Antimicrobial Policy

Version no:	**8.6**
Issue Status:	**Approved by Drugs & Therapeutics Committee** **Endorsed by Infection Control Committee**
Date of Ratification:	**23rd September 2013**
Policy Authors:	**Microbiologists (Royal Free Hospital)**
	Pharmacy Department (RNOH)
	Infection Control (RNOH)
Policy Owner:	**Medical Director, RNOH**
Review Frequency:	**1 year**
Last Review:	**September 2013**
Next Review:	**August 2014**

POLICY AWARENESS	
People who need to know this policy in detail	**All Clinicians, nurses and pharmacy staff**
People who need to have a broad understanding of this policy	**All Clinicians, nurses and pharmacy staff**
People who need to know this policy exists	**Clinical Governance, Medical Staffing, D&T Committees**

CHANGE CONTROL DETAILS			
DATE (DD/MM/YY)	**VERSION**	**DESCRIPTION**	**REASON FOR CHANGE**
November 2009	**1**	**New specialist policy – Sent to DTC for ratification**	
January 2010	**2**	**Final approval at DTC**	**Minor amendments, sent off to CG**
January 2011	**3**	**Review and updated in line with current national guidance**	
17/09/12	**4**	**Send to DTC for ratification**	
18/09/12	**5**	**Final approval at DTC**	**Minor amendments, send off to CG**
19/10/12	**6**	**Ratified by CG**	**Document changed from Guideline to Policy.**
23/10/12	**7**	**Ratified through CG from chairman's action**	**Amendment of Sepsis section**
23/09/13	**8**	**Approval at DTC**	**Review and updated in line with current national guidance.**
07/10/13	**8.1**	**Endorsed by Infection Control Committee**	**Final Review by pharmacy**
08/11/13	**8.2**	**Chairman's action**	**Comments from anaesthetists**
13/11/13	**8.3**	**Comments from DTC**	
21/11/13	**8.4**	**Final policy for intranet**	
06/03/14	**8.5**	**Update**	**Removal of doripenem as withdrawn from UK market**
07/08/14	**8.6**	**Update**	**Review for consistency with app**

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Introduction

The purpose of this document is to provide surgeons, anaesthetists, junior medical and surgical staff, and theatre and ward nurses with the appropriate guidance of the use of antimicrobials at the Royal National Orthopaedic Hospital.

Notes

1. All guidance within this policy is applicable to adult patients only with the exception of section 8.1 (orthopaedic surgical prophylaxis) with is also applicable to paediatrics.
2. Refer to the British National Formulary (BNF) for further details of cautions, contra-indications, side effects and dosages. Doxycycline and ciprofloxacin are teratogenic. Refer to BNF or contact Microbiology/Infectious Diseases for advice on prescribing in pregnancy.
3. Consult Microbiology/Infectious Diseases for complex enquiries:

Monday – Friday, 9am – 5pm	
For lab results and administrative queries including sample tracing:	Microbiology office via switchboard: 020 7794 0500 ext. 33547
For clinical advice including results interpretation and treatment:	Microbiology Registrar dedicated RNOH mobile: 07887 650 795 If unavailable contact: 1. Registrars' office @ RFH ext 33973 2. Consultant on RNOH bleep 801 (when on site at RNOH) 3. Consultants Dr. Simon Warren, Dr. Susan Hopkins or Dr. Damien Mack on call via Royal Free Hospital switchboard
Specialist Pharmacist Antimicrobials	Bleep 690
All other times (evenings, weekends)	
On-call service:	Contact the Microbiology Registrar on-call via the Royal Free Switchboard: 020 7794 0500 The on-call consultant is available via the Registrar

- ## Good prescribing principles

All antimicrobial prescriptions must follow Trust guidelines where they exist. The rationale behind any deviations from these guidelines must be documented in the medical notes. Repeated breaches of the Trust antimicrobial policy will be reviewed by the Medical Director.

Broad-spectrum antimicrobials should be restricted to the treatment of serious infections when the pathogen is not known or when other effective agents are unavailable. Using narrower spectrum agents reduces the likelihood of the emergence of resistant organisms and super-infections e.g. diarrhoea associated with *Clostridium difficile*.

Prescribing of some antimicrobial agents is restricted. Please refer to Penicillin allergy status and restricted antimicrobials list. Pharmacists are required to confirm authorisation which may require a review/discussion with Microbiology/Infectious Diseases before dispensing restricted antimicrobials.

- **Antimicrobial stewardship:** *"Start Smart – then Focus"*

START SMART

• **Obtain Cultures First.** Knowing the susceptibility of an infecting organism can lead to narrowing of broad-spectrum therapy, changing therapy to effectively treat resistant pathogens and stopping antimicrobials when cultures suggest an infection is unlikely.
• **Do not start antimicrobials in the absence of clinical evidence of bacterial infection.**
• **If there is evidence/suspicion of bacterial infection, use these guidelines to initiate prompt effective antimicrobial treatment within one hour of diagnosis (or as soon as possible) in patients with life threatening infections. (Avoid inappropriate use of broad-spectrum antimicrobials).**
Consider the following individual patient and drug-specific factors:

- ~ previous antimicrobial history
- ~ previous infection with multi-resistant organisms
- ~ allergy to antimicrobials
- ~ bioavailability of antimicrobials and effective absorption by oral route

• **Document on drug chart and in medical notes: clinical indication, duration or review date, route and dose**
• **Prescribe single dose or a 24 hour course of antimicrobials for surgical prophylaxis; where antimicrobials have been shown to be effective (see prophylaxis section 8.1)**

- For confirmed or suspected bone and joint infection, delay the administration of antimicrobials until samples have been taken for culture.
- For other cases, the first dose is administered within the 30 minutes *prior* to surgical incision or tourniquet inflation to enable peak blood levels to be present at the start of the surgical procedure.
- A repeat dose of antimicrobial prophylaxis is required when the operation for prolonged procedures and where there is significant blood loss.
- A treatment course of antimicrobials may also need to be given (in addition to appropriate prophylaxis) in cases of dirty surgery or infected wounds.

THEN FOCUS

Review the clinical diagnosis and the continuing need for antimicrobials by 48 hours and make a clear plan of action - the "Antimicrobial Prescribing Decision".

Antimicrobials are generally started before a patient's full clinical picture is known. By 48 hours, when additional information is available, including microbiology, radiographic and clinical information, it is important for clinicians to re-evaluate why the therapy was initiated in the first place and to gather evidence on whether there should be changes to the therapy. Consult Microbiology/Infectious Diseases and/or pharmacists if appropriate. Discuss all patients who remain septic after 72h.

The five Antimicrobial Prescribing Decision options are Stop, Switch, Change, Continue and OPAT:

1. **Stop** antimicrobials if there is no evidence of infection
2. **Switch** antimicrobials from intravenous to oral
3. **Change** antimicrobials – ideally to a narrower spectrum – or broader if required
4. **Continue** and review again at 72 hours
5. **Outpatient** Parenteral Antimicrobial Therapy (**OPAT**)

It is essential that the review and subsequent decision is clearly documented in the medical notes.

- **IV to oral switch**

Consideration for IV to oral switch should be given when the following criteria are met:

• Able to swallow and absorb
• Temperature < 38°C
• Clinical improvement
• Improvement in markers of infection (WBC, CRP)
• Suitable oral substitute available
• IV treatment not indicated

- **Cautions**

Renal and Liver Function

All drug doses are based on normal renal function and liver function in adults. For dosing in renal or liver impairment please contact your ward pharmacist.

Please also check the 'Dosing in renal impairment' section in this policy

Oral bioavailability

Clarithromycin, ciprofloxacin, co-amoxiclav, doxycycline, fluconazole, metronidazole, rifampicin and sodium fusidate are well absorbed orally. Unless oral administration is not possible or gut function is impaired, there is no advantage in intravenous administration.

Prescribing in Pregnancy and Breast Feeding

Some antibiotics are teratogenic and should not be prescribed at all or some stages of pregnancy
Please refer to latest edition of BNF or contact Pharmacy or Microbiology for advice on prescribing in pregnancy and breast feeding.

Myasthenia Gravis

Aminoglycosides and quinolones are contra-indicated. Refer to Microbiology or Pharmacy for advice in prescribing in these patients.

Clostridium difficile

Cephalosporin's, ciprofloxacin and clindamycin are associated with *C. difficile* diarrhoea and pseudomembranous colitis – use of these antimicrobials is strictly restricted. Only use as shown or advised by Microbiology/Infectious Diseases.

Surgical prophylaxis does not routinely continue after surgery. Antimicrobials given routinely after surgery have been shown to increase *C. difficile* infection three fold whilst conferring no further reduction in infection.
Penicillin allergy

Penicillins are life-saving antimicrobials and patients should not be labelled 'penicillin-allergic' without careful consideration. Life-threatening adverse reactions to penicillins due to immediate hypersensitivity (IgE mediated, Type I) are rare. A reliable drug history is key.

Drugs in RED are contraindicated in penicillin allergy.
Drugs in ORANGE should be prescribed with caution. They should not be prescribed for patients with cephalosporin allergy or anaphylactic reactions to penicillin.
Drugs in GREEN are considered safe.

True penicillin allergy occurs in only 7-23% of those who give a history. In life threatening infections such as bacterial meningitis, consider using third generation cephalosporins even in patients with a history of penicillin allergy

Characteristics of penicillin allergy and restricted antimicrobials list

Penicillin Allergy		
Severe allergy = all Type I reactions and some non-Type I reactions, depending on clinical severity e.g. Stevens Johnson Syndrome (SJS) **Non-severe allergy** = most non-Type I reactions		
Characteristics	**Type I immediate hypersensitivity reactions**	**Non-Type I reactions (Types II-IV and idiosyncratic)**
Timing of onset	Usually 1 to 4 hours from exposure (up to 72 hours)	More than 72 hours from exposure
Clinical signs	Anaphylaxis Laryngeal oedema Wheezing / bronchospasm Angioedema Urticaria / pruritis Diffuse erythema	Maculopapular rash Morbilliform rash Drug fever (serum sickness) Tissue injury (immune complex) Contact dermatitis SJS / toxic epidermal necrolysis
In patients with a history of clinical signs of Type I immediate hypersensitivity (life-threatening allergy): **Drugs in RED** are **contra-indicated** **Drugs in ORANGE** are NOT for use in patients with a severe penicillin allergy, unless at the discretion of microbiology/ID. Use with caution in patients with a history of minor allergic symptoms. **Drugs in GREEN** are considered **safe** **All patients – all antimicrobials with * are restricted. They must be prescribed according to the guidelines or discussed with and agreed by Microbiology/ID before use or prescribed in specialities per specialist guidelines. This also applies to any antibacterial not listed below.**		

FACT: PENICILLINS CAN KILL
If given to patients with penicillin allergy.

