacillin	Pivmecillinam

Caution: Not for use in patients with **serious** penicillin allergy i.e. anaphylaxis, breathing difficulties, facial swelling, urticaria rash or other major skin reactions. If in doubt, contact the pharmacy/ microbiology department.

Cefaclor	Ceftazidime	Ertapenem
Cefalexin	Ceftriaxone	Imipenem
Cefixime	Cefotaxime	Meropenem
Cefradine	Cefuroxime	

Considered Safe

Amikacin	Doxycycline	Norfloxacin
Azithromycin	Erythromycin	Sodium Fusidate
Aztreonam	Gentamicin	Teicoplanin
Ciprofloxacin	Levofloxacin	Tigecycline
Clarithromycin	Linezolid	Trimethoprim
Clindamycin	Metronidazole	Tetracycline
Colistin	Moxifloxacin	Tobramycin
Cotrimoxazole	Nitrofurantoin	Vancomycin

Appendix 2 - Restricted Antibiotics – Adults

The below antibiotics all have restrictions to their use within the Trust, Pharmacy will question and restrict supplies of these antibiotics if criteria for usage are not met.

All microbiologist approved antibiotic prescriptions are valid for a maximum period of 72 hours when review of the patient and further discussion with a Microbiologist or Senior Doctor is required.

Antibiotic	Route	Approved Indications	Restricted
Cefuroxime	Oral	Not stocked and not recommended for any indications	
Cefuroxime	IV	Approved for indications stated in the antibiotic policy for maximum of 72 hours.	Usage over 72 hours required daily review by senior doctor/microbiologist.
Ciprofloxacin	IV	Approved for indications stated in antibiotic policy/microbiology sensitivities for maximum 48 hours unless patient NBM.	All other indications require microbiologist approval. Usage over 48 hours requires daily review by senior doctor/microbiologist.
Ciprofloxacin	Oral	Approved for indications stated in antibiotic policy/microbiology sensitivities.	All other indications require microbiologist approval.
Co-amoxiclav	Oral	Approved for indications listed in the antibiotic policy. Should not be prescribed with metronidazole.	Associated with high incidence of C. diff so where possible restrict to discharge use only. Not for in-hospital use if recommended with cefpodoxime for ESBL infections.
Co-amoxiclav	IV	Not stocked and not approved for use in adults. If unsure refer to appropriate section of antibiotic policy for guidance or discuss with a microbiologist.	
Ertapenem	IV	For the inpatient treatment of sensitive ESBL infections or treatment of patients with severe UTI with a history of ESBL infection.	All other indications require microbiologist approval.

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Gentamicin	IV	Approved for indications stated in the antibiotic guidelines/sensitivities.	Not to be prescribed by FY1's unless checked by a pharmacist or senior doctor before giving and renal function and weight has been checked.
Meropenem	IV	Approved for indications stated in the antibiotic policy/microbiology sensitivities.	All other indications require microbiologist approval.
Piperacillin/Tazobactam	IV	Approved for indications stated in antibiotic policy	All other indications require microbiologist approval
Tigecycline	IV		Microbiologist recommendation only
Daptomycin	IV		Microbiologist approval only.
Linezolid	IV/PO	Approved for use based on sensitivities.	Microbiologist approval required for indications other than MRSA and where no sensitivities are available.
Levofloxacin	IV/PO	Approved for use in pneumonia for patients with severe penicillin allergy (anaphylaxis)	Microbiologist approval only for treatment of patients with severe penicillin allergy (anaphylaxis)
Caspofungin	IV		Microbiologist approval only.
Voriconazole	IV/PO		Microbiologist approval only.
Micafungin	IV		Microbiologist approval only.
Oseltamivir	IV		Microbiologist approval only.

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