

Adult Antimicrobial Guidelines 2011-2013

Cork University Hospital

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PREFACE

The aim of this document is to provide guidance on the prudent use of antimicrobials at Cork University Hospital (CUH).

These guidelines have been produced by the Antimicrobial Stewardship Subcommittee of the Regional Infection Control Committee (RICC) HSE South. They have been adapted for CUH by Mala Shah (Antimicrobial Pharmacist, CUH), Dr. Bartley Cryan and Dr. Dan Corcoran (Consultant Microbiologists, CUH) and Paula Murphy (Senior Pharmacist, CUH). They have been approved by the Drugs and Therapeutics Committee, CUH.

Disclaimer:

While every attempt has been made to ensure the accuracy of the content, doctors should ensure that the correct drug and dose is prescribed, as is appropriate for each individual patient. The interpretation and application of the guidelines remains the responsibility of the individual clinician. Please seek advice if in doubt.

References that should be used in conjunction with these guidelines include the British National Formulary (BNF) and the drug data sheets (available on www.medicines.ie). It remains the responsibility of individuals to ensure they have the most up-to-date version of this guideline. This is available on the hospital intranet.

We would like to thank our colleagues on the Antimicrobial Stewardship Subcommittee and doctors locally who have contributed to the guidelines.

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INTRODUCTION

This is a guide to empiric treatment of commonly seen infections in hospitals. If in doubt, always seek advice.

Useful numbers:

Microbiology:	extension 22504 / 22694
Infectious Diseases SpR:	bleep 203
Antimicrobial Pharmacist:	bleep 479
Pharmacy:	extension 22146 / 22542

Before starting antibiotics

- The decision to prescribe an antibiotic must be based on clinical evidence of infection. Establish a provisional diagnosis. This will give an indication of the most likely causative organisms, and the most suitable empiric treatment.
- If possible, take samples (especially blood cultures) for culture and sensitivity testing before starting antibiotics. In certain circumstances, e.g. suspected bacterial meningitis, antibiotics should be given immediately. In patients with life threatening infections, do not delay empirical therapy whilst awaiting microbiology results.
- Consider the patient's medical history when deciding on treatment options: check allergy status, renal and hepatic function, pregnancy or breast feeding and concomitant medication. Refer to the BNF for drug – drug interactions.
- If there has been a history of anaphylaxis with penicillin avoid the following antibiotics: all beta lactam antibiotics (e.g. penicillin, flucloxacillin, amoxicillin, ampicillin, co-amoxiclav, piperacillin-tazobactam, meropenem) and cephalosporins.
There is a 10% cross- sensitivity with cephalosporins in penicillin allergy and they may be trialled in patients with a penicillin allergy that was not severe, e.g. mild rash only. Ensure allergy box is completed on the drug charts and cover of notes. See back page of guidelines for more details on suitability of individual antibiotics in penicillin allergy.
- Take account of recent culture reports as empiric treatment may require modification as a result: e.g. recent MRSA culture.
- Recent antibiotic use - consider use of an antibiotic from a different class, if suitable.
- Always document the reason why an antibiotic is commenced, and the proposed duration of treatment.
- Take appropriate samples. Refer to the Laboratory Users Manual.

- A microbiology result should not be examined in isolation: treat the patient, not the result. The sensitivity profile on the report is not necessarily a recommendation to treat with antibiotics, as organisms of no clinical significance may grow from non-sterile sites (colonisation).

Reviewing antibiotic treatment

- **Review need and choice of antibiotic daily.**
- When sensitivities are known, change to the narrowest spectrum agent to which the culture is sensitive. If in doubt, seek advice.
- **Route of administration:** although severe infections may require intravenous antibiotics, where possible use oral therapy. See Appendix 1, p50-51 for more information.
- **Duration of treatment:** in general, most antibiotic courses need not exceed 5-7 days. Unnecessarily prolonged courses may result in unwanted side effects (e.g. pseudomembranous colitis) and may contribute to the selection of resistant organisms, e.g. MRSA and VRE. Some infections will require a longer duration of treatment: e.g. endocarditis, severe pneumonia, bacteraemias and bone and joint infections.
- **Antibiotic level monitoring:** some antibiotics require serum levels to be monitored to avoid toxicity and ensure efficacy. These include vancomycin, gentamicin, tobramycin, amikacin and streptomycin. See Appendix 2 and 3, p52-55 for monitoring details.

Resistance

The development of antimicrobials is generally accepted as the most significant medical development of the last century. In addition to saving thousands of lives, antimicrobials have enabled advances such as the use of cytotoxic chemotherapy, the use of immunosuppressive drugs, transplantation and other types of surgery. The problem of antimicrobial resistance (AMR), however has been recognised since the introduction of penicillin into clinical practice in the 1940s. In the past, the development of new agents partially compensated for this problem. However, over the last 15 years the prevalence of AMR has continued to escalate and the number of new classes of antibacterial drug marketed has been extremely limited.

AMR is now accepted as a major public health threat and is associated with excess morbidity and mortality, prolongation of hospital stay and epidemics of infection, and increased antibiotic costs.

The prevention of spread of antimicrobial resistance focuses on two main strategies: ensuring the appropriate use of antimicrobials and good hygiene.

When agreeing local guidelines in relation to antimicrobial use it is important to consider local variations in resistance rates. These guidelines have been developed taking into account locally available data.

Resistance: EARSS data

The European Antimicrobial Resistance Surveillance Network (EARS-Net) collects routinely-generated antimicrobial susceptibility testing data on invasive infections caused by seven important bacterial pathogens: *Staphylococcus aureus*, *Streptococcus pneumoniae*, *Escherichia coli*, *Enterococcus faecalis*, *Enterococcus faecium*, *Klebsiella pneumoniae* and *Pseudomonas aeruginosa*. Currently all laboratories in Ireland participate in EARS-Net, giving 100% coverage.

Table 1. Summary of EARSS data (blood cultures only), HSE-S (Cork and Kerry) and Ireland by pathogen, 2010

	<i>S. aureus</i>		<i>S. pneumoniae</i>		<i>E. faecalis</i>		<i>E. faecium</i>		<i>E. coli</i>		<i>K. pneumoniae</i>		<i>P. aeruginosa</i>	
	HSE-S	Ireland	HSE-S	Ireland	HSE-S	Ireland	HSE-S	Ireland	HSE-S	Ireland	HSE-S	Ireland	HSE-S	Ireland
No of isolates	163	1252	51	314	39	298	34	392	296	2170	32	326	30	222
% MRSA	31.9%	24.3%												
% Penicillin-NS			7.8%	18.2%										
% Erythromycin-R			3.9%	15.6%										
% Ampicillin-R					0%	2.0%	91.2%	95.4%	67.6%	68.4%	93.8%	99.1%		
% Vancomycin-R					0%	0.3%	47.1%	39.2%						
% HLG-R					25%	29.5%	54.5%	39.5%						
% 3GC-R									8.4%	8.3%	9.4%	10.5%		
% Ciprofloxacin-R									23.0%	23.6%	6.3%	10.5%	23.3%	13.2%
% Gentamicin-R									9.5%	9.4%	3.1%	6.8%	17.2%	8.7%
% ESBL-producers									6.8%	6.1%	0%	5.2%		
% Piperacillin/tazobactam-R													10.0%	10.0%
% Ceftazidime-R													13.3%	9.2%
% Imipenem/meropenem-R													7.1%	8.3%

HLG = High level gentamicin, 3GC= 3rd generation cephalosporins, ESBL = Extended spectrum Beta-lactamase, R = resistant, NS = non-susceptible

HSE-S Laboratories participating: Cork University Hospital, Mercy University Hospital, Kerry General Hospital, Bon Secours Cork and Bon Secours Tralee

Resistance

Urine isolates

Table 2. Percentage of isolates non-susceptible to 1st line antibiotics, isolated from urine samples collected in February 2010

	Enterobacteriaceae		Enterococcus sp	
	n	%Non -Susceptible	n	%Non Susceptible
Ampicillin	1178	54%	75	3%
Cephalexin	57	18%	*	
Cephadrine	1190	13%	55	98%
Ciprofloxacin	1242	14%	58	97%
Co-amoxiclav	1212	18%	76	5%
Nalidixic Acid	34	15%	*	
Nitrofurantoin	1147	10%	75	3%
Trimethoprim	1249	29%	59	37%

* Results not reported as resistance rates based on less than 30 samples

Laboratories contributing: Cork University Hospital, Mercy University Hospital, Kerry General Hospital, Bon Secours Hospital Cork and Bon Secours Hospital Tralee

Respiratory data, Oct 2006-March 2007 (CUH and MUH only)

Table 3. Antibiotic susceptibility of *H. influenzae*, Cork University Hospital and Mercy University Hospital Oct 2006-March 2007.

Antibiotic	<i>H. influenzae</i>	
	n	% Resistant
Amoxicillin	356	9%
Co-amoxiclav	324	3%
Cefaclor	294	0%
Clarithromycin	293	12%
Moxifloxacin	66	0%

Table 4. Antibiotic susceptibility of *S. pneumoniae*, Cork University Hospital and Mercy University Hospital Oct 2006-March 2007.

Antibiotic	<i>S. pneumoniae</i>	
	n	% Resistant
Penicillin	175	12%
Erythromycin / Clarithromycin	179	16%
Moxifloxacin	174	2%

RESTRICTED ANTIMICROBIALS

Exposure to antibiotics increases the rate of emergence of resistant strains. Therefore it is important to use antibiotics only when clinically indicated, for the shortest effective duration and using an appropriate dose. Resistant organisms are especially important in a hospital setting and outbreaks of cross infection may be facilitated by inappropriate use of antibiotics. Because of this, some antibiotics are restricted and usually only prescribed after specialist advice.

Prescribers will be advised to seek specialist advice as outlined below before these antimicrobials are dispensed by the Pharmacy Department.

Antimicrobial	Restricted to:
Meropenem	Microbiology / Infectious Diseases / Respiratory Consultant only
Ceftazidime	Microbiology / Infectious Diseases / Respiratory Consultant only
Linezolid	Microbiology / Infectious Diseases / Respiratory Consultant only
Aztreonam	Microbiology / Infectious Diseases / Respiratory Consultant only
Daptomycin	Microbiology / Infectious Diseases only
Tigecycline	Microbiology / Infectious Diseases only
Ambisome® (liposomal amphotericin)	Microbiology / Infectious Diseases / Haematology Consultant only
Caspofungin	Microbiology / Infectious Diseases / Haematology Consultant only
Voriconazole	Microbiology / Infectious Diseases only
Posaconazole	Microbiology / Infectious Diseases only

The following antibiotics are not used at CUH, in adults.

- Imipenem (alternative: meropenem)
- Cefotaxime (alternative: ceftriaxone. Cefotaxime reserved for use in neonates and children)
- Ampicillin (alternative: amoxicillin)
- Oral cephalosporins (except oral cefalexin for treatment of urinary tract infection).
- Oral cefuroxime (poor bioavailability, so reserved for treatment of urinary tract infections sensitive only to cefuroxime. Use co-amoxiclav if an oral stepdown needed from iv cefuroxime, seek advice in penicillin allergy)
- Oral penicillin (alternative: oral amoxicillin, as penicillin has poor bioavailability.
Exception: patients on long-term oral penicillin post splenectomy)

MENINGITIS (CNS INFECTIONS)

Treatment should not be delayed pending investigations.

Specimens for collection: blood: for culture, glucose and EDTA blood for meningococcal & *pneumococcal* PCR

CSF: for microscopy and culture, glucose estimation and PCR

Throat swab for culture: labelled ' ? *N. meningitidis* '

Once pathogen is identified, treatment should be tailored to the narrowest spectrum agent that is sensitive. Seek microbiology advice.

Infection	Most likely organisms	1st line empiric treatment	In penicillin allergy	Comments
Adult meningitis	<i>Neisseria meningitidis</i> <i>Streptococcus pneumoniae</i> <i>Haemophilus influenzae</i>	Ceftriaxone 2g q12h iv If <i>Listeria monocytogenes</i> meningitis suspected* add amoxicillin 2g q4h iv If resistant <i>S. pneumoniae</i> suspected** or TB meningitis suspected*** seek specialist advice.	Chloramphenicol 25mg/kg q6h iv PLUS Vancomycin loading dose then 15mg/kg q12h iv NB: only if history of anaphylaxis with penicillin. Always seek advice from microbiology NB: chloramphenicol is an unlicensed product and is located on the unlicensed shelf in pharmacy	Do not switch to oral therapy. Duration: • 7 days for <i>N. meningitidis</i> and <i>H. influenzae</i> • 10-14 days for <i>S. pneumoniae</i> • 21 days for <i>Listeria monocytogenes</i> • TB meningitis – seek advice on treatment and duration. If vancomycin used: maintain pre-dose levels 15-20mg/L. See p54-55 for vancomycin dosing information.

* Risk factors for *Listeria monocytogenes*: age >50 years, immunosuppressed, alcohol abuse, pregnancy, malignancy

** Risk factors for resistant *S pneumoniae*: age <10 or >50 years, immunosuppressed, prolonged hospital stay, frequent, prolonged or prophylactic antibiotic use, recent visit to country with high rates of resistant *S pneumoniae*, e.g. Spain

*** Risk factors for TB meningitis: homelessness, alcohol abuse, immunosuppressed, recent immigration, recent contact with index case

MENINGITIS (CNS INFECTIONS) cont'd

Infection	Most likely organisms	1st line empiric treatment	In penicillin allergy	Comments
Encephalitis	<i>Herpes virus</i> <i>Other viruses</i>	Aciclovir 10mg/kg q8h iv NB: use IBW to calculate aciclovir dose		Send CSF for HSV PCR Adjust dose in renal impairment Duration: 14-21 days
Post neurosurgery / CSF shunt	<i>Staph aureus</i> <i>Coagulase negative staph</i> Gram negative bacilli	Vancomycin loading dose then 15mg/kg q12h iv PLUS Piperacillin – tazobactam 4.5g q8h iv	Vancomycin loading dose then 15mg/kg q12h iv PLUS Ceftazidime 2g q8h iv Seek advice from microbiology in severe penicillin allergy	Vancomycin: maintain pre-dose levels 15-20mg/L. See p54-55 for vancomycin dosing information. Seek advice from microbiology

Role of steroids: use dexamethasone 4-8mg q6h iv for 4 days, particularly if pneumococcal meningitis suspected. Should be started with / just before first dose of antibiotics. Avoid in septic shock. Not indicated in meningococcal septicaemia (e.g. petechial rash). Discontinue if not pneumococcal meningitis.

Meningitis prophylaxis:

Chemoprophylaxis may be necessary for contacts of meningitis cases. Please refer to Meningitis prophylaxis section p41-42.