F lucloxacillin **A** moxicillin **C** o-amoxiclav (Augmentin) **T** azocin, Temocillin and other penicillins	Are contra-indicated in patients with penicillin allergy

BEFORE any drugs are prescribed or administered, a patient should be consulted about any drug allergies and the allergy box on the drug chart MUST be completed.

Contraindicated in penicillin allergy	Use with caution in penicillin allergy	Considered safe in penicillin allergy	
Amoxicillin Flucloxacillin Benzylpenicillin Phenoxymethylpenicillin (penicillin V) *Co-amoxiclav (Augmentin) Piperacillin/tazobactam *Temocillin	AVOID if history of severe penicillin allergy (e.g. anaphylaxis, bronchospasm, urticaria) USE WITH CAUTION if non-severe allergy (e.g. delayed rash)	Amikacin *Azithromycin *Ciprofloxacin Clarithromycin Clindamycin Chloramphenicol *Colistimethate sodium/Colistin Co-trimoxazole Doxycycline *Daptomycin *Fosfomycin	Gentamicin *Linezolid *Levofloxacin Metronidazole Nitrofurantoin *Rifampicin *Sodium Fusidate Teicoplanin *Tetracycline *Tigecycline Trimethoprim *Vancomycin
	***Cephalosporins** *Cefalexin *Ceftazidime *Ceftriaxone Cefuroxime		
	***Carbapenems** *Meropenem *Ertapenem		

***Use of these antimicrobials is restricted according to policy or with Microbiology approval only.**
Note: This is not an exhaustive list – refer to BNF for unlisted drugs.

- **Infection Guidelines**

Urinary Tract

Urinary tract infections (UTI)

Take specimen(s) for culture and sensitivities before starting treatment. Antimicrobial choice can then be guided by sensitivities.

INFECTION		ANTIMICROBIALS	COMMENTS
Uncomplicated community acquired UTI	1st line	**Nitrofurantoin** 50mg qds PO	Contraindicated in patients: • with a creatinine clearance of <40ml/min • in the 3rd trimester of pregnancy • with G6PD deficiency Duration: Female - 5 days, Male - 7days
	2nd line	**Trimethoprim** 200mg bd PO	Contraindicated in 1st trimester of pregnancy Duration: Female - 3days, Male - 7days
Urosepsis/Acute Pyelonephritis **Think Sepsis 6 – see Sepsis 6 algorithm**	1st line	Days 1-2: **Gentamicin** IV* Day 3 onwards: Oral antimicrobial guided by culture results	Total duration 10-14 days
	2nd Line	Days 1-2: **Temocillin** 2g bd IV Day 3 onwards: Oral antimicrobial guided by culture results	
Catheter associated UTI		Days 1-2 **Gentamicin** IV* Day 3 onwards: oral antimicrobials guided by culture results	Duration: 7 days If symptomatic ensure sample sent to Microbiology for culture
UTI in Pregnancy	1st line	**Cefalexin** 500mg tds PO	Duration: 7 days
	β-lactam allergy	Discuss with Microbiology/Infectious Diseases	

^ 2nd line treatment is indicated if

1) 1st line treatment is contraindicated
2) Treatment failure
3) Microbiological cultures indicate resistance to 1st line but susceptibility to 2nd line treatment.

If neither regimen is suitable please discuss with Microbiology/Infectious Diseases

* See **Gentamicin** prescribing section for dosing and monitoring

Antimicrobial prophylaxis in urinary catheterisation

Antimicrobial prophylaxis is only indicated in patients in whom bacteriuria (*positive urine culture)* is associated with a high risk of sepsis or endocarditis or prosthetic joint infection:

1. History of catheter-associated UTI following catheter manipulation
2. Traumatic catheterisation
3. Neutropenic patients
4. Patients with prosthetic joint replacements and megaprostheses. Antimicrobial prophylaxis is ***NOT*** recommended in those with spinal or long bone implants or metalware.
5. Patients requiring endocarditis prophylaxis i.e. heart valve lesion, septal defect, patent ductus or prosthetic valve. *Prophylaxis for endocarditis is* ***NOT*** *indicated in the* ***absence*** *of bacteriuria.*

In all other patients, antimicrobial prophylaxis is not recommended for urinary catheterisation. Check sensitivities of urinary isolates before prescribing.

PROCEDURES	CATEGORY	ANTIMICROBIALS	COMMENTS
Urethral catheterisation **Change of urethral catheter in male patients** **Trial without catheter (TWOC)** Suprapubic catheterisation: **no prophylaxis.**	Groups 1, 2, 3, 4 (as described above)	Single dose **Gentamicin** 80mg IV/IM just before procedure	Check sensitivities of urinary isolates before prescribing. **Omit gentamicin if less than 24 hours since a pre-op gentamicin dose was given.**
	Group 5	Prophylaxis is based on isolates. Discuss with Microbiology	

Prophylaxis for urological procedures

Give single dose IV prophylaxis <30 minutes pre-procedure.
Give single dose oral prophylaxis 1-2 hours pre-procedure.

1. Modification may be needed to cover resistant pathogens in the surgical site in individual cases
2. Intra-operative doses are indicated if surgery involves large volume replacement (blood loss > 80 mg/kg)
3. Prophylaxis does not routinely continue after surgery. Antibiotics given after surgery have been shown to increase *C.difficile* infection 3 fold whilst conferring no further reduction in infection
4. Empirical treatment with post-operative antibiotics is indicated for operations with contaminated or dirty wounds
5. It is not appropriate to continue antibiotic prophylaxis until removal of drains/catheters
6. The use of topical antimicrobials on surgical wounds is not appropriate

TYPE OF SURGERY	PROPHYLAXIS	PROPHYLAXIS (β-LACTAM ALLERGY)	COMMENT
Flexible cystoscopy	Gentamicin 5mg/kg (see Gentamicin dosing section) Prophylaxis *not* indicated if: 1. Dipstick negative 2. No bladder dysfunction 3. No recent history of UTI 4. Not catheterised	Gentamicin 5mg/kg (see Gentamicin dosing section) Prophylaxis *not* indicated if: 1. Dipstick negative 2. No bladder dysfunction 3. No recent history of UTI 4. Not catheterised	
Other Endoscopic procedures: **TURP** **TURT** **Urethrotomy** **Ureteroscopy** **Stone fragmentation or removal** **PCNL/ECSL** **Stent/nephrostomy** **Manipulation**	Gentamicin 5mg/kg (see Gentamicin dosing section)	Gentamicin 5mg/kg (see Gentamicin dosing section)	
TRUS (Transrectal Ultrasound of the Prostate) and biopsy **Implantation of gold grains** **Transperineal prostate biopsy** **Prostate Brachytherapy**	**Ciprofloxacin** 750 mg PO 1-2h pre-procedure / 400 mg IV Any risk-factors for **Ciprofloxacin** resistance*: Add **Temocillin** 2g bd IV	**Ciprofloxacin** 750 mg PO 1-2h pre-procedure / 400 mg IV Any risk-factors for **Ciprofloxacin** resistance*: Add **Amikacin** 7.5 mg/kg IV (see Amikacin dosing section)	*Risk factors for **Ciprofloxacin** resistance: a) Quinolone or cephalosporin exposure in last 6 months b) Indwelling urinary catheter c) Hospitalisation in last 6 months d) Travel to the Indian subcontinent in the last 6 months e) Previous isolate of ciprofloxacin resistant enterobacteriaeceae f) Healthcare worker

- **Respiratory tract**

Lower respiratory tract infections

INFECTION	CATEGORY	ANTIMICROBIALS	COMMENTS
Community acquired Pneumonia Send naso-pharyngeal swabs for virology	Mild (CURB-65 <2)*	**Amoxicillin** 500mg-1g tds PO	Duration: 5-7 days (Max 5 days if patient is not septic)
	Mild (CURB -65 <2)* β-lactam allergy	**Clarithromycin** 500mg bd PO	
	Moderate (CURB-65=2)*	**Amoxicillin** 500 mg - 1g tds PO. Consider **Clarithromycin** 500 mg bd IV/PO if evidence of atypical infection [atypical infection unlikely in patients > 80 years]	Duration: 7 days **Clarithromycin** monotherapy may be adequate if recent course of β –lactam
	Moderate (CURB-65=2)* β-lactam allergy	**Clarithromycin** 500mg bd PO	Duration: 7 days
	Severe (CURB-65 ≥3)*	**Co-amoxiclav** 1.2g tds IV +**Clarithromycin** 500mg bd IV	Duration: 7 days IV to Oral switch when clinically appropriate: **Co-amoxiclav** 625 mg TDS PO + **Clarithromycin** 500 mg BD PO
	Severe (CURB-65 ≥3)* β-lactam allergy	**Levofloxacin** 500mg bd IV	Duration: 7 days IV to Oral switch when clinically appropriate: **Levofloxacin** 500 mg bd PO
	Severe (CURB SCORE ≥3)* AND Severe Chronic Lung Disease/Immunosuppressed	**Piperacillin-tazobactam** 4.5 g qds IV **+ Clarithromycin** 500 mg bd IV β-Lactam Allergy: Discuss with Microbiology	Duration: Discuss with Microbiology

INFECTION	CATEGORY	ANTIMICROBIALS	COMMENTS
Healthcare associated pneumonia (i.e. >4/7 inpatient or nursing home)	Mild	**Co-amoxiclav** 1.2g tds IV/625mg tds PO. If MRSA positive add **Doxycycline** 100mg bd PO **Previous *C. difficile*:** **Amoxicillin** 500 mg -1g tds IV/PO + **Temocillin** 2g bd IV If also MRSA positive add **Doxycycline** 100mg bd PO and discuss with Microbiology	Duration: 5-7 days (Max 5 days if patient is not septic) IV to Oral switch when clinically appropriate: Review cultures and discuss with Microbiology
	Mild β-lactam allergy	**Doxycycline** 100mg bd PO	Duration: 5-7 days(Max 5 days if patient is not septic)
	Moderate/severe	**Amoxicillin** 1g tds IV +**Temocillin** 2g bd IV If MRSA positive add **Teicoplanin** 400mg bd IV for 3 doses then 400mg od IV and discuss with Microbiology.	Duration: 7 days IV to Oral switch when clinically appropriate: Review cultures and discuss with Microbiology
	Moderate/severe β-lactam allergy:	**Levofloxacin** 500mg bd IV If MRSA positive add **Teicoplanin** 400mg bd IV for 3 doses then 400mg od IV and discuss with Microbiology.	Duration: 7 days IV to Oral switch when clinically appropriate: **Levofloxacin** 500 mg BD PO. For MRSA positive IV to Oral switch discuss with Microbiology
Aspiration Pneumonia (NB Antibiotic therapy may not always be necessary as many cases represent chemical pneumonitis)	Community or inpatient ≤4 days	**Amoxicillin** 500mg-1g tds IV/ + **Metronidazole** 500mg tds IV	Duration: 5-7 days (Max 5 days if patient is not septic) IV to Oral switch when clinically appropriate: **Amoxicillin** 500 mg TDS PO + **Metronidazole** 400 mg TDS PO
	β-lactam allergy (all aspiration pneumonia)	**Levofloxacin** 500mg bd IV + **Metronidazole** 500mg tds IV	Community or inpatient ≤4 days, OR Mild, inpatient >4 days or nursing home resident: Duration: 5 - 7 days(Max 5 days if patient is not septic) Moderate/Severe or Previous *C.difficile* infection: Duration: 7 days ** IV to Oral switch when clinically appropriate **Levofloxacin** 500 mg BD PO + **Metronidazole** 400 mg TDS PO

INFECTION	CATEGORY	ANTIMICROBIALS	COMMENTS
	MRSA positive (all aspiration pneumonia)	Add **Teicoplanin** 400mg IV bd x 3 doses then 400mg od. Discuss with micro/ID.	Community or inpatient ≤4 days, OR Mild, inpatient >4 days or nursing home resident: Duration: 5 - 7 days(Max 5 days if patient is not septic) Moderate/Severe or Previous *C.difficile* infection: Duration: 7 days ** IV to Oral switch when clinically appropriate: Discuss with microbiology
	Mild, inpatient >4 days or nursing home resident	**Co-amoxiclav** 1.2g tds IV/625 mg tds PO	Duration: 5-7 days (Max 5 days if patient is not septic) IV to Oral switch when clinically appropriate
	Moderate/severe, inpatient >4 days or nursing home resident OR Previous *C.difficile* infection	**Amoxicillin** 1g tds IV + **Temocillin** 2g bd IV + **Metronidazole** 500mg tds IV	Duration: 7 days** IV to Oral switch when clinically appropriate Review cultures and discuss with Microbiology or Infectious Diseases
Infective exacerbation of COPD	1st line	**Amoxicillin** 1g tds IV or 500mg tds PO	Duration: 5-7 days (Max 5 days if patient is not septic) IV to Oral switch when clinically appropriate
	β-lactam allergy	**Doxycycline** 100mg bd PO	

***CURB-65 assessment – score one point for each**:
Confusion (Abbreviated Mental Test Score of ≤8), Urea > 8 mmol/l, Respiratory rate ≥ 30/min, Blood pressure systolic < 90 and/or diastolic <60 mmHg, Age >65 years.

****Longer duration indicated if:**
1. Co-existent extra-pulmonary infection
2. Empyema
3. Necrotising pneumonia (e.g. *S. aureus, K. pneumonia)*
4. Lung abscess
5. Severe lung disease (e.g. bronchiectasis).

Tuberculosis

If a new diagnosis of tuberculosis is suspected, contact infection control and microbiology/infectious disease. If a patient is admitted with tuberculosis diagnosed elsewhere, liaise with the referring healthcare service for detailed information and contact infection control and microbiology/infectious diseases as above.

- **Skin, soft tissue and wound infections**

INFECTION	CATEGORY	ANTIMICROBIALS	COMMENTS
Surgical site infection with implant present	Most implant associated surgical site infections arise from an infected implant and spread from the implant outwards through the skin.	*Use no antimicrobials unless systemically septic or definite cellulitis, or after debridement.* Always consult senior surgical cover and/or microbiology/infectious diseases if prosthetic material present.	**Before starting antimicrobial treatment strongly consider exploration and debridement and sampling to identify the causative organisms.**
Surgical site infection with implant present, after debridement **OR** **Superficial surgical site infection with cellulitis** **OR** **Other cellulitis** **OR** **IV line site infection**	Mild (1st line)	**Flucloxacillin** 1-2g qds IV or 500mg-1g qds PO	Duration for cellulitis or surgical site infection without implant present is 7 days. Discuss all cases of severe infections or no response within 72 hours or immunocompromised or diabetic patients or with implant present with microbiology/Infectious Diseases.
	Mild (MRSA sensitive to doxycycline/β-lactam allergy)	**Doxycycline** 100mg bd PO	
	Severe (MRSA positive or status unknown/β-lactam allergy)	**Teicoplanin** 400mg bd IV x 3 doses, then 400mg od thereafter + **Sodium fusidate** 500mg tds PO	
Abdomino-pelvic surgical wound infection	Non-severe	**Flucloxacillin** 1-2g qds IV IV to Oral switch when clinically appropriate: **Flucloxacillin** 500mg-1g qds PO	Total duration: 7 days If no response after 72 hours: Discuss with Microbiology/Infectious Diseases. Send wound swab (with clinical details) for culture. Rationalise antimicrobials with results of investigations. Consider imaging and drainage of any collections. See **Gentamicin** and **Amikacin** sections for dosing and monitoring information. IV to Oral switch when clinically appropriate: If not stated, discuss with Microbiology
	Non-severe (MRSA positive or β-lactam allergy)	**Doxycycline** 100mg bd PO +**Metronidazole** 400mg tds PO	
	Severe	**Co-amoxiclav** 1.2g tds IV If evidence of sepsis (see sepsis section) add **Gentamicin** IV If evidence of severe sepsis (see sepsis section), add **Amikacin** IV IV to Oral switch when clinically appropriate: **Co-amoxiclav** 625 mg TDS PO β-lactam allergy: Discuss with Microbiology	

INFECTION	CATEGORY	ANTIMICROBIALS	COMMENTS
	Severe and MRSA positive	**Teicoplanin** 400mg IV bd x 3 doses then 400mg od thereafter + **Sodium fusidate** 500mg tds PO + **Co-amoxiclav** 1.2g tds IV β-lactam allergy: Discuss with Microbiology	
Animal and human bites	1st line	**Co-amoxiclav** 625mg tds PO	Total duration: 7 days Consider risk / prophylaxis for blood born virus infections and discuss with Microbiology / Infectious Diseases if appropriate.
	β-lactam allergy	**Doxycycline** 100mg bd PO + **Metronidazole** 400mg tds PO	
Necrotising Fasciitis	1st line	**Benzylpenicillin** 1.2g 2 hourly (14.4g/day) IV + **Clindamycin** 600mg qds IV + **Ciprofloxacin** 400mg bd IV	Discuss all cases with Microbiology/Infectious Diseases. Assess need for debridement and tetanus risk (see notes below) Duration: 14 days
	β-lactam allergy	**Clindamycin** 600mg qds IV + **Ciprofloxacin** 400mg bd IV	
	MRSA positive or status unknown	**Teicoplanin** 400mg IV bd x 3 doses then 400mg od thereafter + **Metronidazole** 500mg tds IV + **Sodium fusidate** 500mg tds PO + **Ciprofloxacin** 400mg bd IV	
Infected sacral sore Treatment usually only indicated in the context of spreading cellulitis and/or purulent exudate	Pseudomonas NOT isolated	**Co-amoxiclav** 1.2g tds IV IV to Oral switch when clinically appropriate: **Co-amoxiclav** 625mg tds PO	Osteomyelitis – contact Microbiology/Infectious Diseases as regimens given unsuitable for osteomyelitis Duration: 7 days empiric therapy. Discuss with microbiology/Infectious Diseases if longer required. β-lactam allergy: contact Microbiology/Infectious Diseases.
	Pseudomonas isolated	**Piperacillin/tazobactam** 4.5g qds IV IV to Oral switch when clinically appropriate: Discuss with Microbiology	
	MRSA positive or status unknown	Add **Teicoplanin** 400mg IV bd x 3 doses then 400mg od thereafter + **Sodium fusidate** 500mg tds PO	

Notes: 1. Cellulitis due to IV cannula/catheter: remove cannula and treat as “other cellulitis” above
2. Traumatic/surgical wound: assess possibility of underlying collection requiring drainage
3. Assess need for debridement and tetanus risk

- **Diabetic Foot Infection**
    - Routine surface swabs inadequate to determine main pathogen within the polymicrobial colonisation of a diabetic foot ulcer
    - Many diabetic foot ulcers show muted signs of infection
    - Use antibiotics early and aggressively
    - Refer to Microbiology
    - Consider MRI scan to exclude osteomyelitis if plain X-ray inconclusive or if clinical suspicion is high

INFECTION	CATEGORY	ANTIMICROBIALS	COMMENTS
Cellulitis	1st line	**Flucloxacillin** 1 - 2 g qds IV IV to Oral switch when clinically appropriate: **Flucloxacillin** 500 mg - 1g qds PO	If no response after 72 hours - discuss with Microbiology or Infectious Diseases Duration: 7 days if no osteomyelitis
	β-lactam allergy	**Doxycycline** 100 mg bd PO	
	MRSA positive	**Teicoplanin** 400 mg bd IV for 3 doses then 400 mg od IV + **Sodium fusidate** 500 mg tds PO	Duration: Discuss with Microbiology
Diabetic Foot Ulcer with Associated Infection - *P. aeruginosa negative* Baseline X-ray (consider repeat in 2 weeks if no clinical improvement)	1st Line	**Co-amoxiclav** 1.2 g tds IV or 625 mg tds PO If MRSA positive add **Teicoplanin** 400 mg bd IV for 3 doses then 400 mg od IV + **Sodium fusidate** 500 mg tds PO	IV to Oral switch when clinically appropriate: **Co-amoxiclav** 625 mg tds PO, for MRSA positive oral switch discuss with Microbiology or Infectious Diseases Duration: 7 days if no osteomyelitis
	β-lactam allergy	**Levofloxacin** 500 mg bd IV or 500 mg PO + **Metronidazole** 500 mg tds IV or 400 mg tds PO If MRSA positive**:** add **Teicoplanin** 400 mg bd IV for 3 doses then 400 mg od IV + **Sodium fusidate** 500 mg tds PO	IV to Oral switch when clinically appropriate: **Levofloxacin** 500 mg bd PO + **Metronidazole** 400 mg tds PO, for MRSA positive oral switch discuss with Microbiology or Infectious Diseases Duration: 7 days if no osteomyelitis

NFECTION	CATEGORY	ANTIMICROBIALS	COMMENTS
Diabetic Foot Ulcer with Associated Infection - *P. aeruginosa positive*	1st Line	**Piperacillin-tazobactam** 4.5g qds IV If MRSA positive add **Teicoplanin** 400 mg bd IV for 3 doses then 400 mg od IV + **Sodium fusidate** 500 mg tds PO	IV to Oral switch when clinically appropriate: Discuss with Microbiology or Infectious Diseases Duration: 7 days if no osteomyelitis
	β-lactam allergy	**Teicoplanin** 400 mg bd IV for 3 doses then 400 mg od IV + **Ciprofloxacin** 400 mg bd IV or 500 mg bd PO + **Metronidazole** 500 mg tds IV or 400 mg tds PO If MRSA positive add **Sodium fusidate** 500 mg tds PO	
Diabetic foot infections Requiring Toe/partial foot Amputations	• Pre-operative antibiotic plan with Microbiology where possible • Send multiple microbiology specimens - tissue/bone-from "cleaner" side of amputation wound, prior to antibiotics where possible • Day 3 & 7 review of microbiological results and antibiotics targeted as necessary • Antibiotics to be continued for 7-14 days if no osteomyelitis present • If evidence of osteomyelitis, treat for 6 weeks with ID OPD review before stopping		

- **Bone and joint infections**

Orthopaedic surgical prophylaxis

THIS SECTION IS APPLICABLE TO BOTH ADULTS AND PAEDIATRIC PATIENTS

Give single dose IV Prophylaxis (unless stated otherwise)
≤ 30 min Pre Incision/Tourniquet

Note: For orthopaedic surgery in the presence of suspected or confirmed infection do NOT follow these guidelines (see empirical treatment in the following sections).