References:

- Begg N et al, Consensus Statement on Diagnosis, Investigation, Treatment and Prevention of Acute Bacterial Meningitis in Immunocompetent Adults. Journal of Infection 1999; 39: 1-15
- Tunkel AR et al, Practice Guidelines for the Management of Bacterial Meningitis; Clinical Infectious Diseases; 2004: 39 1267-1284
- Guidelines on the management of community acquired bacterial meningitis. Euro J of Neurology 2008;15:649-59
- Viral meningitis Euro J of Neurology 2010;17:999-1009

EAR, NOSE AND THROAT INFECTIONS

NB: Many upper respiratory tract infections are viral and do not require antibiotics

Infection	Most likely organisms	1st line empiric treatment	In penicillin allergy	Comments
Acute pharyngitis / tonsillitis	Viruses <i>S. pyogenes</i>	No antibiotic if viral <u>Severe:</u> Benzylpenicillin 1.2-2.4g q6h iv PLUS Metronidazole 500mg q8h iv / 400mg q8h po <u>Moderate:</u> Amoxicillin 500mg – 1g q8h po	Clarithromycin* 500mg q12h po/iv. In severe, hospitalised cases, add Metronidazole 500mg q8h iv / 400mg q8h po	Majority viral, most patients do not benefit from antibiotics. Duration: 10 days Consider infectious mononucleosis
Vincent's Angina (acute necrotising gingivitis)	Oral anaerobes	Benzylpenicillin 1.2-2.4g q4-6h iv PLUS metronidazole 400mg q8h po	Clindamycin 600mg q6h iv/po	Duration: 10 days
Acute sinusitis	Viruses, Streptococci, <i>H. influenzae</i> , <i>Moraxella catarrhalis</i> , <i>S. aureus</i>	No antibiotic if considered viral Co-amoxiclav 625mg q8h po OR Doxycycline 200mg stat then 100–200mg q24h po	No antibiotic if considered viral Clarithromycin* 500mg q12h po OR Doxycycline 200mg stat then 100–200mg q24h po	Many attacks resolve without antibiotics. Consider allergic conditions or viral infection. Duration: 7-10 days
Acute otitis media	Viruses <i>S. pneumoniae</i> <i>H. influenzae</i>	As for sinusitis, but see comments.		Use pain relief for 24 hours before deciding whether antibiotic is required. Duration: 5-7 days

***Clarithromycin can cause significant increases in INR.** For patients on warfarin and clarithromycin, INR must be monitored very closely and appropriate warfarin dose adjustments made as necessary.

EAR, NOSE AND THROAT INFECTIONS (cont'd)

NB: Many upper respiratory tract infections are viral and do not require antibiotics

Infection	Most likely organisms	1st line empiric treatment	In penicillin allergy	Comments
Acute otitis externa		See comments		Antibiotics often not indicated unless cellulitis present. In malignant otitis externa (<i>Pseudomonas</i>), seek advice.
Acute epiglottitis	<i>H influenzae</i>	Ceftriaxone 2g q12h iv	Moxifloxacin** 400mg q24h po/iv	Duration: 10 days Take blood cultures and contact microbiology
Oro-pharyngeal / peri-tonsillar abscess	<i>S pyogenes</i> anaerobes	Benzylpenicillin 1.2-2.4g q6h iv PLUS Metronidazole 400mg q8h po	Clarithromycin* 500mg q12h po PLUS Metronidazole 400mg q8h po	Seek surgical review, as may require drainage.

***Clarithromycin can cause significant increases in INR.** For patients on warfarin and clarithromycin, INR must be monitored very closely and appropriate warfarin dose adjustments made as necessary.

** **Note about moxifloxacin:** It is contraindicated in clinically relevant heart failure with reduced left ventricular ejection fraction, in bradycardia, where there is a history of QT prolongation or history of symptomatic arrhythmias. Moxifloxacin should not be used concurrently with other drugs that prolong the QT interval, e.g. amiodarone, sotalol, neuroleptics e.g. haloperidol, chlorpromazine. Seek advice from pharmacy. It is also contraindicated in patients with impaired liver function (Child PughC). There are ongoing concerns regarding hepatic and serious skin reactions with moxifloxacin. Only use when there is no other alternative.

Reference

- Bisno AL et al. IDSA Practice Guidelines for the diagnosis and management of Group A Streptococcal Pharyngitis. CID 2002: 35, p113-125

LOWER RESPIRATORY TRACT INFECTIONS

Review recent antibiotic therapy. Recent antibiotic use - consider use of an antibiotic from a different class.

Infection	Most likely organisms	1st line empiric treatment	In penicillin allergy	Comments
Community acquired pneumonia CURB score 0-1 (see p15)	<i>S. pneumoniae</i>	Co-amoxiclav 625mg q8h po Alternatives: Clarithromycin* 500mg q12h po OR Doxycycline 100mg q12h po	Clarithromycin* 500mg q12h po OR Doxycycline 100mg q12h po	Risk of aspiration: add Metronidazole 400mg q8h po (not necessary with co-amoxiclav) Duration: 7 days
Community acquired pneumonia CURB score 2-3 (see p15)	<i>S. pneumoniae</i>	Co-amoxiclav 1.2g q8h iv PLUS Clarithromycin* 500mg q12h iv/po <u>If recent co-amoxiclav use:</u> Cefuroxime 1.5g q8h iv PLUS Clarithromycin* 500mg q12h iv/po <u>Oral:</u> Co-amoxiclav 625mg q8h po PLUS Clarithromycin* 500mg q12h po	<u>History of rash with penicillin:</u> Cefuroxime 1.5g q8h iv PLUS Clarithromycin* 500mg q12h iv/po Oral stepdown: Doxycycline 100mg q12h po <u>Severe penicillin allergy only:</u> Moxifloxacin** 400mg q24h iv/po	Duration: 7 days <i>Legionella pneumophila</i> , atypical, <i>S. aureus</i> or gram negative pneumonia need 14-21 days treatment. Seek advice from microbiology on choice of agents for these infections. Switch to oral therapy when afebrile and clinical parameters improving. Risk of aspiration: add Metronidazole 500mg q8h iv / 400mg q8h po (not necessary with co-amoxiclav)

* Clarithromycin can cause significant increases in INR. For patients on warfarin and clarithromycin, INR must be monitored very closely and appropriate warfarin dose adjustments made as necessary.

** **Note about moxifloxacin:** It is contraindicated in clinically relevant heart failure with reduced left ventricular ejection fraction, in bradycardia, where there is a history of QT prolongation or history of symptomatic arrhythmias. Moxifloxacin should not be used concurrently with other drugs that prolong the QT interval, e.g. amiodarone, sotalol, neuroleptics e.g. haloperidol, chlorpromazine. Seek advice from pharmacy. It is also contraindicated in patients with impaired liver function (Child Pugh C). There are ongoing concerns regarding hepatic and serious skin reactions with moxifloxacin. Only use when there is no other alternative.

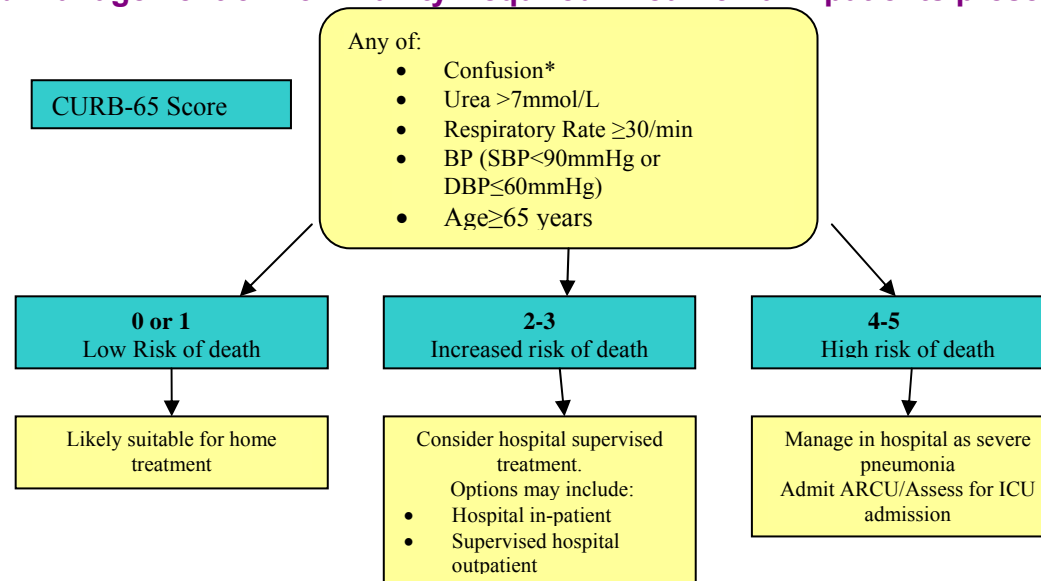
LOWER RESPIRATORY TRACT INFECTIONS (cont'd)

Infection	Most likely organisms	1st line empiric treatment	In penicillin allergy	Comments
Community acquired pneumonia CURB score 4-5 (see p15)	<i>S. pneumoniae</i>	Ceftriaxone 2g q24h iv PLUS Clarithromycin* 500mg q12h iv Switch to oral therapy when afebrile and clinical parameters improving. <u>Oral:</u> Co-amoxiclav 625mg q8h po PLUS Clarithromycin* 500mg q12h po	Ciprofloxacin 400mg q12h iv / 500-750mg q12h po PLUS either (Vancomycin loading dose then 15mg/kg q12h iv OR Teicoplanin 6mg/kg iv q12h for 3 doses, then q24h thereafter) Switch to oral therapy when afebrile and clinical parameters improving. <u>Penicillin allergy only:</u> Moxifloxacin** 400mg q24h iv/po	Perform pneumococcal and legionella urinary antigen test in all patients. Consult Respiratory Medicine / Microbiology / ID Duration: 10 days <i>Legionella pneumophila</i> , atypical, <i>S. aureus</i> or gram negative pneumonia need 14-21 days treatment. Seek advice from microbiology on choice of agents for these infections. Risk of aspiration: add Metronidazole 500mg q8h iv / 400mg q8h po If no clinical improvement after 48- 72 hours, consider MRSA cover and seek advice from Microbiology / ID / Respiratory Medicine. If vancomycin used: maintain pre-dose levels 15-20mg/L. See p54-55 for vancomycin dosing information.

* Clarithromycin can cause significant increases in INR. For patients on warfarin and clarithromycin, INR must be monitored very closely and appropriate warfarin dose adjustments made as necessary.

** **Note about moxifloxacin:** It is contraindicated in clinically relevant heart failure with reduced left ventricular ejection fraction, in bradycardia, where there is a history of QT prolongation or history of symptomatic arrhythmias. Moxifloxacin should not be used concurrently with other drugs that prolong the QT interval, e.g. amiodarone, sotalol, neuroleptics e.g. haloperidol, chlorpromazine. Seek advice from pharmacy. It is also contraindicated in patients with impaired liver function (Child PughC). There are ongoing concerns regarding hepatic and serious skin reactions with moxifloxacin. Only use when there is no other alternative

Assessment and management of Community Acquired Pneumonia in patients presenting to hospital



* Confusion defined as Mental test score of 8 or less OR new disorientation

Very Severe Community Acquired Pneumonia

Direct admission to ICU is for patients with very severe CAP.

This is defined in the 2007 American Thoracic Society/Infectious Diseases of America 2007 guidelines for the management of community acquired pneumonia

Either of the major or Any Three of the minor criteria defines very severe CAP

Minor Criteria

Respiratory Rate >30breaths/min	Uraemia >7mmol/L
PaO ₂ /FiO ₂ ratio ≤ 250	Leucopenia (WBC count <4000cells/mm ³)
The need for non-invasive ventilation	Thrombocytopenia (platelets <100,000/mm ³)
Multilobar infiltrates	Hypothermia (core temperature <36°C)
Confusion/Disorientation	Hypotension requiring aggressive fluid resuscitation

Major Criteria

Invasive mechanical ventilation	Septic shock with the need for vasopressors
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Switch from parenteral drug to the equivalent oral preparation

This should be made as soon as clinically appropriate, in the absence of microbiologically confirmed infection. Patients should be haemodynamically stable and improving clinically, able to ingest oral medications and have a normally functioning GI tract.

Discharge

Patients should be reviewed within 24 hours of planned discharge home and those suitable for discharge should not have more than one of the following characteristics present (unless they represent the usual baseline status for that patient)

Temp >37.8°C; Heart Rate >100/min; Respiratory Rate >24/min; SBP <90mmHg; O₂ saturation <90%; Inability to maintain oral intake; Abnormal Mental Status

A follow up appointment should be arranged for 6-8 weeks with a CXR to ensure resolution of the consolidation and no underlying malignancy process, particularly in smokers

LOWER RESPIRATORY TRACT INFECTIONS (cont'd)

Infection	Most likely organisms	1st line empiric treatment	In penicillin allergy	Comments
Healthcare associated pneumonia Early onset i.e. <72 hours from admission	Follow the community acquired pneumonia guidelines			
Healthcare associated pneumonia Late onset i.e. >72 hours from admission or the following: Attended hospital > 2 days within past 90 days, Resident in nursing home, On chronic dialysis, Recent wound care, IV antibiotics or chemotherapy) Ventilator associated pneumonia	Gram negative organisms <i>S. aureus</i>	Piperacillin-tazobactam 4.5g q8-6h iv If septic / septic shock: add Gentamicin 5-7mg/kg q24h iv (max 500mg) If MRSA pneumonia suspected, seek advice from Microbiology / ID / Respiratory Medicine.	Ciprofloxacin 400mg q8-12h iv / 750mg q12h po PLUS either (Vancomycin loading dose then 15mg/kg q12h iv OR Teicoplanin 6mg/kg q12 h for 3 doses, then q24h thereafter) Risk of aspiration: add Metronidazole 500mg q8h iv / 400mg q8h po	Duration: 7 days if uncomplicated and early clinical improvement, otherwise 10-14 days days. If no clinical improvement after 48- 72 hours, consider MRSA cover and seek advice from Microbiology / ID / Respiratory Medicine. NB: If recent antibiotic use, choose a different class. Tailor therapy according to culture and sensitivities If vancomycin used: maintain pre-dose levels 15-20mg/L. See p54-55 for vancomycin dosing information.

LOWER RESPIRATORY TRACT INFECTIONS (cont'd)

Infection	Most likely organisms	1st line empiric treatment	In penicillin allergy	Comments
Infective Exacerbation of COPD / bronchitis	<i>H. influenzae</i> , <i>S. pneumoniae</i> <i>Moraxella catarrhalis</i> <i>Mycoplasma pneumonia</i>	Co-amoxiclav 1.2g q8h iv or 625mg q8h po	Clarithromycin * 500mg q12h iv/po OR Doxycycline 100mg q12h po	Duration: 7 days Contact Respiratory Medicine if no clinical improvement after 48- 72 hours.
Bronchiectasis	Bronchiectasis: refer to Respiratory Medicine.			
Pleural infection: Community acquired	<i>S. pneumoniae</i> , <i>H. Influezae</i> , <i>S. aureus</i> anaerobes	(Co-amoxiclav 1.2g q8h iv OR Cefuroxime 1.5g q8h iv) PLUS Metronidazole 500mg q8h iv / 400mg q8h po	Clindamycin 600mg q6h iv/po PLUS Ciprofloxacin 400mg q12h iv / 500-750mg q12h po	Refer to Respiratory Medicine and review culture results. Duration: at least 3 weeks and consult with Respiratory Medicine.
Pleural infection: Hospital acquired	Gram +ve and –ve organisms, anaerobes.	Piperacillin-tazobactam 4.5g q8h-q6h iv PLUS (Vancomycin loading dose then 15mg/kg q12h iv OR Teicoplanin 6mg/kg q12 h for 3 doses, then q24h thereafter) PLUS Metronidazole 500mg q8h iv / 400mg q8h po	Ciprofloxacin 400mg q8-12h iv/ 500-750mg q12h po PLUS (Vancomycin loading dose then 15mg/kg q12h iv OR Teicoplanin 6mg/kg q12 h for 3 doses, then q24h thereafter) PLUS Metronidazole 500mg q8h iv / 400mg q8h po	On clinical improvement, consider oral stepdown and consult with Respiratory Medicine regarding choice of antibiotics. If vancomycin used: maintain pre-dose levels 15-20mg/L. See p54-55 for vancomycin dosing information.

* Clarithromycin can cause significant increases in INR. For patients on warfarin and clarithromycin, INR must be monitored very closely and appropriate warfarin dose adjustments made as necessary.

LOWER RESPIRATORY TRACT INFECTIONS (cont'd)

Infection	Most likely organisms	1st line empiric treatment	In penicillin allergy	Comments
<i>Pneumocystis carinii</i> Pneumonia (PCP)	<i>Pneumocystis carinii (jiroveci)</i>	Co-trimoxazole iv 120mg/kg/day in 3-4 divided doses (i.e. 1920mg q6h iv for a 65 kg patient) Oral stepdown: same dose as iv, (i.e. 1920mg q6h po for a 65 kg patient)		Duration 14-21 days. Broncho-alveolar lavage necessary to confirm diagnosis.
Cystic fibrosis exacerbations	<i>P. aeruginosa</i> <i>S. aureus</i> <i>H. influenzae</i> <i>B. cepacia</i>	Always consult Respiratory Medicine. Choice of antibiotics will depend on patient history.		

References:

- Guidelines for the management of community acquired pneumonia in adults: update 2009. British Thoracic Society Community Acquired Pneumonia in Adults Guideline Group Thorax 2009; Vol 64 (Suppl III)
- Infectious Diseases Society of America / American Thoracic Society Consensus Guidelines on the Management of Community -Acquired Pneumonia in Adults. Mandell L et al. CID 2007; 44 (Suppl 2)
- Guidelines for the management of hospital-acquired pneumonia in the UK: Report of the Working Party on Hospital-Acquired Pneumonia of the British Society for Antimicrobial Chemotherapy. Journal of Antimicrobial Chemotherapy 2008; 62: 5-34
- Guidelines for the management of adults with hospital-acquired, ventilator-associated, and healthcare-associated pneumonia, American Thoracic Society. Am J Respir Crit Care Med 2005; 171: 388-416
- Management of pleural infection in adults: British Thoracic Society pleural disease guideline 2010, Davies H et al. Thorax 2010; 65: 1141-1153

ENDOCARDITIS TREATMENT

Take 3 sets of blood cultures before starting antibiotics, then begin treatment immediately. Consult microbiology. Treatment should be modified in consultation with microbiology when culture results available.

Target serum drug levels:

- Vancomycin pre-dose level: 10-20mg/L (15-20mg/L for staphylococcal endocarditis)
- Vancomycin 1 hour post-dose level: 30-45mg/L
- Gentamicin pre-dose: ≤1mg/L
- Gentamicin 1 hour post dose: 3-4mg/L

See page 52-55 for vancomycin and gentamicin dosing and monitoring guidelines.

Infection	Most likely organisms	1st line empiric treatment	In penicillin allergy	Comments
Native valve endocarditis – blind treatment	<i>Streptococci</i> <i>S. aureus</i> <i>Enterococcus</i> sp.	Amoxicillin 2g q4h iv PLUS Flucloxacillin 2g q4h iv PLUS Gentamicin 1mg/kg q8h iv Always seek advice from microbiology.	Vancomycin loading dose then 15mg/kg q12h iv PLUS Gentamicin 1mg/kg q8h iv	Seek advice from microbiology. If MRSA / CNS suspected use Vancomycin loading dose then 15mg/kg q12h iv PLUS Gentamicin 1mg/kg q8h iv PLUS Rifampicin 300-600mg q12h po Duration: minimum 4-6 weeks. Seek advice from microbiology.
Prosthetic valve endocarditis – blind treatment	<i>S. aureus</i> <i>Coagulase negative staphylococci</i> <i>Streptococci</i> <i>Enterococci</i>	Vancomycin loading dose then 15mg/kg q12h iv PLUS Gentamicin 1mg/kg q8h iv PLUS Rifampicin 300-600mg q12h po		Seek advice from microbiology. Duration: at least 6 weeks.

ENDOCARDITIS TREATMENT (cont'd)

Infection	Most likely organisms	1st line empiric treatment	In penicillin allergy	Comments
Staphylococcal endocarditis	<i>S. aureus</i> : MSSA MRSA Coagulase negative staphylococci	<p><u>MSSA native valve:</u> Flucloxacillin 2g q4h iv PLUS Gentamicin 1mg/kg q8h iv (see comment)</p> <p><u>MSSA prosthetic valve:</u> Flucloxacillin 2g q4h iv PLUS Gentamicin 1mg/kg q8h iv PLUS Rifampicin 600mg q12h po</p> <p><u>CNS or MRSA native / prosthetic valve:</u> Vancomycin loading dose then 15mg/kg q12h iv PLUS Rifampicin 300-600mg q12h po AND/OR Gentamicin 1mg/kg q8h iv</p>	<p>Vancomycin loading dose then 15mg/kg iv q12h iv PLUS Rifampicin 300-600mg q12h po PLUS Gentamicin 1mg/kg q8h iv</p>	<p>Seek advice from microbiology. Duration: at least 4 weeks, at least 6 weeks if intracardiac prosthesis.</p> <p>Gentamicin duration: 3-5 days for native valves, two weeks for prosthetic valves</p>
Streptococcal endocarditis	<i>Viridans streptococci</i> <i>Group A streptococci</i> <i>S. pneumoniae</i>	<p>Benzylpenicillin 2.4g q4h iv PLUS Gentamicin 1mg/kg q8-12h iv</p>	<p>Vancomycin loading dose then 15mg/kg q12h iv PLUS Gentamicin 1mg/kg q8-12h iv</p>	Microbiology to advise as antibiotic regimen and duration depends on penicillin MIC values.
Enterococcal endocarditis	<i>Enterococcus faecalis</i> <i>Enterococcus faecium</i>	<p>Amoxicillin 2g q4h iv PLUS Gentamicin 1mg/kg q8-12h iv</p>	<p>Vancomycin loading dose then 15mg/kg q12h iv PLUS Gentamicin 1mg/kg q8-12h iv</p>	Microbiology to advise as antibiotic regimen and duration depends on MIC values.

ENDOCARDITIS TREATMENT (cont'd)

References

- Elliot TSJ et al. Guidelines for the antibiotic treatment of endocarditis in adults: report of the Working Party of the British Society for Antimicrobial Chemotherapy. *Journal of Antimicrobial Chemotherapy* 2004; 54: 971-981
- Guidelines on the prevention, diagnosis and treatment of infective endocarditis (new version 2009), The Task Force on the Prevention, Diagnosis and Treatment of Infective Endocarditis of the European Society of Cardiology. *European Heart Journal*, 2009; 30: 2369-2413
- American Heart Association Scientific Statement, endorsed by the Infectious Diseases Society of America. Infective Endocarditis. *Circulation*. 2005;111:e394-e434

Endocarditis prophylaxis : see p43

SEPTICAEMIA

Always take blood cultures before commencing antibiotics. Development of septicaemia is often secondary to primary infection elsewhere. Therefore treatment will vary depending on primary condition.

Infection	Most likely organisms	1st line empiric treatment	In penicillin allergy	Comments
Source unclear	Coliforms <i>S. aureus</i> <i>Streptococcus</i> sp.	Piperacillin-tazobactam 4.5g q8h iv If severe sepsis or septic shock add Gentamicin 5-7mg/kg q24h iv (max 500mg q24h) <u>If MRSA:</u> Add either (Vancomycin 15mg/kg q12h iv OR Teicoplanin 6mg/kg q12h for 3 doses, then q24h thereafter)	Ciprofloxacin 400mg q8-12h iv PLUS (Vancomycin 15mg/kg q12h iv OR Teicoplanin 6mg/kg q12 h for 3 doses, then q24h thereafter) PLUS Metronidazole 500mg q8h iv If severe sepsis or septic shock add Gentamicin 5-7mg/kg q24h iv (max 500mg q24h)	See p52-55 for vancomycin and gentamicin dosing guidelines. Seek advice for oral options.
Skin / soft tissue / line-associated sepsis	<i>S. aureus</i> (inc MRSA) <i>S. pyogenes</i>	<u>Community acquired, no MRSA history:</u> Flucloxacillin 1-2g q6h iv <u>Hospital acquired / history of MRSA:</u> Vancomycin 15mg/kg q12h iv OR Teicoplanin 6mg/kg q12h for 3 doses, then q24h thereafter	Vancomycin 15mg/kg q12h iv OR Teicoplanin 6mg/kg q12h for 3 doses, then q24h thereafter	If peripheral line sepsis, remove line and replace at a different site. For central line sepsis, perform central and peripheral blood cultures. Remove line if possible. When microbiological results available, tailor antibiotic therapy where appropriate. See p54-55 for vancomycin dosing guidelines.

SEPTICAEMIA (cont'd)

Infection	Most likely organisms	1st line empiric treatment	In penicillin allergy	Comments
Urinary tract sepsis	Coliforms <i>Enterococcus</i> sp.	Piperacillin-tazobactam 4.5g q8h iv PLUS Gentamicin 5mg/kg iv stat (max 500mg q24h), depending on severity. Seek review of gentamicin.	Ciprofloxacin 400mg q8-12h iv PLUS Gentamicin 5mg/kg stat (max 500mg q24h). Seek review of gentamicin.	<ul style="list-style-type: none"> • Send urine sample in addition to blood culture. • Previous culture results may help guide therapy. • See p52 for gentamicin dosing guidelines
Intra-abdominal sepsis	Coliforms	Piperacillin-tazobactam 4.5g q8h iv PLUS Gentamicin 5mg/kg iv stat (max 500mg q24h), depending on severity. Seek review of gentamicin.	Ciprofloxacin 400mg q8-12h iv PLUS Metronidazole 500mg q8h iv PLUS (Vancomycin 15mg/kg q12h iv OR Teicoplanin 6mg/kg q12 h for 3 doses, then q24h thereafter)	<ul style="list-style-type: none"> • If patient requires surgery, send specimen from theatre. • See p52-55 for vancomycin and gentamicin dosing guidelines. • Consider oral therapy when on clinical improvement, seek advice for options.
Neutropenic sepsis	Aerobic gram negative rods Gram positives usually associated with central venous catheters	Piperacillin-tazobactam 4.5g q6h iv PLUS Gentamicin 5-7mg/kg q24h iv (max 500mg q24h) <u>If line infection suspected,</u> add (Vancomycin 15mg/kg q12h iv OR Teicoplanin 6mg/kg q12 h for 3 doses, then q24h thereafter)	Ciprofloxacin 400mg q8h iv PLUS Gentamicin 5-7mg/kg q24h (max 500mg q24h) iv PLUS (Vancomycin 15mg/kg q12h iv OR Teicoplanin 6mg/kg q12 h for 3 doses, then q24h thereafter)	<ul style="list-style-type: none"> • See neutropenic sepsis protocol for further information • See p52-55 for vancomycin and gentamicin dosing guidelines.

SEPTICAEMIA (cont'd)

Definition of SIRS / severe sepsis / septic shock

Systemic inflammatory response syndrome (SIRS)	Sepsis	Severe sepsis	Septic shock
<p>Two or more of the following:</p> <ul style="list-style-type: none"> • Body temperature $>38.5^{\circ}\text{C}$ or $<35^{\circ}\text{C}$ • Heart rate $>90\text{bpm}$ • Respiratory rate $>20\text{bpm}$ or arterial CO_2 tension $<32\text{mmHg}$ or need for mechanical ventilation • WCC >12 or $<4 \times 10^9/\text{L}$ or immature forms $>10\%$ 	<p>SIRS and documented infection (culture or gram stain of blood, sputum, urine or normally sterile body fluid positive for pathogenic microorganism; or focus of infection identified by visual inspection).</p>	<p>Sepsis and at least one sign of organ hypoperfusion or organ dysfunction:</p> <ul style="list-style-type: none"> • Areas of mottled skin • Capillary refilling time ≥ 3 sec • Urinary output $<0.5\text{ml/kg}$ for at least 1 hr or renal replacement therapy • Lactates $>2\text{mmol/L}$ • Abrupt change in mental status or abnormal electroencephalogram • Platelet count $<100 \times 10^9/\text{L}$ or disseminated intravascular coagulation • Acute lung injury – acute respiratory distress syndrome • Cardiac dysfunction (echocardiography) 	<p>Severe sepsis and one of:</p> <ul style="list-style-type: none"> • Systemic mean blood pressure $<60\text{mmHg}$ ($<80\text{mmHg}$ if previous hypertension) after 40-60ml/kg saline, or pulmonary capillary wedge pressure between 12 and 20 mmHg. • Need for dopamine $>5\text{mcg/kg}$ per min or norepinephrine or epinephrine $>0.25\text{mcg/kg}$ per min to maintain mean blood pressure above 60 mmHg (80 mmHg if previous hypertension).

Reference:

- Septic Shock. Lancet 2005; 365: 63-78

GASTRO-INTESTINAL INFECTIONS

Infection	Most likely organisms	1st line empiric treatment	In penicillin allergy	Comments
Acute infectious diarrhoea	Salmonella, Shigella, Campylobacter	Usually no antibiotic treatment necessary. Seek advice if treatment required.		
Antibiotic associated diarrhoea See Appendix 4, p56-59 for full guideline	<i>Clostridium difficile</i>	Metronidazole 400mg q8h po If severe or recurrent, refer to Appendix 4, p56-59 Consult microbiology if no improvement.		Duration of treatment: 10 days. Discontinue current antibiotics if possible, or consult microbiology for advice on choice of agent. If iv treatment is required only metronidazole will be effective.
Intra-abdominal infections (cholangitis / cholecystitis / appendicitis)	Gram negative organisms (e.g. <i>E. coli</i>) Anaerobes <i>Enterococcus</i> sp.	Mild – moderate: Co-amoxiclav 1.2g q8h iv Severe: Piperacillin-tazobactam 4.5g q8h iv If severe sepsis or septic shock add Gentamicin 5mg/kg q24h iv (max 500mg q24h)	Mild-moderate community acquired: Ciprofloxacin 400mg q12h iv / 500mg q12h po PLUS Metronidazole 500mg q8h iv / 400mg q8h po Severe community acquired or hospital acquired infection: Ciprofloxacin 400mg q12h iv PLUS Metronidazole 500mg q8h iv PLUS (Vancomycin 15mg/kg q12h iv OR Teicoplanin 6mg/kg q12 h iv for 3 doses, then q24h thereafter)	If MRSA risk: add either (Vancomycin 15mg/kg q12h iv OR Teicoplanin 6mg/kg q12h iv for 3 doses then q24h thereafter) Duration: generally 5-7 days, with regular review. Switch to oral therapy when improving. See p52-55 for vancomycin and gentamicin dosing guidelines.

GASTRO-INTESTINAL INFECTIONS (cont'd)

Infection	Most likely organisms	1st line empiric treatment	In penicillin allergy	Comments
Peritonitis	Primary: Coliforms <i>S. pneumoniae</i> <i>Enterococcus</i> sp. Secondary: as above plus <i>Bacteroides</i>	Primary: Co-amoxiclav 1.2g q8h iv Secondary: Piperacillin-tazobactam 4.5g q8h iv If faecal peritonitis: add Metronidazole 400mg q8h po / 500mg q8h iv	Clarithromycin *500mg q12h iv/po PLUS Ciprofloxacin 400mg q12h iv / 500mg q12h po PLUS Metronidazole 500mg q8h iv / 400mg q8h po	Consider drainage in all cases.
CAPD peritonitis	<i>S. aureus</i> <i>S. epidermidis</i> Coagulase negative staphylococci Gram negative bacilli	Vancomycin 30mg/kg body weight (max 3grams) intraperitoneally PLUS Ceftazidime 1.5g intraperitoneally Refer to full CAPD peritonitis guidelines for more information	Seek advice in severe penicillin allergy.	See CAPD Peritonitis Guidelines for guidance in taking samples prior to initiation of antibiotics and for follow up doses of antibiotics. Maintain vancomycin levels between 15-20mg/L

* Clarithromycin can cause significant increases in INR. For patients on warfarin and clarithromycin, INR must be monitored very closely and appropriate warfarin dose adjustments made as necessary.