1. These regimens may need modification to cover resistant pathogens in the surgical site in individual cases.
2. Both teicoplanin and gentamicin provide 24 hours of prophylactic cover. Repeat doses are thus NOT required.
3. Prophylaxis does **NOT** routinely continue after surgery. Antimicrobials given routinely after surgery have been shown to increase *C. difficile* infection three fold whilst conferring no further reduction in infection.
4. Empirical treatment with post-operative antimicrobials is indicated for emergency operations with contaminated or dirty wounds (see empirical treatment section below).
5. It is **NOT** appropriate to continue antimicrobial prophylaxis until removal of drains/catheters.
6. Routine use of topical antimicrobials is **NOT** appropriate.

If allergic to any of the antimicrobials below please contact Microbiology for further advice prior to surgery.

TYPE OF SURGERY	PROPHYLAXIS	PROPHYLAXIS (β-LACTAM ALLERGY)	COMMENT
Clean orthopaedic procedures without prosthesis/implants e.g. arthroscopy	No prophylaxis Recommended	No prophylaxis recommended	
Primary arthroplasty **Revision arthroplasty (one stage) - take samples before giving prophylaxis** **Insertion, exchange or removal of non-joint replacement implant (spinal, fracture fixation etc.) with no suspected infection** **Spinal fusion** **Laminectomy** **Open reduction of closed fracture** **Hip fracture**	Teicoplanin 10mg/kg IV **(to a maximum of 800mg)** + Gentamicin 5mg/kg (see Gentamicin dosing section) These doses provide 24 hours prophylaxis.	Teicoplanin 10mg/kg IV **(to a maximum of 800mg)** + Gentamicin 5mg/kg (see Gentamicin dosing section) These doses provide 24 hours prophylaxis.	These doses provide 24 hours prophylaxis. If infection possible, take ≥5 samples **before giving prophylaxis.** Antimicrobial loaded cement is recommended (containing gentamicin +/- vancomycin).
Lower limb amputation	Teicoplanin 10mg/kg IV **(to a maximum of 800mg)** + Gentamicin 5mg/kg (see Gentamicin dosing section) These doses provide 24 hours prophylaxis. + Metronidazole 500mg IV and continue Metronidazole 500mg IV or 400mg tds PO for 5 days post-surgery	Teicoplanin 10mg/kg **IV (to a maximum of 800mg)** + Gentamicin 5mg/kg (see Gentamicin dosing section) These doses provide 24 hours prophylaxis. + Metronidazole 500mg IV and continue Metronidazole 500mg IV or 400mg PO tds for 5 days post-surgery	Give 24 hours prophylaxis starting at induction. Give for longer only if there is residual infected soft tissue/bone.

Empirical antimicrobial treatment for orthopaedic implant associated infections

Consult the clinical notes for a specific antimicrobial plan for patients discussed in MDTs and/or who have organisms isolated pre-operatively.
Take multiple (≥5) tissues samples from the implant/tissue interface using separate sets of instruments prior to starting antimicrobials. Fluid samples are also useful; swabs are not useful. Always take samples before starting treatment unless patient septic.
Where possible use antimicrobial loaded cement with **Gentamicin** (1-2 grams per 40 grams of cement) and **Vancomycin** (1-2 grams per 40 grams of cement).
Commence treatment at the time of surgery if possible.

TYPE OF SURGERY	EMPIRICAL TREATMENT (excluding B-lactam allergy)	EMPIRICAL TREATMENT (β-lactam allergy)	COMMENT
Discharging sinus/infected wound with implant present, before surgery	Most implant associated infections arise from the infected implant and spread outwards through the skin. *Avoid antimicrobials unless systemically septic or definite cellulitis or after debridement and sampling.*		Always consult senior surgical cover and/or Microbiology/Infectious diseases if prosthetic material present.
Debridement and retention of implant/prosthesis for acute infection (<3 weeks duration) **First stage, second stage, or single stage revision arthroplasty with suspected infection** **Removal of implant with suspected infection**	Take ≥5 samples, then start **Piperacillin/tazobactam** 4.5g IV tds, stop after 5 days if no gram negative organisms identified AND **Amikacin** (see Amikacin dosing section) for 2 days then stop (see Amikacin section, dose if CrCl ≥40ml/min is 15mg/kg od) AND **Teicoplanin** 10mg/kg IV 12 hourly for 3 doses then 10mg/kg IV 24 hourly until final culture results are available.	Take ≥5 samples, then start **Teicoplanin** 10mg/kg IV 12 hourly for 3 doses then 10mg/kg IV 24 hourly until final culture results are available. AND **Amikacin** (see Amikacin dosing section) for 2 days then stop (see Amikacin section if CrCl ≥40ml/min is 15mg/kg od)	Antimicrobial loaded cement is recommended, containing (**Gentamicin** (1-2 grams per 40 grams of cement) and **Vancomycin** (1-2 grams per 40 grams of cement) Stop **Amikacin** after 2 days. Stop **Piperacillin/tazobactam** if no gram negative organisms identified after 5 days. Continue **Teicoplanin** until final culture results are available. Empirical treatment should be modified according to culture results. Discuss culture results and duration of treatment with Microbiology/Infectious Diseases.

Empirical antimicrobial treatment for orthopaedic infections with NO IMPLANT present: septic arthritis, osteomyelitis, discitis, epidural abscess and vertebral osteomyelitis

Always take samples before starting treatment unless patient septic. Commence treatment at the time of surgery if possible.

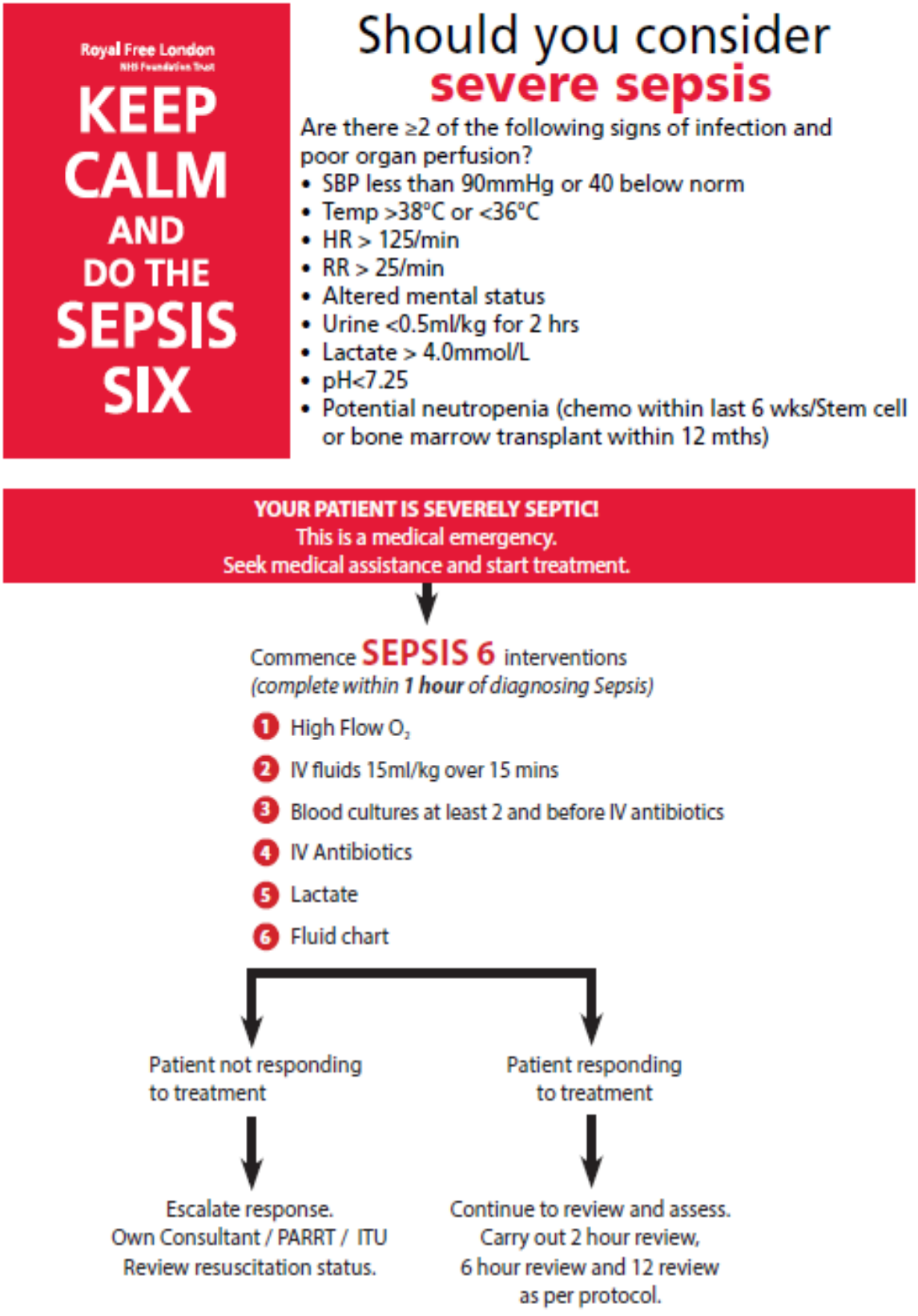
INFECTION	CATEGORY	ANTIMICROBIALS	COMMENTS
Native joint acute septic arthritis or acute osteomyelitis	1st line	**Flucloxacillin** 1-2g qds IV (+ **Sodium fusidate** 500mg tds PO if osteomyelitis)	Discuss with Microbiology/Infectious Diseases. Duration: typically 6 weeks.
	β-lactam allergy/MRSA positive or status unknown	**Doxycycline** 100mg bd PO or **Teicoplanin** 10mg/kg IV 12 hourly for 3 doses then 10mg/kg IV 24 hourly (+ **Sodium fusidate** 500mg tds PO if osteomyelitis)	
Debridement/resection of chronic osteomyelitis **Discitis, epidural abscess, vertebral osteomyelitis** **-Post-surgical** **-Post trauma** **-Catheter related**	1st line/MRSA positive or status unknown	**Piperacillin/tazobactam** 4.5g IV qds AND **Amikacin** (see Amikacin dosing section) dose if CrCl ≥40ml/min is 15mg/kg od) AND **Teicoplanin** 10mg/kg IV 12 hourly for 3 doses then 10mg/kg IV 24 hourly	Stop **Amikacin** after 2 days. Empirical treatment should be modified according to culture results. Discuss culture results and duration of treatment with Microbiology/Infectious Diseases. Duration: typically 12 weeks.
	β-lactam allergy (anaphylaxis)	**Teicoplanin** 10mg/kg IV 12 hourly for 3 doses then 10mg/kg IV 24 hourly AND **Amikacin** (see Amikacin dosing section) for 2 days then stop. Dose if CrCl >=40ml/min is 15mg/kg od)	

- **Sepsis**

THINK SEPSIS 6 - SEE SEPSIS 6 ALGORITHM

If source of infection is known, treat as per specific body system in guideline. If unknown cause or origin use these guidelines

INFECTION	CATEGORY	ANTIMICROBIALS	COMMENTS
Unknown cause/origin THINK SEPSIS 6	NON-SEVERE Known/possible infection + 1 of the criteria in comments#	**Co-amoxiclav** 1.2g tds IV + **Gentamicin** IV (see Gentamicin dosing section)	For non-severe: IV to Oral switch when clinically appropriate. Review cultures and discuss with Microbiology. Total duration: 5 - 7 days unless agreed with Microbiology If MRSA positive add **Teicoplanin** 400 mg BD IV for 3 doses then 400 mg OD IV If atypical pathogen likely add **Clarithromycin** 500mg BD IV **#Criteria for assessing sepsis:** -Systolic BP <90 mmHg or acute drop 40 mmHg (not associated with dialysis) -Urine output <0.5 ml/kg for 2h (unless established oliguria) -Altered mental status -Tachycardia >125/min -Pyrexia >38°C or <36°C -Respiratory rate >25/min -Serum lactate > 4.0mmol/L -pH <7.25 -Potential neutropenia **Contact Microbiology if toxic shock suspected**
	SEVERE Known/possible infection + ≥2 of the criteria in comments# +evidence of organ hypoperfusion	**Piperacillin-tazobactam** 4.5g qds IV +/- **Amikacin** IV (see Amikacin dosing section)	
Unknown cause/origin THINK SEPSIS 6 β-lactam allergy	NON-SEVERE Known/possible infection + 1 of the criteria in comments #	**Teicoplanin** 400mg bd IV for 3 doses then 400mg od IV + **Gentamicin** IV (see Gentamicin dosing section) + **Metronidazole** 500mg tds IV	
	SEVERE Known/possible infection + ≥2 of the criteria in comments # +evidence of organ hypoperfusion	**Teicoplanin** 400mg bd IV for 3 doses then 400mg od IV + **Amikacin** IV(see Amikacin dosing section) + **Metronidazole** 500mg tds IV	


Royal Free London
NHS Foundation Trust
KEEP CALM AND DO THE SEPSIS SIX
Should you consider
severe sepsis
Are there ≥2 of the following signs of infection and poor organ perfusion?
• SBP less than 90mmHg or 40 below norm
• Temp >38°C or <36°C
• HR > 125/min
• RR > 25/min
• Altered mental status
• Urine <0.5ml/kg for 2 hrs
• Lactate > 4.0mmol/L
• pH<7.25
• Potential neutropenia (chemo within last 6 wks/Stem cell or bone marrow transplant within 12 mths)
YOUR PATIENT IS SEVERELY SEPTIC!
This is a medical emergency.
Seek medical assistance and start treatment.
Commence SEPSIS 6 interventions
(complete within 1 hour of diagnosing Sepsis)
1 High Flow O2
2 IV fluids 15ml/kg over 15 mins
3 Blood cultures at least 2 and before IV antibiotics
4 IV Antibiotics
5 Lactate
6 Fluid chart
Patient not responding to treatment
Escalate response.
Own Consultant / PARRT / ITU
Review resuscitation status.
Patient responding to treatment
Continue to review and assess.
Carry out 2 hour review,
6 hour review and 12 review
as per protocol.

- **Central nervous system infections**

INFECTION	CATEGORY	ANTIMICROBIALS	COMMENTS
Community acquired Meningitis	**All**	**Ceftriaxone** 2g bd IV + Dexamethasone 0.15 mg/kg IV qds	Give Dexamethasone for 4 days starting with or just before first dose of antimicrobial. Duration varies with aetiology – discuss with Microbiology/Infectious Diseases. Discuss Public Health implications with Microbiology/Infectious Diseases. If encephalitis suspected: Add Aciclovir 10mg/kg tds IV. Duration: Discuss with microbiology
	>55years or pregnant or immunocompromised	Add **Amoxicillin** 2g 4hrly IV	
	β-lactam allergy	Obtain clear history Discuss with Microbiology/Infectious Diseases	

- **Gastrointestinal infections**

INFECTION	CATEGORY	ANTIMICROBIALS	COMMENTS
***Clostridium difficile* associated diarrhoea (CDAD)** Review concomitant antibiotic therapy and rationalise any proton pump inhibitor use	Mild	Mild diarrhoea often settles once the offending antimicrobial is stopped.	Total duration: 10-14 days. Treat as severe if WBC >15, OR temp >38.5, OR creatinine >50% above baseline OR evidence of colitis. If severe discuss case with Microbiology/Infectious Diseases and consider surgical referral.
	Moderate	**Metronidazole** 400mg tds PO	
	Severe	**Metronidazole** 400mg tds PO **+** **Vancomycin** 500mg qds PO **Metronidazole** IV is an option if PO is not possible	
	Recurrent	Discuss with microbiology	
Abdomino-pelvic Sepsis including biliary tree (NOT STI-related)	1st line	**Co-amoxiclav** 625mg tds PO/1.2g tds IV + **Gentamicin** IV* (see Gentamicin dosing section). If severe sepsis give **Amikacin** IV** instead of **Gentamicin** (see Amikacin dosing	Identify and remove source. Drain any collections. Duration: 7 days then review.

INFECTION	CATEGORY	ANTIMICROBIALS	COMMENTS
		section)	
	Septic after 72 h	Switch **Co-amoxiclav** to **Piperacillin/tazobactam** 4.5g qds IV +/- **Amikacin** IV** (see Amikacin dosing section)	Discuss with Microbiology/Infectious Diseases if severely unwell or not responding to therapy.
	β-lactam allergy 1st line (extra biliary)	**Metronidazole** 400mg tds PO/500mg tds IV + **Gentamicin** IV* If severe sepsis give **Amikacin** IV** instead of **Gentamicin**	
	β-lactam allergy Biliary Sepsis	**Ciprofloxacin** 500 mg bd PO/400 mg bd IV + **Gentamicin** IV* (see Gentamicin dosing section)	
	β-lactam allergy Septic after 72 h	Discuss with Microbiology/Infectious Diseases	
	MRSA positive or status unknown	Add **Teicoplanin** 400mg bd IV for 3 doses then 400mg od IV	
Acute Gastroenteritis	Mild	Supportive treatment only	
	Systemically unwell or immunocompromised	**Azithromycin** 500mg od PO for 3 days	
	Amoebic dysentery suspected	Send hot stool to Microbiology and contact Infectious Diseases	
	Recent antimicrobials	Consider *C.difficile* (see above)	

- **Ophthalmic infections**

INFECTION	CATEGORY	ANTIMICROBIALS	COMMENTS
Conjunctivitis	1st line	**Chloramphenicol** eye ointment, topically 3-4 times a day	Duration: 5-7 days

Head and Neck - Ear Nose and Throat

INFECTION	CATEGORY	ANTIMICROBIALS	COMMENTS
Streptococcal Pharyngo-tonsillitis	1st line	**Penicillin V** 500mg qds PO (If unable to swallow or severe infection start **Benzylpenicillin**1.2g 4 hourly IV and switch to oral when appropriate	NB The most common aetiology for pharyngo-tonsillitis is viral Duration: 10 days
	β-lactam allergy	**Clarithromycin** 250mg bd PO If unable to swallow or severe infection start **Clarithromycin** 250mg IV and switch to oral when appropriate	
Rhinosinusitis/Acute Bacterial Sinusitis	1st Line	**Co-amoxiclav** 625mg tds PO	NB The most common infective aetiology for sinusitis is viral Duration: 7 days
	β-lactam allergy	**Doxycycline** 200mg stat PO then 100mg bd PO	
Acute otitis media	1st line	**Amoxicillin** 500mg tds PO	Duration: 5-7 days
	β-lactam allergy	**Clarithromycin** 500mg bd PO	

- **Sexual health**

- Notes: all patients with suspected STI must be referred urgently to a sexual health clinic – consult Microbiology

INFECTION	CATEGORY	ANTIMICROBIALS	COMMENTS
Epidydymo-orchitis	>35 years & STI unlikely	**Ciprofloxacin** 500mg bd PO	Duration: 10 days
	<35yrs or STI likely	**Ceftriaxone** 500mg stat IM + **Doxycycline** 100mg bd PO	Duration: 10-14 days
Pelvic Inflammatory Disease	Inpatients 1st line	**Ceftriaxone** 1-2g od IV + **Metronidazole** 500mg tds IV + **Doxycycline** 100mg bd PO	Duration: 14 days
	Inpatients β-lactam allergy	**Ciprofloxacin** 400mg bd IV + **Metronidazole** 500mg bd IV + **Doxycycline** 100mg bd PO IV to Oral switch when clinically appropriate: **Ciprofloxacin** 500mg bd PO + **Metronidazole** 400mg bd PO + **Doxycycline** 100mg bd PO	
	Outpatients	**Ceftriaxone** 500mg stat IM + **Metronidazole** 400mg bd PO + **Doxycycline** 100mg bd PO	
	Outpatients β-lactam allergy	**Discuss with Microbiology**	

- **Process for Monitoring Compliance**

The antimicrobial guidelines will be audited comprehensively every 6-12 months to monitor uptake and compliance.

In addition, ward pharmacists do monthly point prevalence audits using Auditr® when needed.

Results of audits are discussed at the Antimicrobial Stewardship Committee and reported to the Infection Control Committee and the Drugs and Therapeutics Committee.

Weekly ward rounds by the Infectious Diseases and Microbiology team and Pharmacy teams will endorse antimicrobial prescriptions and change as necessary.

- **Process for administering intravenous antimicrobials**

- Pre-plan before drawing up doses.
- Be sure of local protocols and the RNOH Administration of Medicines document.
- Check drug against the prescription.
  - Check dose, time, route correct
- Check patient identification.
- Check IV site.
- Check that any equipment required is working.
- Know how to administer each drug.
  - Calculation of concentration and rate.
  - Reconstitution
  - Addition of drugs only to recommended diluents.
  - Check package insert, Data Sheet, Pharmacy Drug Information for further information.
- Use aseptic technique during reconstitution steps, addition of drugs to diluents, and care of the line.
  - Maintain a sterile, particle-free solution.
- Thoroughly mix any additions, checking for precipitation or particles.
- Complete yellow infusion additive label and attach to infusion.
- Understand how the drug works (and can explain this to the patient if appropriate).
- Continue to monitor for precipitation and patient response where appropriate.
- **ALL STEPS FOR PREPARATION SHOULD BE CARRIED OUT IN THE TREATMENT ROOM BEFORE ADMINISTRATION TO THE PATIENT.**

IF IN DOUBT/CHECK (Pharmacist, Nursing Colleagues, Doctor)

KEY POINTS
Finally…….. IV's are hazardous,
Policies and procedures should always be followed, and
If you are in any doubt DON'T!