GENITO-URINARY TRACT INFECTIONS

Infection	Most likely organisms	1st line empiric treatment	In penicillin allergy	Comments
Uncomplicated urinary tract infection	<i>E. coli</i>	Co-amoxiclav 625mg q8h po OR Nitrofurantoin 50-100mg q6h po OR Cefalexin 250-500mg q6h po	Nitrofurantoin 50-100mg q6h po OR If no history of anaphylaxis with penicillin: Cefalexin 250-500mg q6h po	Duration: 3 days for women, 7 days for men. Review treatment with culture results Pregnant women should be treated with co-amoxiclav (unless allergy). Do not use nitrofurantoin in renal impairment.
Complicated urinary tract infection (pyelonephritis)	Coliforms <i>Pseudomonas sp.</i> in chronic disease	Ciprofloxacin 500-750mg q12h po PLUS/MINUS Gentamicin 5mg/kg q24h iv (max 500mg q24h)		Duration: 7-14 days See p52 for gentamicin dosing guidelines.
Catheter-related bacteriuria		Usually antibiotics are not indicated. Only treat if clinical evidence of infection. Seek advice from microbiology.		
Prostatitis / epididymo-orchitis	<i>Chlamydia trachomatis</i> <i>N. gonorrhoea</i>	<u>Acute and <35 years old:</u> Ceftriaxone 250mg im stat PLUS Doxycycline 100mg q12h po	In severe penicillin allergy contact microbiology or Infectious Diseases for advice.	For 10 days Treatment should be reviewed with culture results.
	<i>Pseudomonas</i> <i>Enterobacteriaceae</i>	<u>Chronic or >35 years old:</u> Ciprofloxacin 500mg-750mg q12h po		For 28 days. Treatment should be reviewed with culture results. Consider TB as a diagnosis

GENITO-URINARY TRACT INFECTIONS (cont'd)

Infection	Most likely organisms	1st line empiric treatment	In penicillin allergy	Comments
Pelvic inflammatory disease	<i>Chlamydia trachomatis</i> <i>N. gonorrhoea</i> Coliforms Anaerobes Streptococci	Ceftriaxone 250mg stat im PLUS Metronidazole 400mg q8h po PLUS Doxycycline 100mg q12h po	In severe penicillin allergy contact microbiology or Infectious Diseases for advice.	Duration: 14 days Take blood culture and endocervical swab for culture and Chlamydia investigation. Send serum for VDRL/RPR. If surgical drainage required, send pus for culture.
Vaginal candidiasis	<i>Candida sp.</i>	Fluconazole 150mg po stat OR Clotrimazole pessary 500mg pv stat		Consider bacterial vaginosis if not responding and malodorous discharge. <u>Bacterial vaginosis treatment:</u> Metronidazole 400mg q12h po for 5 days

SKIN, SOFT TISSUE, BONE AND JOINT INFECTIONS

Infection	Most likely organisms	1st line empiric treatment	In penicillin allergy	Comments
Cellulitis	<i>S. aureus</i> Streptococci	Flucloxacillin 1-2g q6h iv If erysipelas or streptococcal infection suspected ADD Benzylpenicillin 1.2-2.4g q6h iv <u>Oral switch:</u> Flucloxacillin 1g qds po If erysipelas or streptococcal infection suspected ADD Amoxicillin 500mg q8h po	Clarithromycin* 500mg q12h po/iv If severe cellulitis/ risk of MRSA consider adding either (Vancomycin 15mg/kg q12h iv OR Teicoplanin 6mg/kg q12h iv for 3 doses, then q24h thereafter)	Duration 7-14 days Consider oral switch following clinical improvement. If necrotising fasciitis is suspected see section below and contact surgical team. See p54-55 for vancomycin dosing guidelines
Line infection	<i>S. aureus</i> , Coagulase negative staphylococci and other organisms	Take blood cultures prior to commencing antibiotics (Vancomycin 15mg/kg q12h iv OR Teicoplanin 6mg/kg q12h iv for 3 doses, then q24h thereafter). If gram negative organisms are suspected add Ciprofloxacin 400mg q12h iv or 500mg q12h po		Contact microbiology for advice. See p54-55 for vancomycin dosing guidelines
Necrotising fasciitis	Multiple organisms including Group A Streptococci	Flucloxacillin 2g q6h iv PLUS Benzylpenicillin 2.4g q6h iv PLUS Ciprofloxacin 400mg q12h iv PLUS Metronidazole 500mg q8h iv	Clindamycin 600mg q6h iv PLUS Ciprofloxacin 400mg q12h iv	Seek urgent surgical advice
Gas gangrene	<i>Clostridium perfringens</i> and other gas producing organisms	Benzylpenicillin 2.4g q6h iv PLUS Ciprofloxacin 400mg q12h iv PLUS Metronidazole 500mg q8h iv	Clindamycin 600mg q6h iv PLUS Ciprofloxacin 400mg q12h iv	Seek urgent surgical advice

* Clarithromycin can cause significant increases in INR. For patients on warfarin and clarithromycin, INR must be monitored very closely and appropriate warfarin dose adjustments made as necessary.

SKIN, SOFT TISSUE, BONE AND JOINT INFECTIONS (cont'd)

Infection		1st line empiric treatment	In penicillin allergy	Comments
Infected burns	Send swabs for cultures and sensitivities to direct therapy	Apply silver sulphadiazine 1% cream to the affected areas. Flucloxacillin 1-2g q6h iv PLUS Benzylpenicillin 1.2-2.4g q6h iv	Clarithromycin* 500mg q12h iv/po	
MRSA infection	Confirm with cultures and determine if colonisation or clinical infection Base on sensitivities and site of infection Contact microbiology for advice if confirmed infection			
Surgical wound infection	Following clean surgery	Flucloxacillin 1-2g q6h po/iv and if severe add Benzylpenicillin 1.2-2.4g q6h iv	Clarithromycin* 500mg q12h iv/po	Based on culture and sensitivity results and location of surgical site Contact microbiology for advice <u>If patient is colonised with MRSA</u> then consider adding (Vancomycin 15mg/kg q12h iv OR Teicoplanin 6mg/kg q12h for 3 doses then q24h thereafter).
	Following contaminated surgery	Cefuroxime 1.5g q8h iv PLUS Metronidazole 500mg q8h iv/400mg q8h po OR Co-amoxiclav 1.2g q8h iv / 625mg q8h po	Clarithromycin* 500mg q12h iv/po PLUS Metronidazole 400mg q8h po / 500mg q8h iv	

* Clarithromycin can cause significant increases in INR. For patients on warfarin and clarithromycin, INR must be monitored very closely and appropriate warfarin dose adjustments made as necessary.

SKIN, SOFT TISSUE, BONE AND JOINT INFECTIONS (cont'd)

Infection		1st line empiric treatment	In penicillin allergy	Comments
Diabetic foot infections Take good quality deep tissue swabs to identify organism to direct therapy prior to commencing antibiotics. Infections are often polymicrobial occasionally including MRSA and may require prolonged antibiotic courses so should be discussed with microbiology to advise on the most appropriate treatment.	Superficial ulcer, without penetration into the deeper layers, with evidence of cellulitis	Flucloxacillin 500mg-1g q6h po OR Co-amoxiclav 625mg q8h po	Clarithromycin* 500mg q12h po	Duration 7-14 days
	Deep ulcer, leading to tendon, bone, joint capsule or ligament, in the absence of cellulitis	Flucloxacillin 500mg-1g q6h po PLUS Ciprofloxacin 500mg q12h po PLUS Metronidazole 400mg q8h po	Clarithromycin* 500mg q12h po PLUS Ciprofloxacin 500mg q12h po PLUS Metronidazole 400mg q8h po	Duration up to 6 weeks
	Deep ulcer plus active cellulitis	Flucloxacillin 1-2g q6h iv PLUS Ciprofloxacin 400mg q12h iv PLUS Metronidazole 500mg q8h iv	Clarithromycin* 500mg q12h iv PLUS Ciprofloxacin 400mg q12h iv PLUS Metronidazole 500mg q8h iv	Duration up to 6 weeks (iv + po) treatment in total. Consider oral switch on clinical improvement.
Scabies	1 st line: Permethrin dermal cream (Lyclear®) applied over whole body including palms and soles (but not head and face). Leave on for 8 hours. 2 nd line: Malathion (Derbac M®) applied over whole body including palms and soles (but not head and face). Leave on for 24 hours. Refer to infection control guidelines for isolation precautions. Follow manufacturers instructions.			

***Clarithromycin can cause significant increases in INR.** For patients on warfarin and clarithromycin, INR must be monitored very closely and appropriate warfarin dose adjustments made as necessary.

SKIN, SOFT TISSUE, BONE AND JOINT INFECTIONS (cont'd)

Infection	Most likely organisms	1st line empiric treatment	In penicillin allergy	Comments
Human bites / Animal bites	Mainly oral flora	Co-amoxiclav 1.2g iv q8h / 625mg q8h po if non-severe or on clinical improvement.	Doxycycline 200mg q24h po day 1, then 100mg-200mg q24h thereafter	Tetanus – consider tetanus vaccine / immunoglobulin. If human bite, consider Hepatitis B vaccination. Duration: depends on severity of wound. Seek advice from microbiology.
Septic arthritis, Osteomyelitis	<i>S aureus</i> , group A Streptococci and other Streptococci	Flucloxacillin 2g q6h iv PLUS Benzylpenicillin 2.4g q6h iv Consider addition of Fusidic acid (sodium fusidate) 500mg q8h po for confirmed <i>S. aureus</i> infection.	Vancomycin loading dose then 15mg/kg q12h iv OR Teicoplanin 10-12mg/kg q12h iv for 3 doses, then q24h thereafter Consider addition of Fusidic acid (sodium fusidate) 500mg q8h po for confirmed <i>S. aureus</i> infection. See p54-55 for vancomycin dosing guidelines. Vancomycin pre-dose level: aim for 15-20mg/L.	Duration of treatment; <ul style="list-style-type: none"> septic arthritis: 4-6 weeks, IV for 14 days. osteomyelitis: 6 weeks (although may require up to 3 months), iv therapy for 14-21 days. Shorter duration of iv if responding – e.g. iv therapy for minimum 7 days Always seek advice from microbiology

***Clarithromycin can cause significant increases in INR.** For patients on warfarin and clarithromycin, INR must be monitored very closely and appropriate warfarin dose adjustments made as necessary.

Reference: Lawrence JE et al. Management of skin and soft tissue infections. JAC 2003; 52: Suppl S1:13-17

VIRAL INFECTIONS

Infection	Treatment
Herpes simplex – mouth / lips	Valaciclovir 500mg q12h po for 5 days If immunocompromised: Valaciclovir 1g q12h po for 10 days
Genital herpes	Valaciclovir 500mg q12h po for 5 days If immunocompromised: Valaciclovir 1g q12h po for 10 days
Herpes simplex encephalitis	Aciclovir 10mg/kg q8h iv for 14-21 days. Use IBW to calculate dose and reduce dose in renal impairment. See Appendix 6 for dosing.
Varicella zoster ophthalmicus	Valaciclovir 1g q8h po for 10 days*
Herpes zoster (shingles)	Valaciclovir 1g q8h po for 7 days*
Varicella zoster (chicken pox)	Valaciclovir 1g q8h po for 7 days Consider varicella zoster immunoglobulin in immunocompromised patients / pregnancy. Consider vaccination of susceptible adults and children. Patients with high risk of severe disease: Aciclovir 10mg/kg q8h iv*

*If IV treatment necessary: aciclovir 10mg/kg q8h iv (use IBW to calculate dose). Dose reduction necessary in renal impairment. See Appendix 6, p62.

References:

- Tunbridge et al. Chicken pox in adults – clinical management. Journal of Infection 2008; 57: 95-102
- 2007 National Guideline for the Management of Genital Herpes. Clinical Effectiveness Group, British Society for Sexual Health and HIV

FUNGAL INFECTIONS

Infection	Treatment	Comments
Oropharyngeal thrush	Nystatin suspension 1ml q6h po	If severe , add Fluconazole 50-100mg q24h po for 7-14 days.
Vaginal thrush	Clotrimazole pessary 500mg pv stat	Add Fluconazole 150mg po stat if severe or not responding to clotrimazole pessary.
Fungal skin infection	Clotrimazole 1% cream q12h to affected areas	
Fungal nail infection	Terbinafine 250mg q24h po	Duration: 6 – 12 weeks (occasionally longer in toenails)
Disseminated candidiasis	Fluconazole 800mg iv stat then 400mg q24h iv. Always seek advice from microbiology.	Consider oral switch when there is a clinical improvement. In neutropenic and critically ill patients, or if recent azole exposure, consider alternative agent with advice from microbiology/ID
Aspergillosis	Always seek advice from microbiology/ID	
Immunocompromised patients	Always seek advice from microbiology/ID	

References:

- Clinical Practice Guidelines for the Management of Candidiasis: 2009 Update by the Infectious Diseases Society of America

OPHTHALMIC INFECTIONS

Infection	Treatment	Comments
Bacterial conjunctivitis	Chloramphenicol 0.5% eye drops every 2 hours initially, reduce to four times a day when infection controlled and Chloramphenicol 1% eye ointment at night	Always take a swab. Alternatives: Fusidic acid eye drops : apply twice daily
Preseptal cellulitis (not involving the orbit)	Co-amoxiclav 625mg q8h po <u>Penicillin allergy:</u> Clarithromycin* 500mg q12h po	Consider Benzylpenicillin 1.2-2.4g q4-6h iv PLUS Flucloxacillin 1-2g q6h iv if severe infection or group A streptococci isolated.
Orbital cellulitis	Urgent referral to ophthalmology	CT scan necessary.
Herpes zoster ophthalmicus	Valaciclovir 1g q8h po for 10 days	Consider referral to ophthalmology. If sight is threatened, use aciclovir 10mg/kg q8h iv. Use IBW to calculate aciclovir dose, and reduce dose in renal impairment.
Suspected endophthalmitis	Urgent referral to ophthalmology	
Corneal infection (keratitis)	Urgent referral to ophthalmology	

***Clarithromycin can cause significant increases in INR.** For patients on warfarin and clarithromycin, INR must be monitored very closely and appropriate warfarin dose adjustments made as necessary.