Signed _____

Print Name _____

Date _____

Assessor's Signature _____

- **Guidelines for the Use of Intravenous Vancomycin**

Background

Vancomycin is a glycopeptide with antibacterial activity against Gram-positive bacteria, both aerobic and anaerobic. It is indicated in infections due to susceptible gram-positive organisms that cannot be treated by other effective, less toxic antimicrobial drugs. As vancomycin is an antimicrobial to which nearly all strains of staphylococcus remain susceptible, it should be reserved for those cases where there is a specific indication e.g. MRSA, to minimise the chance of resistance emerging. For systemic infections, vancomycin must be administered intravenously. Oral vancomycin is poorly absorbed.

Vancomycin Dosing

The dose of Vancomycin is dependent upon the renal function. Therefore close monitoring of renal function is essential.

<table>
<tr><th>RENAL FUNCTION</th><th>DOSAGE</th><th>WHEN TO TAKE LEVELS</th><th>ACTION</th></tr>
<tr><td>Normal renal function
(CrCl ≥ 50 ml/min)</td><td>15mg/kg
(max 1.5g
12 hourly)</td><td>Trough (pre) level immediately before 3rd and 4th dose and GIVE DOSE
(do not wait for level to be reported)</td><td rowspan="3">Trough within specified range.
Continue on current dose. Re-check trough 2-3 days in or sooner if signs of renal deterioration.

Trough outside of specified range.
Dose/dosage interval may need to be adjusted.

Discuss with Microbiology/Infectious Diseases or Pharmacy. Repeat trough level immediately before 2nd dose of the new regimen.</td></tr>
<tr><td>Mild renal impairment
(CrCl 20-49 ml/min)</td><td>15mg/kg
(max 1g)
24 hourly</td><td>Trough (pre) level immediately before 3rd dose and GIVE DOSE
(do not wait for level to be reported)</td></tr>
<tr><td>Moderate renal impairment
(CrCl 10-19 ml/min)</td><td>15mg/kg
(max 1g in
24 hourly</td><td>Trough (pre) level immediately before 2nd dose and GIVE DOSE
(do not wait for level to be reported)</td></tr>
<tr><td>Severe renal impairment
(CrCl < 10 ml/min)
And not on dialysis</td><td>15mg/kg
(max 1g)
stat</td><td>Trough (pre) level at 24 hours

DO NOT GIVE 2nd DOSE - AWAIT RESULT OF LEVEL</td><td>Check trough levels daily and do NOT give a further dose until the trough level is within the specified range. If the trough is below the specified range, contact microbiology</td></tr>
<tr><td>Severe renal impairment
(CrCl <10 ml/min) and on intermittent haemodialysis</td><td colspan="3">Discuss with Pharmacist or Microbiology/Infectious diseases doctors.</td></tr>
</table>

CrCl (ml/min) = (140 –age) x ideal body weight (kg) x N
Serum creatinine (micromol/L)

Where N = 1.23 for males and
N = 1.04 for females

Use ideal body weight (IBW) if actual weight > 115% IBW
Ideal body weight (male) = 50 kg + (2.3 x every inch over 5 feet)
Ideal body weight = 45.5 = (23.3 x every inch over 5 feet)

Trough (Pre) level reference range: 10-15mg/L
OR
15-20 mg/L for less sensitive strains of MRSA as advised by Microbiology

There is NO need to monitor peak vancomycin levels

Level Monitoring and Dose Regime Adjustment

Levels are processed at everyday 10 am, 3 pm & 10 pm seven days a week at the Royal Free Hospital – in order to ensure minimal delay, specimens should be clearly labelled with the time of the patient's last dose and time the sample was taken.

Send samples on the next available transport to the Royal Free Hospital. Inform the microbiology scientist on call [bleep 1686] of any specimens sent after 5 pm.

Discuss levels and need for dosage adjustment with Microbiology or Pharmacy on a case by case basis

Adverse Effects

- Nephrotoxicity, Ototoxicity (discontinue if tinnitus occurs)
- Rapid bolus administration may be associated with exaggerated hypotension, including shock, and, rarely cardiac arrest.
- Rapid infusion may also cause flushing of upper body ('red-man' syndrome) or pain in the chest or back.

For any further advice on dosing, contact your ward pharmacist or pharmacy on ext. 5832.
For ITU patients contact the Specialist Pharmacist – Critical Care, Theatres & Pain, bleep 807.

Reconstitution & Administration

Dose	Vials	Reconstitute with	Draw up	Further dilute to	Infuse over 10mg/min	Infusion rate
500mg	1 x 500mg	10ml WFI	10ml (500mg)	100ml with N/S 0.9% or G5%	1 hr	100 ml/hr
750mg	1 x 1g	20ml WFI	15ml (750mg)	250ml with N/S 0.9% or G5%	1.5 hrs	167 ml/hr
1g	1 x 1g	20ml WFI	20ml (1g)	250ml with N/S 0.9% or G5%	2 hrs	125 ml/hr

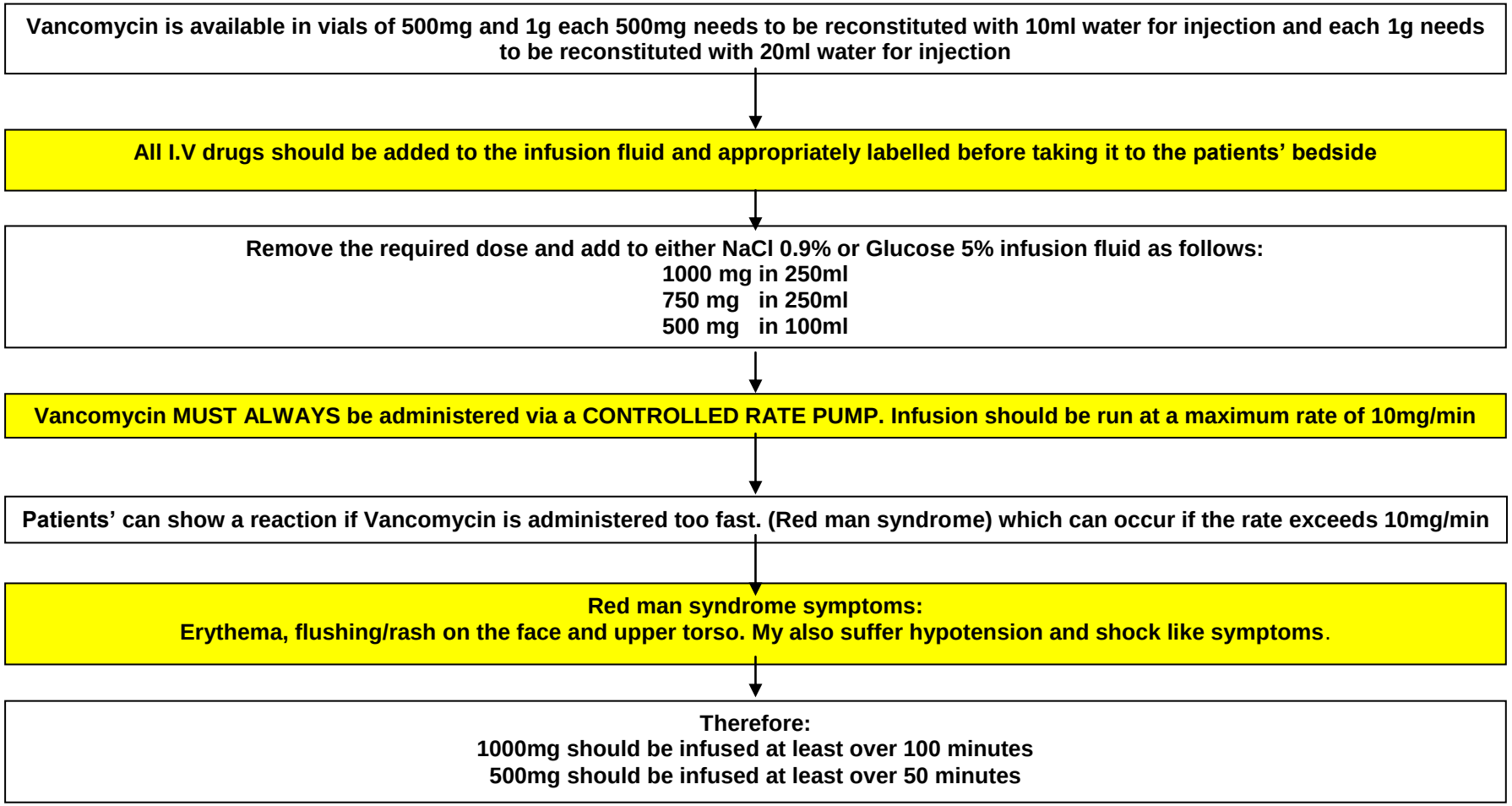
Abbreviations: WFI = Water for Injection, N/S 0.9% = Sodium chloride 0.9% (normal saline), G5% = Glucose 5%

Vancomycin is irritant therefore maximum concentration of infusion for peripheral intravenous administration is 5mg/ml.

- Intravenous infusions should run at a maximum rate of 10mg/min. Usual rates of infusion are 500mg infusions over 60mins and 1g infusions over 100-120mins. **Vancomycin must always be administered via a rate controlled pump.**

- Intravenous use of Vancomycin may be associated with ''red-man'' syndrome (characterised by erythema, flushing or rash over the face and upper torso, and sometimes hypotension and shock-like symptoms.) The effect is usually related to histamine release and is related to rapid infusion.

- **Guidelines for the use of intravenous Vancomycin: Nurses' Algorithm**



- **Guidelines for the Use of Intravenous Amikacin**

Background

Amikacin sulphate is an aminoglycoside antibiotic which is active against a broad spectrum of Gram-negative organisms, including Pseudomonas spp & Escherichia coli. The principal Gram-positive organism sensitive to amikacin is Staphylococcus aureus, including methicillin-resistant strains. Amikacin is indicated in the short-term treatment of serious infections due to susceptible strains of Gram-negative bacteria. It may also be indicated for the treatment of known or suspected staphylococcal disease.

Amikacin dosing

Wherever possible treatment with aminoglycosides should not exceed 7 days.
Courses exceeding 15g in total must be discussed with Microbiology/Infectious Diseases and regular audiometry performed.
Doses >1300 mg must not be used without discussion with Microbiology/Infectious Diseases.

Appropriate dosage and careful monitoring are essential to minimise the risks of ototoxicity and nephrotoxicity – all patients must be discussed with Microbiology/Infectious Diseases. Patients with a history of hearing loss, current/persistent vestibular dysfunction or a family history of maternal early onset deafness may be at increased risk of ototoxicity with aminoglycosides.
Alternatives should be used in these patients whenever possible.
All aminoglycoside dosage regimens are based on mg/kg. Use ideal body weight (IBW) if actual body weight is > 115% IBW:

Ideal body weight (male) = 50kg + (2.3 x every inch over 5ft)
Ideal body weight (female) = 45.5kg + (2.3 x every inch over 5ft)
OR
Ideal body weight (male) = 50kg + [(height(cm) – 154) x 0.9]
Ideal body weight (female) = 45.5kg + [(height(cm) – 154) x 0.9]

Extended interval amikacin regimens ensure target peak concentrations and are associated with less toxicity. These regimens should be used in all patients unless the following contraindications apply:

1) Endocarditis (1 mg/kg tds)
2) The dose is being given prophylactically
3) Neonate
4) CrCl < 60ml/min
5) Pregnancy
6) Burns
7) Ascites, severe liver disease, jaundice
8) Cystic fibrosis

The eGFR value reported is NOT sufficient for accurate dosing. Creatinine clearance should be calculated using the Cockcroft-Gault equation shown below:

$$\text{CrCl (ml/min)} = \frac{N \times (140 - \text{age}) \times \text{weight (kg)}}{\text{SrCr } (\mu\text{mol/L})}$$

Where N = 1.23 for males
N = 1.04 for females

Category	Initial IV Amikacin Regimen Use ideal body weight where appropriate	Monitoring
CrCl ≥ 40ml/min and no contraindication 1-6 (as above)	15mg/kg every 24 hours. Max dose 1300mg	- Take trough level just before 2nd dose - Give 2nd dose - Check result before giving 3rd dose. Monitor levels twice weekly if stable renal function. - Level <5 mg/L: give 3rd dose. Monitor levels twice weekly if stable renal function. - Levels ≥5 mg/L: recheck level every 12-24 hours until <5mg/L. Then give 3rd dose. Review dosage regimen accordingly. Take trough level just before 4th dose and repeat level every 12-24 hours as above until <5 mg/L before giving 5th dose. Review dosage regimen as necessary.
CrCl 30-39 ml/min and no contraindications 1-6 (as above)	15mg/kg every 36 hours. Max dose 1300mg	
CrCl 20-29 ml/min and no contraindications 1-6 (as above)	15 mg/kg every 48 hours. Max dose 1300mg	
CrCl >20ml/min and contraindications 4-6 apply (as above) - Burns - Severe Liver disease/ascites - Cystic fibrosis	7.5mg/kg BD	- Take trough (just before) and peak (1 hour after) levels across 3rd dose. - Check results before giving 4th dose -Reference ranges: Trough <10mg/L Peak: 20-30 mg/L - Discuss with Microbiology/Infectious Diseases/Pharmacy and adjust dosage regimen accordingly. - Monitor levels twice weekly if stable renal function.
CrCL <20 ml/min	7.5 mg/kg stat	- Take trough level 24 hrs later. - Check result before giving next dose - Only give next dose if level <5mg/L - this process is repeated daily.

Adverse Effects

- Nephrotoxicity, Ototoxicity (discontinue if tinnitus occurs)
- Neuromuscular blockade

Reconstitution and Administration

For intravenous administration; dilute with 100 ml Sodium Chloride 0.9% or Glucose 5% and administer over **ONE HOUR**

Amikacin regimens must be prescribed on a dose-by-dose basis

Details of level monitoring must be recorded in the patient notes and on the drug chart.

In order to interpret results, the time the infusion was started and time blood sample was taken MUST be recorded.

- **Guidelines for the Use of Intravenous Gentamicin**

Background

Gentamicin is an aminoglycoside antibiotic with broad-spectrum bactericidal activity. It is usually active against most strains of the following organisms: Escherichia coli, Klebsiella spp., Proteus spp. Pseudomonas aeruginosa, Staphylococci, Enterobacter spp., Citrobacter spp and Providencia spp. Gentamicin is indicated in urinary-tract infections, chest infections, bacteraemia, septicaemia, and other systemic infections due to sensitive organisms.

Contraindications

Patients with a family history of maternal early-onset deafness may be at increased risk of ototoxicity with aminoglycosides. Alternatives should be used in these patients whenever possible. Aminoglycosides should be avoided in patients with current/persistent vestibular dysfunction or history of hearing loss.

Gentamicin dosing

Extended interval IV gentamicin (5-7 mg/kg) regimens ensure target peak concentrations and are associated with less toxicity. These regimens should be used in all patients unless any of the following contraindications apply:
1) Endocarditis
2) The dose is being given prophylactically (see Surgical Prophylaxis Policy)
3) Pregnancy
4) Burns
5) Ascites, severe liver disease, jaundice
6) Cystic fibrosis

WEIGHT BASED DOSING & CREATININE CLEARANCE

All aminoglycoside dosage regimens are based on mg/kg. Use ideal body weight (IBW) if actual weight >115% IBW.
Estimating ideal body weight (IBW) (see Table 1 below for ADULTS)

	Ideal body weight table		
Height (inches)	**Height (cm)**	**IBW Male(kg)**	**IBW Female (kg)**
5 ft 1 in	155	52.3	47.8
5 ft 2 in	157	54.6	50.1
5 ft 3 in	160	56.9	52.4
5 ft 4 in	163	59.2	54.7
5 ft 5 in	165	61.5	57.0
5 ft 6 in	168	63.8	59.3
5 ft 7 in	170	66.1	61.6
5 ft 8 in	173	68.4	63.9
5 ft 9 in	175	70.7	66.2
5 ft 10 in	178	73.0	68.5
5 ft 11 in	180	75.3	70.8
6 ft 0 in	183	77.6	73.1
6 ft 1 in	185	79.9	75.4
6 ft 2 in	188	82.2	77.7

Ideal body weight (male) = 50kg + (2.3 x every inch over 5ft)
Ideal body weight (female) = 45.5kg + (2.3 x every inch over 5ft)

OR
Ideal body weight (male) = 50kg + [(height(cm) – 154) x 0.9]
Ideal body weight (female) = 45.5kg + [(height(cm) – 154) x 0.9]

Estimating creatinine clearance (CrCl)
The eGFR value reported by Clinical Biochemistry is **NOT** sufficiently accurate for aminoglycoside dosing. Creatinine clearance should be calculated using the Cockcroft-Gault equation shown below:

$$\text{CrCl (ml/min)} = \frac{(140 - \text{age}) \times \text{ideal body weight (kg)} \times N}{\text{Serum creatinine (micromol/L)}}$$

Where N = 1.23 for males and
N = 1.04 for females

Use ideal body weight (IBW) if actual weight > 115% IBW
Ideal body weight (male) = 50 kg + (2.3 x every inch over 5 feet)
Ideal body weight = 45.5 = (23.3 x every inch over 5 feet)

For Children, please refer to the BNF-C

Wherever possible treatment with aminoglycosides should not exceed 7 days

LEVEL MONITORING & DOSE REGIMEN ADJUSTMENT

Levels are processed at **10 am, 3 pm & 10 pm seven days a week at the Royal Free Hospital** – in order to ensure minimal delay, specimens should be clearly labelled with the time of the patient's last dose and time the sample was taken.

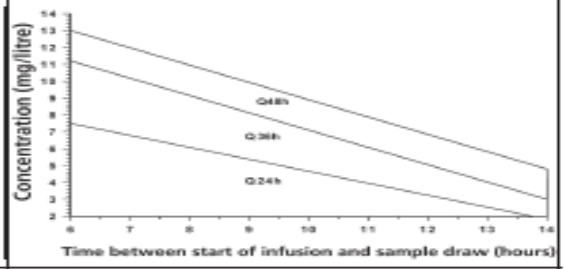
Send samples on the next available transport to Pathology at the Royal Free Hospital. Inform the microbiology scientist on call [bleep 1686] of any specimens sent after 5 pm.

Discuss levels and need for dosage adjustment with Microbiology or Pharmacy on a case by case basis.

For further advice contact microbiology or pharmacy.

Adverse Effects

- Nephrotoxicity, Ototoxicity (discontinue if tinnitus occurs)
- Neuromuscular blockade

CATEGORY	INITIAL IV GENTAMICIN REGIMEN Use ideal body weight where appropriate	MONITORING
CrCL ≥60 ml/min and no contraindications 1-6	7 mg/kg EVERY 24 HOURS Max dose 600 mg	• Take levels 6-14 hours AFTER 1st dose. • Use Hartford Nomogram below to guide dosing regimen. • Monitor levels twice weekly 6-14 hours after dose if stable renal function.
CrCL 40-59 ml/min and no contraindications 1-6	7 mg/kg EVERY 36 HOURS Max dose 600 mg	
CrCL 20-39 ml/min and no contraindications 1-6	5 mg/kg EVERY 48 HOURS HARTFORD NOMOGRAM DOES NOT APPLY	• Take trough level just before 2nd dose. • Give 2nd dose. • Check result before giving 3rd dose. - Level <2 mg/L: give 3rd dose. Monitor levels twice weekly if stable renal function. - Level ≥2 mg/L: recheck level every 12-24 h until <2 mg/L. Then give 3rd dose. Review dosage regimen accordingly. Take trough level just before 4th dose, give 4th dose and repeat level every 12-24 hours as above until <2 mg/L before giving 5th dose. Review dosage regimen as necessary.

CATEGORY	INITIAL IV GENTAMICIN REGIMEN Use ideal body weight where appropriate	MONITORING
CrCL ≥20 ml/min and contraindications 3-6 apply • Pregnancy • Burns • Severe liver disease/ascites • Cystic fibrosis	2 mg/kg BD HARTFORD NOMOGRAM DOES NOT APPLY	• Take trough (just before) and peak (1 hour after start of infusion) across 3rd dose. • Check results before giving 4th dose • Reference ranges: Trough: <2mg/L Peak: 5-10 mg/L • Discuss levels outside this range with Microbiology/Pharmacy and adjust dosage regimen accordingly. • Monitor levels twice weekly if stable renal function.
CrCL <20 ml/min	2 mg/kg stat HARTFORD NOMOGRAM DOES NOT APPLY	• Take trough level 24 hours later. • Check result before giving next dose. • Only give next dose if level <2 mg/L • REPEAT THIS PROCESS DAILY

Reconstitution and Administration

For intravenous administration; dilute with 100 ml Sodium Chloride 0.9% or Glucose 5% and administer over 1 hour.
Gentamicin regimens must be prescribed on a dose-by-dose basis
Details of level monitoring must be recorded in the notes and on the drug chart.
In order to interpret results, the time the infusion was started and time blood sample was taken MUST be recorded.