SURGICAL ANTIBIOTIC PROPHYLAXIS

Principles of Surgical Prophylaxis

1. Prophylaxis should be started ideally within one hour prior to incision.
Please note that certain antibiotics (e.g. vancomycin, erythromycin, clarithromycin, clindamycin and metronidazole) cannot be given as bolus injections. It is important that the infusions are completed within one hour PRIOR to incision to ensure adequate plasma levels during surgery.
2. Prophylaxis should be confined to the peri-operative period (i.e. immediately before and during procedure). The administration of additional doses of antibiotic after the end of procedure provides little or no additional prophylactic benefit. The use of antibiotics post-procedure is strongly discouraged in most cases.
3. Post operative doses of antibiotics will further disturb normal microbiological flora and increase the risk of *Clostridium difficile*. Only use post-operative antibiotics if specifically advised in the guideline or the patient requires treatment of infection (e.g. peritonitis post-perforated appendicitis). Antibiotic usage in this scenario is therapeutic rather than prophylactic.
4. An additional peri-operative prophylactic dose should be considered by the surgeon for procedures lasting > 4 hours, or if there is blood loss >1500ml or haemodilution >15ml/kg
5. Always check previous microbiology cultures and sensitivities (MC&S) to guide choice of antibiotic for surgical prophylaxis. If recent history of MRSA colonisation, a glycopeptide antibiotic should be given as part of surgical prophylaxis. Consult microbiologist.
6. Clean surgery is associated with a low risk of infection and there is usually no indication for surgical antibiotic prophylaxis.
7. NB: Vancomycin infusion must be run ONE HOUR PRIOR TO INCISION to ensure that adequate serum levels are achieved by time of incision.

SURGICAL ANTIBIOTIC PROPHYLAXIS (cont'd)

Type of surgery	Procedures*	Recommended agents	Comments
Neurosurgery	Craniotomy CSF shunt	Cefuroxime 1.5g iv single dose <u>Severe penicillin allergy:</u> Clarithromycin 500mg iv single dose	Single dose
ENT	Head and neck	Co-amoxiclav 1.2g iv single dose <u>Penicillin allergy:</u> Clindamycin 600mg iv PLUS Gentamicin 2mg/kg iv single dose	Only for clean-contaminated / contaminated surgery Single dose
Cardiothoracic	Coronary Artery Bypass Graft Thoracotomy	Cefuroxime 1.5g iv (q8h) <u>Penicillin allergy / risk of MRSA:</u> Gentamicin 240mg (q24h) iv PLUS either (Vancomycin 1g (q12h) iv OR Teicoplanin 6mg/kg iv)	For 24-48hrs
	Prosthetic valve surgery	Gentamicin 240mg (q24h) iv PLUS either (Vancomycin 1g (q12h) iv OR Teicoplanin 6mg/kg iv)	For 24-48 hrs
	Pacemaker insertion	Flucloxacillin 1g iv stat <u>Penicillin allergy / risk of MRSA:</u> (Vancomycin 1g iv stat OR Teicoplanin 6mg/kg iv)	Single dose

*NB: List of procedures requiring surgical antibiotics is not exhaustive

SURGICAL ANTIBIOTIC PROPHYLAXIS (cont'd)

Type of surgery	Procedures*	Recommended agents	Comments
General	Appendectomy Biliary surgery Gastro-duodenal surgery Gastrostomy Small bowel surgery Oesophageal surgery Colorectal surgery Thyroid surgery	Co-amoxiclav 1.2g iv single dose <u>In penicillin allergy:</u> Gentamicin 2mg/kg iv PLUS Metronidazole 500mg iv single dose	Prophylaxis not indicated for laparoscopic cholecystectomy or laparoscopic hernia repair without mesh. Use of antibiotics post surgery only if clinical evidence of infection, at the discretion of the surgeon.
	Breast	Co-amoxiclav 1.2g iv single dose <u>Penicillin allergy:</u> Vancomycin 1g iv single dose OR Teicoplanin 6mg/kg iv single dose	Single dose
	Endoscopic retrograde cholangiopancreatography	Ciprofloxacin 750mg po single dose one hour pre-op	Single dose
Vascular	Aortic aneurysm Vascular bypass Amputation	Co-amoxiclav 1.2g iv (q8h) <u>If risk of MRSA</u> Co-amoxiclav 1.2g iv (q8h) PLUS either (Vancomycin 1g iv (q12h) OR Teicoplanin 6mg/kg iv single dose) <u>In penicillin allergy:</u> Gentamicin 2mg/kg iv PLUS either (Vancomycin 1g iv (q12h) OR Teicoplanin 6mg/kg iv single dose)	For up to 24 hrs only.

*NB: List of procedures requiring surgical antibiotics is not exhaustive

SURGICAL ANTIBIOTIC PROPHYLAXIS (cont'd)

Type of surgery	Procedures*	Recommended agents	Comments
Urology	Transrectal prostate biopsy	<u>Oral option:</u> Ciprofloxacin 750mg po PLUS Metronidazole 800mg po one-hour before procedure stat dose <u>IV option:</u> Gentamicin 3-5mg/kg IV PLUS Metronidazole 500mg IV ≤30minutes before procedure stat dose	NB: Use previous MC&S to guide choice for antibiotic. Prophylaxis recommended in guideline assumes the patient has NOT had a positive urine culture.
	Shock-wave lithotripsy	<u>Oral option:</u> Ciprofloxacin 750mg po stat dose one-hour before procedure <u>IV option:</u> Gentamicin 3-5mg/kg IV ≤30minutes before procedure stat dose	
	Percutaneous nephrolithotomy	Only if stone >20mm or with pelvicalyceal dilation. If used, use Ciprofloxacin 500mg q12h oral for 7 days pre-procedure	
	Endoscopic ureteric stone fragmentation/removal	<u>Oral option:</u> Ciprofloxacin 750mg oral single dose one-hour before procedure <u>IV option:</u> Gentamicin 3-5mg/kg IV at induction only	Seek advice from Microbiology for ESBL colonised or other complex patients.
	Transurethral resection of prostate	Gentamicin 3-5mg/kg IV at induction only If gentamicin contraindicated: Co-amoxiclav 1.2g IV at induction only (repeat at 4 hours if operation ≥4 hours). If penicillin allergic: seek advice from microbiology.	
	Radical cystectomy and nephrectomy	Co-amoxiclav 1.2g IV at induction only (repeat at 4 hours if operation ≥4 hours) Penicillin allergy – Gentamicin 3-5mg/kg IV PLUS either (Vancomycin 1g iv OR Teicoplanin 6mg/kg iv) at induction only	

*NB: List of procedures requiring surgical antibiotics is not exhaustive

SURGICAL ANTIBIOTIC PROPHYLAXIS (cont'd)

Type of surgery	Procedures*	Recommended agents	Comments
Orthopaedic	Total hip replacement Knee replacement Closed fracture fixation Hip fracture repair Spinal surgery Insertion of prosthetic device	Cefuroxime 1.5g iv pre-op, then 750mg q8h iv for 2 doses <u>Penicillin allergy:</u> Gentamicin 160mg iv single dose PLUS Clarithromycin 500mg iv (q12h) for 2 doses only. <u>MRSA positive patients:</u> Teicoplanin 10mg/kg iv pre-op then one dose of 6mg/kg 12 hours after PLUS Gentamicin 160mg iv single dose pre-op	For up to 24 hours only. Prophylaxis not recommended for elective orthopaedic surgery where there is no insertion of prosthetic device
Obstetrics and gynaecology	Hysterectomy Caesarian section	Co-amoxiclav 1.2g iv single dose <u>Pencillin allergy:</u> Clindamycin 600mg iv PLUS Gentamicin 160mg iv single dose	

*NB: List of procedures requiring surgical antibiotics is not exhaustive

Reference:

- Antibiotic Prophylaxis in Surgery, A National Clinical Guideline. Scottish Intercollegiate Guidelines Network, 2008

MENINGITIS PROPHYLAXIS

Bacterial meningitis is a notifiable disease. Inform Public Health: Tel: 021 4927363. They will advise on chemoprophylaxis of contacts.

Meningococcal Infection

- Chemoprophylaxis is indicated only for close contacts, defined as those who, in the preceding seven days:
 - shared living/sleeping accommodation with case
 - were mouth kissing contacts
 - were nursery/crèche contacts
 - were boarding school dormitory contacts.
- Casual contacts, e.g. school classmates, playmates and neighbours are generally not considered to need chemoprophylaxis.
- Seek advice from Public Health or microbiology if unsure.
- Unless the index case has received ceftriaxone in hospital, chemoprophylaxis should also be given to the patient prior to discharge. When the disease has been treated with cefotaxime it may be prudent to give chemoprophylaxis until studies are available on its effectiveness in eradicating carriage.
- Only healthcare workers who do not wear a mask and whose mouth or nose is directly exposed to respiratory secretions and / or droplets, from a case of meningococcal disease are at risk.

Haemophilus influenzae type b (Hib) infection

Chemoprophylaxis is rarely indicated in Hib infection; only when there are unvaccinated or incompletely vaccinated children or persons at increased risk (e.g. asplenia or complement deficiency) in the household. Unless the index case has received ceftriaxone or cefotaxime in hospital, chemoprophylaxis should also be given to the patient prior to discharge. Seek advice from Public Health or microbiology if unsure.

MENINGITIS PROPHYLAXIS (cont'd)

Chemoprophylaxis for Meningococcal Disease

Adults and children >12 years	1st line: Rifampicin 600mg every 12 hours for 4 doses 2 nd line: Ciprofloxacin 500mg po stat
Female adults on the oral contraceptive pill	Ciprofloxacin 500mg po stat
Pregnant women	Ceftriaxone 250mg im stat
Children: 1-12 years	Rifampicin syrup 10mg/kg every 12 hours for 4 doses
Children 0 – 11 months	Rifampicin syrup 5mg/kg every 12 hours for 4 doses

Chemoprophylaxis for Hib Disease

Children and adults	Rifampicin 20mg/kg once daily for 4 days up to max of 600mg/day
Infants under 1 year of age	Rifampicin 10mg/kg once daily for 4 days
Pregnant women	Not indicated

Notes on rifampicin: Rifampicin may colour urine / tears red and stain contact lenses – do not wear contact lenses for a few days after rifampicin treatment. If on other drugs, check BNF / consult pharmacy regarding drug interactions with rifampicin.

Vaccination

If *Haemophilus influenzae* type b, pneumococcal meningitis or *Neisseria meningitidis* Groups C, A, Y and W135, vaccination of contacts and index may be indicated. Please refer to Public Health for advice.

References:

- British National Formulary 61 March 2011
- Immunisation Guidelines for Ireland 2008 Edition (Online update August 2010), National Immunisation Advisory Committee, Royal College of Physicians of Ireland
- Guidance for public health management of meningococcal disease in the UK 2011. Health protection agency (accessed via www.hpa.org.uk)
- Cochrane Database Syst Rev. 2006 Oct;(4):CD004785. Antibiotics for preventing meningococcal infections.

ENDOCARDITIS PROPHYLAXIS

- Endocarditis prophylaxis is only recommended in the situations detailed below, as antibiotic prophylaxis may only be effective at preventing a very small number of endocarditis cases. Infective endocarditis is much more likely to be caused by frequent exposure to random bacteraemias than bacteraemias caused by dental, GI tract or GU tract procedures. The risk of antibiotic-related adverse events exceeds the benefit, if any, from prophylactic antibiotic therapy.
- Maintenance of optimal oral health and hygiene is important in reducing the risk of endocarditis from dental procedures

Cardiac conditions that require endocarditis prophylaxis:

- Prosthetic cardiac valve or prosthetic material used for cardiac valve repair.
- Previous infective endocarditis
- Cardiac transplantation recipients who develop cardiac valvulopathy.
- The following forms of Congenital Heart Disease (CHD):
 - unrepaired cyanotic CHD, including palliative shunts and conduits
 - completely repaired congenital heart defect with prosthetic material or device, whether placed by surgery or catheter intervention, during the first 6 months after the procedure
 - repaired CHD with residual defects at or adjacent to the site of a prosthetic patch or prosthetic device (which inhibit endothelialisation)

Dental procedures:

Endocarditis prophylaxis recommended only in patients with the above cardiac conditions, for all dental procedures that involve manipulation of gingival tissue or the periapical region of teeth or perforation of oral mucosa.

Endocarditis prophylaxis NOT recommended for the following:

- routine anaesthetic injections through non-infected tissue
- taking dental radiographs
- placement of removable prosthodontic or orthodontic appliances
- adjustment of orthodontic appliances
- placement of orthodontic brackets
- shedding of deciduous teeth
- bleeding from trauma to the lips or oral mucosa

ENDOCARDITIS PROPHYLAXIS (cont'd)

For Dental procedures:

Given as a single dose 30- 60 minutes prior to the procedure:	
1 st line option	In penicillin allergy
Adults: Amoxicillin 2 grams orally /iv Children: Amoxicillin 50mg/kg orally / iv	Adults: clindamycin 600mg orally / iv /im Children: clindamycin 20mg/kg po / iv

GI tract or GU tract procedures:

Endocarditis prophylaxis not recommended.

Respiratory procedures:

Endocarditis prophylaxis is only recommended in patients with the above cardiac conditions for patients undergoing the following:

- Invasive procedure of the respiratory tract involving incision or biopsy of the respiratory mucosa e.g. tonsillectomy or adenoidectomy
- Invasive procedure to treat infections: e.g. drainage of abscess or empyema.

NB: if the infection is known to be caused by *S. aureus*, use flucloxacillin 1g po / iv single dose for prophylaxis. If caused by MRSA or penicillin allergic, use vancomycin 1g iv single dose infusion one hour prior to procedure.

Infected skin, skin structure and musculoskeletal tissue:

Endocarditis prophylaxis is only recommended in patients undergoing surgical procedures with the above cardiac conditions.

Flucloxacillin 1g iv / po should be given 30-60 mins prior to procedure. If MRSA or penicillin allergic: give vancomycin 1g iv single dose infusion one hour prior to procedure.

Reference: AHA Endocarditis prophylaxis guidelines 2007. *Circulation*, Wilson et al. 116 (15): 1736.

MANAGEMENT OF PATIENTS POST SPLENECTOMY & HYPOSPLENIC PATIENTS

Splenectomised and hyposplenic patients are at increased risk of life-threatening infections due to encapsulated micro-organisms such as *Streptococcus pneumoniae* (90%), *Neisseria meningitidis*, and *Haemophilus influenzae* as well as certain parasitic infections such as Malaria and Babesiosis. The risk of sepsis is probably lifelong but can be reduced with simple measures, such as immunisation, the prophylactic administration of antibiotics, and patient education.

Hyposplenic patients should be immunised as soon as the diagnosis is made. Where a patient has had a splenectomy in the past, and has not received the required vaccines at the time, they should be immunised at the earliest possible opportunity.

Elective splenectomy vaccines:

On admission ensure the patient has had the following at least 2 weeks (ideally 4-6 weeks) prior to surgery:

- Pneumococcal vaccine
- Meningococcal vaccine
- *Haemophilus influenza B* vaccine
- Influenza vaccine

If these vaccines haven't been given, please follow guidelines below for emergency procedures.

Emergency procedures vaccines:

All the above vaccinations should be given at least 2 weeks POST surgery (the response to pneumococcal vaccine is poorer if given within 2 weeks of splenectomy).

Post-operative antibiotics (adult doses):

Patient should be prescribed either:

- ORAL: either (penicillin V 666mg po q12h) OR (amoxicillin 250-500mg q12h po)
OR IV Benzylpenicillin 1.2g q12h if oral route not available
- In penicillin allergy: clarithromycin 250mg q12h po or IV if oral route unavailable

Antibiotics usually continued for life

MANAGEMENT OF PATIENTS POST SPLENECTOMY & HYPOSPLENIC PATIENTS (cont'd)

Ongoing Management of Patients Post Splenectomy and Patients with Functional Hyposplenism

Susceptibility to infection is greatest in the first two years post splenectomy but persists for life.