Endocarditis

Microbiology will advise an appropriate regime for patients with endocarditis – if gentamicin is required the dose should be 1mg/kg BD using ideal body weight. Take both trough (just before) and peak (1 hour after start of infusion) levels across the third dose, then wait for results before giving the fourth dose. If the levels are outside of these reference ranges withhold the dose and discuss need for regimen adjustment and frequency of level monitoring with Microbiology.
Reference ranges: Trough: ≤1 mg/L; Peak: 3-5 mg/L

Surgical Prophylaxis

See Surgical Antimicrobial Prophylaxis Policy. Prophylaxis is not routinely continued after surgery and level monitoring is therefore not necessary.

- **Guidelines for the Use of Intravenous Teicoplanin**

Background

Teicoplanin is indicated in potentially serious Gram-positive infections including those which cannot be treated with other antimicrobial drugs e.g. penicillins and cephalosporins.

In severe infections such as septic arthritis, osteomyelitis and implant-associated infections, high dose treatment is indicated to improve cure rates and decrease the emergence of resistance.

Teicoplanin Dosing

Dosage in severe infections: initially 10mg/kg every 12 hours for three doses then 10mg/kg once daily. Actual body weight is used to calculate the dose. This should be rounded down to the nearest 200mg.

Teicoplanin levels should be monitored weekly once patients have been on intravenous Teicoplanin for 7 days and if a prolonged course is planned. Samples will be sent to the Reference Laboratory if these assays are requested.

Indications for assay:
While not indicated in all patients, therapeutic drug monitoring may be of value in severe sepsis, MRSA infection, deep-seated staphylococcal infection, bone and joint infection, intravenous drug mis-users, infective endocarditis, unexpected therapeutic failure, and elderly or renally impaired patients. Therefore a sample needs to be taken 7 days after initiation to check that the selected groups of patients are not sub-therapeutic.

Timing of samples:
A pre dose sample is recommended.

	Indication	Expected Levels	Re-assay Interval
Teicoplanin	Severe Staphylococcal infections including prosthetic joint infections	Pre dose levels >40 mg/l but <60 mg/l	Weekly in prolonged treatment.
	Other infections e.g. non-severe cellulitis	Pre dose levels >20 mg/l but <60mg/l	Weekly in prolonged treatment.

Cautions and Monitoring Standards

- Use Teicoplanin with caution when it is co-administered with potentially ***nephrotoxic*** drugs.
- Renal function should be monitored every 2 weeks with prolonged treatment or if Teicoplanin is co-administered with potentially nephrotoxic drugs.
- LFTs should be performed every 2 weeks during treatment especially in patients with hepatic disease.
- Monitor for increases in serum transaminases and/or serum phosphatase. If the patient is coming for a follow-up appointment in hospital, these tests will be done then. Otherwise, the GP will carry out the tests at his/her convenience and inform the Consultant Team if any abnormalities are observed

Adverse Drug Reactions Reporting

ADVERSE EFFECT	PLAN FOR PATIENT	PLAN FOR GP
Local intravenous injection site reactions: inflammation and/or thrombophlebitis,	Patient to inform GP if self-administering Patient to inform district nurse if they are not self-administering	Stop Teicoplanin after informing specialist team at RNOH and review in conjunction with specialist team
Skin reactions: rash, pruritis, urticaria	Inform GP	Check allergy status and prescribe antihistamine (patient would have received initial doses on the ward and therefore true allergy is rare)
Gastro-intestinal: abdominal pain, nausea, vomiting, diarrhoea, pseudomembranous colitis	Inform GP	Stop Teicoplanin and inform specialist team at RNOH Treat empirically if suspected pseudomembranous colitis
Blood: thrombocytopenia		Monitor FBC and haematopoietic function. Treat according to local haematological guidelines. Inform specialist team at RNOH
Liver function: Alanine aminotransferase increased, aspartate aminotransferase increased. Bilirubin increased, blood alkaline phosphatase increased, gamma – glutamyltransferase increased, hepatitis		Monitor LFTs (monthly) Contact specialist at RNOH
Internal bleeding	Report any bruising/bleeding	
Back pain around kidneys/lower abdominal area	Inform GP	The possibility of the emergence of resistant organisms/Immunoglobulins affecting kidney filtration. Stop Teicoplanin. Contact RNOHT clinicians for review of current therapy

Reconstitution and Administration

Reconstitute vial with provided Water for Injections and give IV bolus over 3-5 minutes (per vial).

- **Guidelines for the Use of Intravenous Daptomycin**

Background

Daptomycin is used to treat Vancomycin - resistant *Enteroccoccus* (VRE) and other glycopeptide-resistant isolates e.g. some *staphylococci*. This antimicrobial is only to be used after discussion with a Consultant Microbiologist.
Daptomycin doses are calculated according to actual body weight.
Daptomycin is eliminated primarily by the kidney.
Due to limited clinical experience, Daptomycin should only be used in patients with any degree of renal impairment (CrCl < 80 ml/min) when it is considered that the expected clinical benefit outweighs the potential risk.
The response to treatment, renal function and creatinine phosphokinase (CPK) levels should be closely monitored in all patients with or without any degree of renal impairment.

Daptomycin dosing

Indication for use	Creatinine Clearance	Dose recommendation
Complication skin and soft tissue infections (cSSTIs)	≥ 30 ml/min	4 - 10 mg/kg once daily
	< 30 ml/min	4 mg/kg every 48 hours

Daptomycin Outpatient Parental Antimicrobial Therapy (OPAT)

Adverse Drug Reactions Reporting

ADVERSE EFFECT	PLAN FOR PATIENT	PLAN FOR GP
Local intravenous injection site reactions: inflammation and/or thrombophlebitis,	Patient to inform GP if self-administering Patient to inform district nurse if they are not self-administering	Stop Daptomycin after informing specialist team at RNOH and review in conjunction with specialist team
Skin reactions: rash, pruritis, urticaria	Inform GP	Check allergy status and prescribe antihistamine (patient would have received initial doses on the ward and therefore true allergy is rare)
Gastro-intestinal: abdominal pain, nausea, vomiting, diarrhoea, pseudomembranous colitis	Inform GP	Stop Daptomycin and inform specialist team at RNOH Treat empirically if suspected pseudomembranous colitis
Blood: thrombocytopenia		Monitor FBC and haematopoietic function. Treat according to local haematological guidelines. Inform specialist team at RNOH
Liver function: Alanine aminotransferase increased, aspartate aminotransferase increased. Bilirubin increased, blood alkaline		Monitor LFTs (monthly) Contact specialist at RNOH

phosphatase increased, gamma – glutamyltransferase increased, hepatitis		
Internal bleeding	Report any bruising/bleeding	
Back pain around kidneys/lower abdominal area	Inform GP	The possibility of the emergence of resistant organisms/Immunoglobulins affecting kidney filtration. Stop Daptomycin. Contact RNOHT clinicians for review of current therapy

Cautions and Monitoring Standards

- Use Daptomycin with caution when it is co-administered with potentially ***nephrotoxic*** drugs.
- Renal function should be monitored every week with prolonged treatment or if Daptomycin is co-administered with potentially nephrotoxic drugs.
- LFTs should be performed every weeks during treatment especially in patients with hepatic disease.
- Monitor for increases in serum transaminases and/or serum phosphatase. If the patient is coming for a follow-up appointment in hospital, these tests will be done then. Otherwise, the GP will carry out the tests at his/her convenience and inform the Consultant Team if any abnormalities are observed

Reconstitution and Administration

IV bolus (preferred method). Add 7ml NaCl 0.9% to 350mg vial, or 10ml NaCl 0.9 % to 500mg vial. Give as IV bolus over 2 minutes (per vial).

OR

IV infusion. Reconstitute as above then add to 50-100ml NaCl 0.9% and give over 30 minutes.

- **Dosing in Renal Impairment**

The following do not require dosage adjustment in renal impairment: **azithromycin, clindamycin, doxycycline, sodium fusidate, metronidazole**, **linezolid, rifampicin** and **caspofungin**.
eGFR has not been validated for drug dosing. Use Cockcroft and Gault formula for estimation:
For **Amikacin/gentamicin/vancomycin** – see respective sections in this policy

Dosage adjustment for commonly used antimicrobials:

Drug (route)	CrCl (ml/min)	Dose
Amoxicillin (PO and IV)	< 10	250mg-1g every 8 hours (Maximum 6g per day in endocarditis)
Benzylpenicillin	10-20 <10	600mg – 2.4g 6 hourly depending on the severity of infection 600mg – 1.2g 6 hourly depending on the severity of infection
Ciprofloxacin (PO and IV)	<10	Oral: 250mg bd IV: 200mg bd
Clarithromycin (PO and IV)	10-30 <10	250-500mg bd 250mg bd
Co-amoxiclav (PO and IV)	<30	Oral: 625mg tds IV: 1.2g bd
Daptomycin	< 30	4mg/kg every 48 hours
Ertapenem	<-30	Use 500mg od
Flucloxacillin (PO and IV)	< 10	4g in 24 hours max
[13]**Fosfomycin** (PO and IV)	 40-20 20-10 <10	In renal insufficiency, the dose of 4g per administration should be kept constant and the interval between doses extended depending on creatinine clearance. 4g every bd 4g every od 4g every 48 hours
Levofloxacin (PO and IV) Give usual loading dose then reduce	20-50 10-20 <10	250mg bd 125mg bd 125mg od
Meropenem	20-50 10-20 <10	1g bd 500mg tds 1g od
Nitrofurantoin	<40	Contraindicated
Piperacillin/Tazobactam	<20	4.5g bd
Teicoplanin	10-20 <10	400 mg every 12 hour for 3 doses then 400 mg every 48 hours 400 mg every 12 hours for 3 doses then 400 mg every 72 hours
Temocillin	10-30 <10	1g bd 2g every 48 hours

For further information please contact Pharmacy

Antimicrobial levels monitoring –Reference Ranges

Please contact Microbiology for further details

ANTIMICROBIAL	TROUGH (mg/L) Immediately pre-dose	PEAK (mg/L) 1 hour after administration (except cycloserine)
Amikacin – once daily dosing	< 5	NA
Amikacin – twice daily dosing	<10	20 – 30
Colistin	2 – 6	5 – 15
Cotrimoxazole – trimethoprim	5 – 7	5 - 10 TOXIC >20
Cotrimoxazole – sulphamethaxazole	<100	120 – 150 TOXIC >200
Cycloserine	10 – 20	20 – 35 4 hours post dose
Flucytosine	20 – 40	70 – 90
Gentamicin – once daily dosing	See gentamicin section	
Gentamicin – endocarditis	<1	3 - 5
Gentamicin – twice daily dosing (non-endocarditis)	<2	5 – 10
Posaconazole	> 0.7	NA
Streptomycin	< 5	15 – 40
Teicoplanin	> 20	NA
Tobramycin – multiple daily dose	<2	4 -8
Vancomycin	10 - 20 depending on the strain	NA
Voriconazole	2-6	NA

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