Patient Group	Recommendations
All adults	Prophylactic antibiotics should ideally be continued for life.
Patients with functional hyposplenism	Lifelong prophylactic antibiotics should be considered for these patients.
ALL	<ul style="list-style-type: none"> • The patient's general practitioner should be informed regarding the prophylactic antibiotic regimen and all vaccinations. • Patients should be educated on how to reduce the risk of infection. • Patients should be advised that prophylaxis may fail and educated on recognizing the first signs and symptoms of infection. • Patients should be given written information (available from Public Health) and carry a card to alert other healthcare professionals of their risk of overwhelming infection. • Patients should be encouraged to obtain a medical alert bracelet. • Patients should be alerted to the risks of overseas travel to countries where Malaria is endemic or where they may be exposed to unusual infections. • Patients should be alerted to the risk of infection following dog and tick bites. • Patients developing infection despite appropriate prophylactic antibiotics and immunisations must be admitted to hospital and prescribed PARENTERAL antibiotics.

MANAGEMENT OF PATIENTS POST SPLENECTOMY & HYPOSPLENIC PATIENTS (cont'd)

VACCINATION	Who should be immunised	When should vaccine be given	Re-immunisation
Pneumococcal Conjugate Vaccine PCV (Prevenar 13) (13 serotypes)	All aged less than 18 years old	<ul style="list-style-type: none"> • Ideally given at least 4 to 6 weeks before elective splenectomy. Where it is not possible it can be given 2 weeks before treatment. • 1 - 3 doses (2 months apart) depending on age and previous vaccinations. (Public Health can advise). • Course should be completed before receiving Pneumococcal Polysaccharide Vaccine. 	There is no data to support reimmunisation at the present time
Pneumococcal Polysaccharide vaccine (Pneumovax II®) (23 serotypes)	All unimmunised patients aged 2 years and over, and those who received Pneumovax II® more than 5 years ago	<ul style="list-style-type: none"> • Ideally given at least 4 to 6 weeks before elective splenectomy. Where it is not possible it can be given 2 weeks before treatment. • For emergency splenectomy or if prior vaccination is overlooked, administration 2 weeks after splenectomy is recommended. • If the patient is being sent home before vaccinations are given, make sure the GP is fully informed about the vaccines required, and the date on which they are due. • If concerned that the patient may not present to the GP for vaccination or for any other reason, vaccination prior to discharge may merit consideration, even if it is before the required 14 day gap. • Immunisation may need to be deferred post immunosuppressive chemo- or radiotherapy (Public Health and Clinician can advise). 	<ul style="list-style-type: none"> • Antibody levels may decline more rapidly, particularly in patients with sickle cell anaemia or lymphoproliferative disorders. • A once only booster is recommended 5 years after first dose. The need for, or benefit of repeated booster doses is unclear and not routinely recommended.
<i>Haemophilus influenzae</i> serotype B (Hib)	<ul style="list-style-type: none"> • All patients who are previously unimmunised should be given two doses at a two-month interval. • Previously immunised patients who develop splenic dysfunction should be give one additional dose 	<ul style="list-style-type: none"> • First dose at same time as Pneumococcal vaccine (at a different site of injection) • Second dose (if indicated) - two months later. <p>Those who have completed a primary series and are undergoing elective splenectomy may benefit from an additional dose of Hib preferably at least 2 weeks prior to the operation.</p> <p style="text-align: center;">SEE OVERLEAF – table continued</p>	There are no data to support routine reimmunisation at the present time.

MANAGEMENT OF PATIENTS POST SPLENECTOMY & HYPOSPLENIC PATIENTS (cont'd)

Table continued from previous page

VACCINATION	Who should be immunised	When should vaccine be given	Re-immunisation
Meningococcal Quadrivalent conjugate vaccine ACYW135 (Menveo®)	<ul style="list-style-type: none"> •Children over 1 year of age and adults: Give two doses of Meningococcal quadrivalent conjugate vaccine covering ACYW135 (Menveo®) at least one month apart •Children under 1 year should be immunised in accordance with the routine schedule but replacing the MenC vaccine with Menveo® 	<p>First dose at same time as Pneumococcal vaccine (at a different site of injection)</p> <p>Second dose – at least one month later</p>	<p>The need for additional doses in high risk groups has not been clearly established - not recommended for the present.</p>
Influenza Vaccine	All patients, annually.	Initial dose - at same time as other vaccines (separate site of administration).	Annually for hyposplenic or asplenic patients ideally at start of flu season (September to October).

MANAGEMENT OF PATIENTS POST SPLENECTOMY & HYPOSPLENIC PATIENTS (cont'd)

Lifelong prophylactic antibiotics	Prophylaxis Dose (adult)*	Treatment Doses (adult)*	Notes
Phenoxymethylpenicillin	333-666mg q12h po (Calvepen®) (666mg q24h po can be given if compliance is a problem)	Oral absorption of phenoxymethylpenicillin can be unpredictable so it should not be used for serious infections. For emergency self initiated therapy of a suspected systemic infection, treatment doses of amoxicillin are preferable (see below).	
Amoxicillin	250-500mg q12h po (500mg po q24h if compliance is a problem).	500mg -1g 8 hourly po	
If penicillin allergy: Clarithromycin	250mg q12h po	500mg q12h po	

***NB: Please seek specialist advice on dosing in children**

Other information

- For patients not allergic to penicillin where infection is suspected, a dose of 1g of amoxicillin should be taken immediately and medical attention sought.
- Patients taking clarithromycin as prophylaxis who suspect infection should take a dose of 1g clarithromycin or change to an alternative broader spectrum preparation (e.g. moxifloxacin or levofloxacin) and seek medical attention immediately.
- Patient records should be clearly labelled to indicate the underlying risk of infection. Vaccination and re-vaccination status should be clearly and adequately documented. Patients should be provided with emergency supplies of antibiotics to take at first signs of infection.

Empiric treatment of hospitalised hypo/asplenic patients with acute infection:

- Ceftriaxone** 2g q24h IV. Take blood samples before commencing antibiotics. May need to increase dose if meningitis suspected.

References

- Department of Health UK (2006). Immunisation against infectious disease (the Green Book). 3rd ed. London: The Stationery Office. Immunisation of individuals with underlying medical conditions. Chapter 7(July 2010). Immunisation against infectious disease- 'the Green Book' 30th October 2007.
- Working Party of the British Committee for Standards in Haematology Task Force. Guidelines for the prevention and treatment of infection in patients with an absent or dysfunctional spleen. BMJ 1996 312:430-434
- Immunisation advisory committee: Royal College of Physicians of Ireland. Immunisation Guidelines for Ireland 2008
- Newland A, Provan D, Myint S. Preventing severe infection after splenectomy. BMJ 2005 ;331 ;417-418
- Health Protection Agency North West, UK. Guidance on minimising infection in patients with an absent or dysfunctional spleen (2007) Available at www.hpa.org.uk
- British Committee for Standards in Hematology, prepared by a Working Party of the Haemato-Oncology Task Force. Update of Guidelines for the Prevention and Treatment of Infection in Patients with an Absent or Dysfunctional Spleen. Published in Clinical Medicine (Journal of the Royal College of Physicians of London), Vol 2, Nos 5 ; 440-443 (2002)
- National Immunisations Advisory Committee Guidelines (2008 as updated Dec 2010), Chapters 2 & 12.

APPENDIX 1: SWITCH OF INTRAVENOUS TO ORAL ANTIBIOTIC THERAPY

Many patients are given intravenous antibiotics at the time of admission to hospital.

As they improve and investigations reveal the site and extent of any infective process, it may be appropriate:

- to discontinue antibiotics OR
- if the patient's condition allows, to change from the intravenous to the oral route

Consider switch to oral antibiotics after 48 hours. If not initially appropriate, continue to review need for IV therapy every 24 hours

Advantages of iv to oral switch

- reduction in likelihood of infected IV lines
- saves nursing and medical time
- reduces patient discomfort and enables improved mobility
- reduces treatment costs
- patient more likely to receive antibiotic at correct time
- potential reduction in adverse effects and errors in preparation

Indications to switch to oral therapy

The following criteria should be fulfilled before switching a patient to oral antibiotics:

- **Appropriate oral antibiotic available**
- **Afebrile for >24 hours**
- **Improvement or resolution of signs of infection (e.g. tachycardia, tachypnoea, hypoxia)**
- **WCC, ESR, CRP improving**
- **Gastrointestinal absorption is normal**
- **Patient does not have the following: vomiting, reduced absorption e.g. severe diarrhoea or steatorrhoea, NPO, non-functioning gut, reduced consciousness/unconscious, swallowing disorder**
- **Patient does NOT have the following conditions:**
 - Febrile neutropenia
 - Endocarditis
 - Septic arthritis, osteomyelitis, severe cellulitis
 - Meningitis
 - Deep-seated or high risk infections (e.g. lung, liver, brain, intra-abdominal and pelvic)
 - Exacerbations of cystic fibrosis/bronchiectasis
 - Infected implant/prosthesis
 - Empyema

APPENDIX 1: SWITCH OF INTRAVENOUS TO ORAL ANTIBIOTIC THERAPY (cont'd)

Antibiotics that may be switched to oral

- Many of these antibiotics have good oral bioavailability and are substantially less expensive than IV formulations.
- Most antibiotics are switched to the oral formulation of the same antibiotic, except cefuroxime (see table)
- Some antibiotics (*) have excellent oral bioavailability and should nearly always be administered by the oral route, except when the patient has impaired gastrointestinal absorption or is unable to take oral medicines.
- Certain infections require treatment with agents only available as intravenous preparations. Liaise with microbiology regarding appropriate length of treatment and potential oral options.

Examples of appropriate oral antibiotics:

IV antibiotic	Typical IV dose	Oral antibiotic	Typical oral dose
Amoxicillin	1g 6-8 hourly	Amoxicillin	500mg-1g tds
Co-amoxiclav	1.2g tds	Co-amoxiclav	625mg tds
Benzylpenicillin	600mg- 2.4 qds	Amoxicillin	500mg – 1g tds
Flucloxacillin	500mg-2g qds	Flucloxacillin	500mg-1g qds
Cefuroxime [#]	750mg-1.5g tds	Co-amoxiclav	625mg tds
Clarithromycin	500mg bd	Clarithromycin	500mg bd
Erythromycin	500mg -1g qds	Erythromycin OR Clarithromycin	500mg-1g qds 500mg bd
*Ciprofloxacin	400mg bd	Ciprofloxacin	500mg-750mg bd
*Metronidazole	500mg tds	Metronidazole	400mg tds
Piperacillin-tazobactam	As no oral piperacillin-tazobactam available, seek advice. If no positive microbiology, co-amoxiclav 625mg tds po may be an option.		
*Moxifloxacin	400mg od	Moxifloxacin	400mg od

[#]Cefuroxime iv is mainly used for surgical prophylaxis. Oral cefuroxime is rarely indicated for treatment of infections and has poor bioavailability. Co-amoxiclav is a suitable alternative. Seek advice for alternative in penicillin allergic patients.

*Antibiotics with excellent oral bioavailability – use orally whenever possible.

APPENDIX 2: AMINOGLYCOSIDE MONITORING IN ADULTS

Gentamicin, tobramycin and amikacin levels should be monitored to minimise risk of renal toxicity or ototoxicity.

In general, once daily aminoglycosides are recommended. Exceptions are for endocarditis, cystic fibrosis, major burns and pregnancy, where multiple daily dosing is recommended^{1,2}.

	Gentamicin / tobramycin OD	Amikacin OD	Gentamicin and tobramycin BD/TDS
Dose	5-7mg/kg iv once daily. Ideally given at 12 noon or earlier. Dose should not exceed 500mg per day. Use equation below on p53 for dosing in obese patients.	15mg/kg iv once daily, ideally given at 12 noon or earlier. Max 1.5g q24h. (Max cumulative dose 15g).	Endocarditis: gentamicin 1mg/kg q8-12h iv Tobramycin: 1-1.7mg/kg q8h iv
Reference range	Once daily gentamicin and tobramycin: pre-dose level $\leq 1\text{mg/L}$	Amikacin once daily dosing: pre-dose level $\leq 5\text{mg/L}$ Amikacin BD dosing: pre-dose level $\leq 10\text{mg/L}$	BD/ TDS gentamicin and tobramycin: Pre-dose level $\leq 2\text{mg/L}$ Post dose level 5-12mg/L Endocarditis gentamicin target levels: Pre-dose: $\leq 1\text{mg/L}$ Post-dose: 3-4mg/L
Admini- stration	In 100mls NaCl over 1 hr	Dilute to 2.5mg/ml with NaCl, infuse over 30 min	iv bolus over 3-5 mins or infuse over 30 mins
When to monitor levels	Monitor pre- dose (trough) level: taken at least 18 hours after dose, or within 6 hours of next dose due. Initially monitor pre-dose level after first dose then every 48 hours or daily if renal function is poor.		Monitor pre-dose levels taken just prior to dose and post-dose levels taken one hour post dose. Initially monitor pre and post dose levels at 3 rd or 4 th dose, then monitor every 48 hours, or more often if renal function is poor.
Taking the sample	Send blood to microbiology, with the following information <ul style="list-style-type: none"> Name of antibiotic and prescribed dose Time and date level was taken (The sample will be meaningless without this information). The time and date of previous dose Whether it is a pre-dose or post-dose level 		
Interpreting results	<ul style="list-style-type: none"> You DO NOT need to wait for the result before administering the next dose unless specifically advised or patient has impaired renal function. <p>If result is high, first check that the level was taken at the correct time. In general, if the result is high, reduce the dose or increase the dosing interval. If in doubt, seek advice from Microbiology or Pharmacist</p>		

APPENDIX 2: AMINOGLYCOSIDE MONITORING IN ADULTS (cont'd)

CALCULATING DOSE FOR OBESE PATIENTS³:

Obese patients (those 20% over their ideal body weight) should receive a reduced dose calculated using these equations providing a dose determining weight³:

1. Calculate ideal body weight (IBW): ideal body weight male = $50\text{kg} + (2.3\text{kg} \times \text{number of inches} > 5 \text{ ft})$
ideal body weight female = $45.5\text{kg} + (2.3\text{kg} \times \text{number of inches} > 5 \text{ ft})$
2. DOSE DETERMINING WEIGHT = ideal body weight + $0.4(\text{actual body weight} - \text{ideal body weight})$
3. GENTAMICIN DOSE (mg): $5\text{mg} - 7\text{mg} \times \text{Dose determining weight (kg)}$

References:1. Freeman C et al. Once-daily dosing of aminoglycosides: review and recommendations for clinical practice, Journal of Antimicrobial Chemotherapy 1997; 39, 677-686

2. Gilbert D et al. A randomised comparison of the safety and efficacy of once-daily gentamicin or thrice-daily gentamicin in combination with ticarcillin-clavulanate. American Journal of Medicine 1998; 105, 182-191

3. Schwarz S et al. A controlled investigation of the pharmacokinetics of gentamicin and tobramycin in obese subjects. Journal of Infectious Diseases 1978; 138: 499-505

APPENDIX 3: INTRAVENOUS VANCOMYCIN DOSING AND MONITORING GUIDELINES

Vancomycin levels are monitored to ensure efficacy and to minimise toxicity (mainly nephrotoxicity and ototoxicity)

Step 1: Give one **LOADING dose** to all patients

Loading dose		
Actual body weight	IV Vancomycin loading dose	Administration (IV infusion)
<40kg	750mg	In 250ml NS or G5 over 1.5 hours
40-59kg	1 gram	In 250ml NS or G5 over 2 hours
60-90kg	1.5 grams	In 500ml NS or G5 over 3 hours
Above 90kg	2 grams	In 500ml NS or G5 over 4 hours

NS = sodium chloride 0.9% G5= glucose 5%

Step 2: MAINTENANCE DOSE:

In normal renal function : **15mg/kg IV every 12 hours at 10am and 10pm**

- Use actual body weight to calculate dose
- Round up to nearest 250mg
- Do not exceed 2g BD
- To commence approximately 12 hours after loading dose

In renal impairment (after loading dose given):

Creatinine clearance*	Vancomycin dose
>50ml/min	15mg/kg q12h (to start 12 hours after loading dose)
20-50ml/min	15mg/kg q24h (to start 24 hours after loading dose)
<20ml/min or haemodialysis	15mg/kg and re-dose once level <20mg/L

***NB: The Cockcroft-Gault equation should be used to calculate creatinine clearance:**

$$\text{Creatinine clearance ml/min} = \frac{N \times (140 - \text{age}) \times \text{weight}^* (\text{kg})}{\text{Serum creatinine (micromol/L)}}$$

Where N= 1.23 for males; 1.04 for females

*Use ideal body weight (IBW) if actual body weight >20% IBW

$$\text{IBW male} = 50\text{kg} + (2.3\text{kg} \times \text{number of inches} > 5\text{ft}) \quad \text{IBW female} = 45.5\text{kg} + (2.3\text{kg} \times \text{number of inches} > 5\text{ft})$$

APPENDIX 3: INTRAVENOUS VANCOMYCIN DOSING AND MONITORING GUIDELINES (cont'd)

Step 3: Monitoring levels:

Send blood to microbiology, with the following information

- Name of antibiotic and prescribed dose
- Time and date level was taken (The sample will be meaningless without this information).
- The time and date of previous dose and whether it is a pre-dose level.
- For BD dosing, check first level immediately prior to third or fourth dose. For patients with renal impairment on once daily dosing, check first level immediately prior to second dose. Subsequent levels should be generally checked every three days.
- Check levels more frequently in renal impairment and if concerned about toxicity or sub-therapeutic levels.
- DO NOT withhold doses whilst waiting for a vancomycin assay result unless specifically advised in cases of renal impairment or suspected toxicity. The assay results should be used to guide subsequent doses.

Target pre-dose (trough) level: 10-20mg/L

(15-20mg/L in endocarditis, meningitis, pneumonia, osteomyelitis, MRSA bacteraemia)

NB: post dose levels only recommended in certain cases of endocarditis – see p6. Target post-dose level: 30-45mg/L)

Step 4: Suggested vancomycin dose adjustments:

NB: ensure level taken at the correct time, i.e. within two hours of next dose (preferably just prior to next dose)

Pre-dose (trough) level	Suggested dose alteration
<10mg/L	Increase each dose by approx 500mg. NB: max dose 2g BD
10-15mg/L	Desired range 10-20mg/L: no change Desired range 15-20mg/L: increase each dose by 250mg
15-20mg/L	No change
>20mg/L	Omit next dose(s) until level <20mg/L and then reduce each dose by 500mg

References:

1. Rybak et al. Therapeutic monitoring of vancomycin in adult patients: A consensus review of the American Society of Health-System Pharmacists, the Infectious Diseases Society of America, and the Society of Infectious Diseases Pharmacists. *Am J Health-Syst Pharm.* 2009; **66**: 82-98
2. Thompson A et al. Development and evaluation of vancomycin dosage guidelines designed to achieve new target concentrations. *Journal of Antimicrobial Chemotherapy* 2009; **63**:1050-1057

APPENDIX 4: MANAGEMENT OF CLOSTRIDIUM DIFFICILE ASSOCIATED DIARRHOEA

Antibiotic Associated Diarrhoea (AAD) occurs in association with the administration of antibiotics. The spectrum of findings ranges from colitis to so-called 'nuisance' diarrhoea. Infection with *Clostridium difficile* accounts for only 10 to 20% of the cases of AAD, but it accounts for the majority of cases of colitis. Major risk factors for *C. difficile* infection include: advanced age, hospitalisation, exposure to antibiotics.

Some antibiotics are frequently implicated in *C. difficile* associated diarrhoea (CDAD) – e.g. Cephalosporins, Clindamycin, Quinolones and broad spectrum antibiotics, but virtually any antibiotic may be implicated, including brief courses eg. surgical prophylaxis. Occasional cases follow treatment with Methotrexate or Paclitaxel (chemotherapy treatments of cancer).

Definition of Clostridium Difficile Associated Diarrhoea (CDAD):

This is defined as a patient to whom one or more of the following criteria applies:

- Diarrhoeal stools or toxic megacolon, with a positive laboratory assay for *C. difficile* toxin A or B in stools, or a *C. difficile* organism detected in stool via culture. (NB: patients with a positive assay for *C. difficile* toxin who do not have diarrhoea are not considered to have CDAD).
- Pseudomembranous colitis revealed by lower gastrointestinal endoscopy
- Colonic histopathology characteristic of *C. difficile* infection (with or without diarrhoea)
- Diarrhoea is defined as three or more loose / watery bowel movements (which are unusual or different for the patient) in a 24 hour period.

Classification of CDAD

- **Mild CDI** is not associated with a raised WCC; it is typically associated with <3 stools of types 5-7 on the Bristol Stool Chart per day.
- **Moderate CDI** is associated with a raised WCC that is $<15 \times 10^9/L$; it is typically associated with 3-5 stools per day
- **Severe CDI** is associated with a WCC $> 15 \times 10^9/L$, or an acute rising serum creatinine (i.e: >50% increase above baseline), or serum albumin $< 25g/L$, or a temperature of $38.5^\circ C$, or evidence of severe colitis (abdominal or radiological signs). The number of stools may be a less reliable indicator of severity.
- **Life-threatening CDI** includes hypotension, partial or complete ileus or toxic megacolon, or CT evidence of severe disease.

Diagnosis

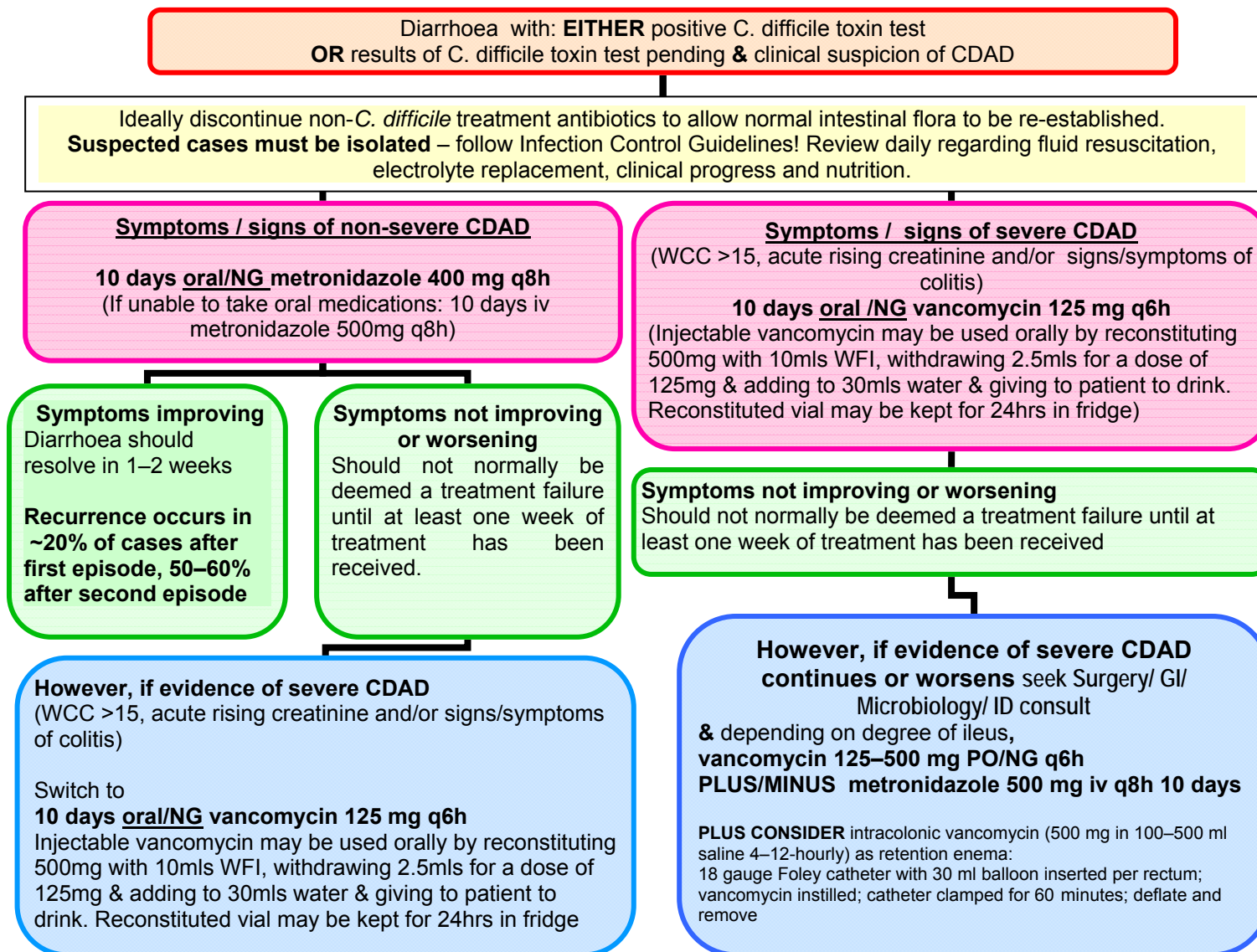
- All patients in whom a diagnosis of gastrointestinal infection is suspected should have a stool specimen sent promptly for microbiological analysis.
- Testing of asymptomatic individuals is not recommended.

APPENDIX 4: MANAGEMENT OF CLOSTRIDIUM DIFFICILE ASSOCIATED DIARRHOEA (cont'd)

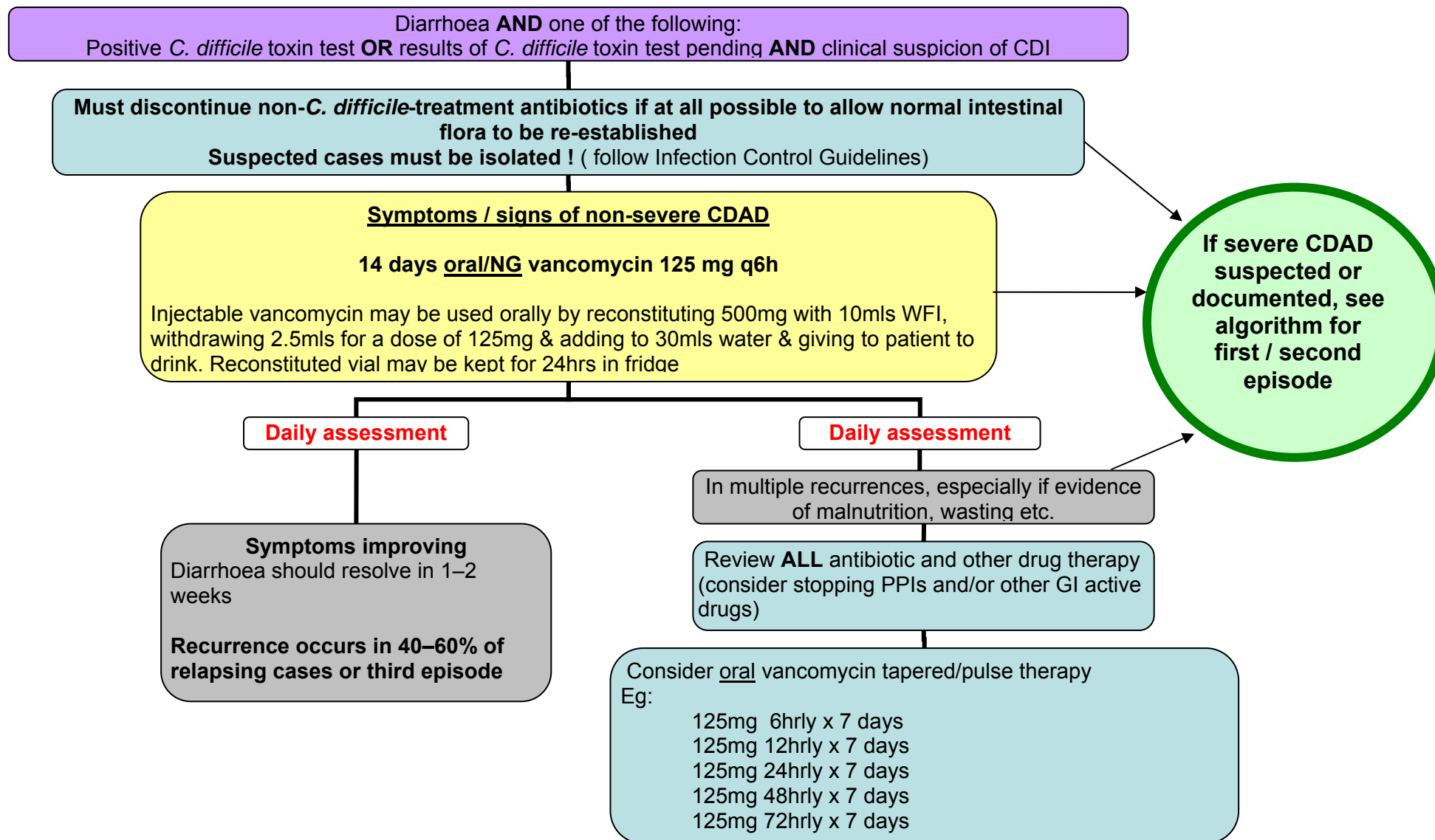
Management and treatment of CDAD

- Refer to local infection control guidelines on isolation and precautions to be used for patients with CDAD.
- Asymptomatic carriers of *C. difficile* should not be treated
- Antiperistaltic agents (e.g. loperamide and Lomotil®) should be avoided because of lack of evidence that they improve diarrhoea in this situation and the theoretical risk of precipitating toxic megacolon by slowing clearance of *C. difficile* toxin from the intestine.
- Refer to local infection control guidelines on isolation and precautions to be used for patients with CDAD.
- Patients should be monitored daily for frequency and severity of diarrhoea using the Bristol Stool Chart
- There is no need to check for microbiological clearance of *C. difficile* toxins as a patient can remain toxin positive for an indefinite period. Resolution of symptoms is the main clinical consideration.
- **See the following algorithms:**
 - **Treatment algorithm for first and second episode of CDAD: p58**
 - **Treatment of third and subsequent (i.e. recurrent) episodes of CDAD: p59**

Treatment algorithm for first and second episodes of CDAD



Treatment algorithm for third & subsequent (i.e. recurrent) episodes of CDAD



APPENDIX 5: TREATMENT OF METHICILLIN RESISTANT *S. AUREUS* (MRSA)

MRSA strains are by definition resistant to Flucloxacillin and all β -lactam antibiotics. MRSA varies in its sensitivity to other antibiotics but is almost always sensitive to glycopeptides (i.e. Vancomycin and Teicoplanin) and Linezolid. If a patient is colonised with MRSA and develops an infection usually caused by staphylococci then it is likely that MRSA is the causative pathogen and this should be considered when treating a patient empirically.

Treatment with antibiotics should only be initiated if there are clinical signs of INFECTION, not just COLONISATION with MRSA.

MRSA Colonisation: From superficial sites MRSA may be present without causing infection i.e. there being no clinical evidence of infection. This is termed colonisation. Systemic antibiotics are not indicated. Topical antiseptics may be used to eradicate / reduce MRSA carriage. Please refer to the Infection Control Guidelines for full details on screening and eradication of MRSA.

ERADICATION (REDUCTION) REGIMEN OF MRSA CARRIAGE – FOR 7 DAYS

1. Apply a small amount of 2% Mupirocin nasal ointment (Bactroban[®]), or Naseptin[®] cream if Bactroban[®] unavailable, applied with a cotton wool swab to each nostril q8h.
2. Antiseptic detergent Chlorhexidine 4% used as a body wash daily.
3. Wash hair twice a week with Chlorhexidine 4% wash
4. CX[®] powder to groin or axilla daily.
5. Chlorhexidine mouth wash twice daily.
6. Wash teeth / dentures with toothpaste (individual patient use) twice daily.

APPENDIX 5: TREATMENT OF METHICILLIN RESISTANT *S. AUREUS* (MRSA) cont'd

MRSA Infection: Systemic antibiotics are indicated where there is clinical evidence of infection & MRSA is known, or strongly suspected to be the cause of infection.

TREATMENT OF INFECTION

Always seek advice from microbiology regarding choice of agent and duration of treatment

SURGICAL ANTIBIOTIC PROPHYLAXIS –

patients who require surgery and have a history of MRSA colonization or infection without documented eradication or are at a high risk of MRSA colonization should receive glycopeptide prophylaxis alone or in combination with other antibiotics active against other potential pathogens. The use of glycopeptides may also be considered if there is an appreciable risk that patients' MRSA carriage may have recurred or they come from facilities with a high prevalence of MRSA.

Glycopeptide prophylaxis: Vancomycin 1g iv / Teicoplanin 6mg/kg iv

MRSA practice points

- Patients require isolation - follow Infection Control Guidelines
- Handwashing is critical in prevention of cross-infection
- Rifampicin and Sodium fusidate must never be used as single agents, to prevent development of resistance to these agents.
- Minimum duration of treatment for MRSA bacteraemia is 14 days. Some indications may need longer duration of treatment. Consult microbiologist for specific recommendations regarding duration of treatment

APPENDIX 6: RENAL IMPAIRMENT: ANTIMICROBIAL DOSING FOR ADULTS

NB: For intermittent haemodialysis (HD), dose should be given post-dialysis

For Continuous haemodiafiltration in the intensive care setting seek specialist advice

Dosing based on estimated creatinine clearance as calculated by the Cockcroft – Gault equation

Antimicrobial	Mild renal impairment (GFR 20-50ml/min)	Moderate renal impairment (GFR 10-20ml/min)	Severe renal impairment (GFR <10ml/min)	Comments
Aciclovir iv	GFR 25-50 ml/min 5-10mg/kg q12h	GFR 10-25 ml/min 5-10mg/kg q24h	2.5-5mg/kg q24h	CAPD /HD : Dose as GFR <10ml/min
Aciclovir po	GFR 25-50 ml/min Dose as in normal renal function	GFR 10-25 ml/min Herpes simplex: 200mg 6-8h Herpes zoster: 800mg q8h	Herpes simplex: 200mg q12h Herpes zoster: 800mg q12h	CAPD /HD : Dose as GFR<10ml/min
Amikacin (Monitor serum levels). See p52	10mg/kg q24h	3-4 mg/kg q24h	2mg/kg q24h-q48h	CAPD: Dose as GFR <10ml/min HD: 5mg/kg after dialysis
Amoxicillin	Dose as in normal renal function	Dose as in normal renal function	250mg – 1g q8h (max 6g/24hrs in endocarditis)	CAPD / HD: dose as GFR <10ml/min
Ambisome [®] (Liposomal amphotericin)	Dose as in normal renal function	Dose as in normal renal function	Dose as in normal renal function	CAPD/HD: dose as normal renal function (Fungizone brand is highly renally toxic. Do not use this brand in renal impairment.)
Azithromycin	Dose as in normal renal function	Dose as in normal renal function	Dose as in normal renal function	CAPD/HD: Dose as in normal renal function

RENAL IMPAIRMENT: ANTIMICROBIAL DOSING FOR ADULTS (cont'd)

NB: For intermittent haemodialysis (HD), dose should be given post-dialysis
For Continuous haemodiafiltration seek specialist advice

Antimicrobial	Mild renal impairment (GFR 20-50ml/min)	Moderate renal impairment (GFR 10-20ml/min)	Severe renal impairment (GFR <10ml/min)	Comments
Benzylpenicillin	Dose as in normal renal function	600mg-2.4g q6h depending on severity of infection	600mg-1.2g q6h depending on severity of infection	Increased risk of neurotoxicity (seizures) in renal impairment. CAPD/HD: dose as GFR <10ml/min
Caspofungin	Dose as in normal renal function	Dose as in normal renal function	Dose as in normal renal function	CAPD/HD: Dose as in normal renal function
Cefotaxime	Dose as in normal renal function	Dose as in normal renal function	GFR <5ml/min 1g stat then 50% of dose	CAPD/HD: Dose as in GFR <5ml/min
Cefalexin	Dose as in normal renal function	Max 500mg q8-12h	250-500mg q8-12h	CAPD/HD: Dose as in GFR <10ml/min In established renal failure use normal doses to treat UTIs
Ceftazidime	GFR 31-50ml/min: 1-2g q12h	GFR 16-30ml/min: 1-2g q24h GFR 6-15ml/min: 500mg-1g q24h	GFR <6ml/min: 500mg-1g q48h	CAPD/HD: dose as per GFR 6-30ml/min
Ceftriaxone	Dose as in normal renal function	Dose as in normal renal function	Max dose 2g per day	CAPD/HD: Dose as in GFR<10ml/min
Cefuroxime iv	Dose as in normal renal function	750mg – 1.5g q8-12h	750mg – 1.5g q24h	CAPD/HD: Dose as in GFR <10ml/min

RENAL IMPAIRMENT: ANTIMICROBIAL DOSING FOR ADULTS (cont'd)

NB: For intermittent haemodialysis (HD), dose should be given post-dialysis
For Continuous haemodiafiltration seek specialist advice

Antimicrobial	Mild renal impairment (GFR 20-50ml/min)	Moderate renal impairment (GFR 10-20ml/min)	Severe renal impairment (GFR <10ml/min)	Comments
Ciprofloxacin	Dose as in normal renal function	50-100% of normal dose	50% of normal dose (100% dose may be given for short periods of time under exceptional circumstances)	CAPD: po 250mg q8-12h. iv 200mg q12h HD: po 250-500mg q12h. iv 200mg q12h
Clarithromycin	Dose as in normal renal function	GFR > 30ml/min: Dose as in normal renal function GFR 10-30ml/min: 250-500mg q12h	250-500mg q12h NB: vomiting may be a problem with high doses	CAPD/HD: dose as GFR <10ml/min
Clindamycin	Dose as in normal renal function	Dose as in normal renal function	Dose as in normal renal function	CAPD/HD: Dose as in normal renal function
Co-amoxiclav	GFR 30-50ml/min: dose as normal renal function	GFR 10-30ml/min: IV: 1.2g q12h PO: dose as in normal renal function	GFR <10ml/min: IV: 1.2g stat then 600mg - 1.2g q12h PO: dose as in normal renal function	CAPD/HD: Dose as GFR <10ml/min
Colomycin IV (colistin)	1-2 million units every 8 hours	1 million units every 12-18 hrs	1 million units every 18-24 hrs	CAPD/HD: 1million unit after dialysis
Co-trimoxazole (treatment doses)	GFR 30-50ml/min: dose as normal renal function	GFR 15-30ml/min PCP: Dose as normal renal function for 3 days, then 50% of normal dose	GFR <15ml/min 50% of normal dose NB: if GFR <15ml/min, use not recommended unless haemodialysis facilities available.	CAPD/HD: 50% of normal dose Note: No dose reductions for PCP prophylaxis

RENAL IMPAIRMENT: ANTIMICROBIAL DOSING FOR ADULTS (cont'd)

NB: For intermittent haemodialysis (HD), dose should be given post-dialysis
For Continuous haemodiafiltration seek specialist advice

Antimicrobial	Mild renal impairment (GFR 20-50ml/min)	Moderate renal impairment (GFR 10-20ml/min)	Severe renal impairment (GFR <10ml/min)	Comments
Doxycycline	Dose as in normal renal function	Dose as in normal renal function	Dose as in normal renal function	CAPD/HD: Dose as in normal renal function
Erythromycin	Dose as in normal renal function	Dose as in normal renal function	50-75% of normal dose, max 2g daily	CAPD/HD: Dose as GFR <10ml/min.
Flucloxacillin	Dose as in normal renal function	Dose as in normal renal function	Dose as in normal renal function Maximum 4g/24hrs	CAPD/HD: Dose as GFR <10ml/min
Fluconazole	Dose as in normal renal function	Dose as in normal renal function	50% of normal dose	CAPD/HD: Dose as GFR <10m/min
Fusidic acid (sodium fusidate)	Dose as in normal renal function	Dose as in normal renal function	Dose as in normal renal function	CAPD/HD: Dose as in normal renal function
Gentamicin Multiple daily dosing (Monitor serum levels)	GFR 30-70ml/min: 80mg q12h (60mg if <60kg)	GFR 10-30ml/min: 80mg q24h (60mg if <60kg)	GFR 5-10ml/min: 80mg q48h (60mg if <60kg)	Monitor levels daily CAPD/HD: Dose as per 5-10ml/min. Give dose post HD
Gentamicin Once daily dosing (Monitor serum levels). See p52	GFR 30-60ml/min: 3mg/kg q24h	GFR 10-30ml/min: 3.5mg/kg q48h	GFR <10ml/min: 2mg/kg q48h	Monitor levels daily CAPD/HD: Dose as per <10ml/min. Give dose post HD

RENAL IMPAIRMENT: ANTIMICROBIAL DOSING FOR ADULTS (cont'd)

NB: For intermittent haemodialysis (HD), dose should be given post-dialysis
For Continuous haemodiafiltration seek specialist advice

Antimicrobial	Mild renal impairment (GFR 20-50ml/min)	Moderate renal impairment (GFR 10-20ml/min)	Severe renal impairment (GFR <10ml/min)	Comments
Isoniazid	Dose as in normal renal function	Dose as in normal renal function	200-300mg daily	CAPD/HD: Dose as per GFR <10ml/min
Itraconazole	Dose as in normal renal function	Dose as in normal renal function	Dose as in normal renal function	CAPD/HD: Dose as in normal renal function
Linezolid	Dose as in normal renal function	Dose as in normal renal function	Dose as in normal renal function, but monitor closely. If platelets drop, consider dose reduction to 600mg q24h.	CAPD/HD: Dose as in normal renal function
Meropenem	Unit dose q12h (Unit dose may be 1-2g depending on severity of infection)	50% of unit dose q12h (Unit dose may be 1-2g depending on severity of infection)	50% of unit dose q24h (Unit dose may be 1-2g depending on severity of infection)	Higher doses may be used in cystic fibrosis patients. CAPD/HD: Dose as GFR <10ml/min
Metronidazole	Dose as in normal renal function	Dose as in normal renal function	Dose as in normal renal function	CAPD/HD: Dose as in normal renal function

RENAL IMPAIRMENT: ANTIMICROBIAL DOSING FOR ADULTS (cont'd)

NB: For intermittent haemodialysis (HD), dose should be given post-dialysis
For Continuous haemodiafiltration seek specialist advice

Antimicrobial	Mild renal impairment (GFR 20-50ml/min)	Moderate renal impairment (GFR 10-20ml/min)	Severe renal impairment (GFR <10ml/min)	Comments
Moxifloxacin	Dose as in normal renal function	Dose as in normal renal function	Dose as in normal renal function	CAPD/HD: Dose as in normal renal function
Nitrofurantoin	Contraindicated	Contraindicated	Contraindicated	Contraindicated in SPC Renal Drug Handbook suggests it can be used at CrCl >20ml/min at normal dose but monitor for adverse effects e.g. blood dyscrasias and neuropathy.
Ofloxacin	200-400mg q24h	200-400mg q24h	200mg q24h	CAPD/HD: Dose as in GFR <10 ml/min
Penicillin V	Dose as in normal renal function	Dose as in normal renal function	Dose as in normal renal function	CAPD/HD: Dose as in normal renal function
Piperacillin /tazobactam	Dose as in normal renal function	4.5g q8-12h	4.5g q12h	CAPD/HD: 4.5g q12h
Pyrazinamide	Dose as in normal renal function	Dose as in normal renal function	50-100% of normal dose	CAPD/HD: Dose as in normal renal function
Rifampicin	Dose as in normal renal function	Dose as in normal renal function	50-100% of normal dose	CAPD/HD: dose as per GFR <10ml/min

RENAL IMPAIRMENT: ANTIMICROBIAL DOSING FOR ADULTS (cont'd)

NB: For intermittent haemodialysis (HD), dose should be given post-dialysis
For Continuous haemodiafiltration seek specialist advice

Antimicrobial	Mild renal impairment (GFR 20-50ml/min)	Moderate renal impairment (GFR 10-20ml/min)	Severe renal impairment (GFR <10ml/min)	Comments
Teicoplanin	Dose as in normal renal function	Dose as per normal renal function for 3 days, then usual dose q24-48h from day 4	Dose as per normal renal function for 3 days, then usual dose q48-72h from day 4	CAPD/HD: Dose as GFR <10ml/min
Tobramycin (Monitor serum levels See p52)	Give 1-2mg/kg then dose according to serum levels	Give 1mg/kg then dose according to serum levels	Give 1mg/kg then dose according to serum levels	CAPD/HD: as per GFR <10ml/min. Monitor levels daily and adjust dose accordingly
Trimethoprim	Dose as in normal renal function	Dose as in normal renal function NB: for treating UTIs use alternative	Dose as in normal renal function NB: for treating UTIs use alternative	CAPD/HD: Dose as in normal renal function NB: for treating UTIs use alternative as trimethoprim may be ineffective.
Valaciclovir	GFR 30-50ml/min: Dose as in normal renal function	GFR 15-30ml/min: Herpes simplex: dose as in normal renal function Herpes zoster: 1g q12h	GFR <15ml/min: Herpes simplex: 500mg q24h Herpes zoster: 1g q24h	CAPD/HD: Dose as in GFR <15ml/min
Vancomycin iv (Monitor serum levels and dose according to levels. Aim for pre-dose level 10-20mg/L). See p54-55	15mg/kg q24h	15mg/kg then re-dose once level is <20mg/L	15mg/kg then re-dose once level is <20mg/L Or consider alternative e.g. teicoplanin	CAPD/HD: as per GFR <10ml/min

RENAL IMPAIRMENT: ANTIMICROBIAL DOSING FOR ADULTS (cont'd)

NB: For haemodialysis, dose should be given post-dialysis
For Continuous haemodiafiltration seek specialist advice

Antimicrobial	Mild renal impairment (GFR 20-50ml/min)	Moderate renal impairment (GFR 10-20ml/min)	Severe renal impairment (GFR <10ml/min)	Comments
Voriconazole	<p>Dose as in normal renal function</p> <p>NB: Only use IV if patient unable to tolerate oral, as IV vehicle accumulates in renal failure and can enhance nephrotoxicity</p>	<p>Dose as in normal renal function</p> <p>NB: Only use IV if patient unable to tolerate oral, as IV vehicle accumulates in renal failure and can enhance nephrotoxicity</p>	<p>Dose as in normal renal function.</p> <p>NB: Only use IV if patient unable to tolerate oral, as IV vehicle accumulates in renal failure and can enhance nephrotoxicity</p>	<p>CAPD/HD: Dose as in normal renal function</p> <p>NB: Only use IV if patient unable to tolerate oral, as IV vehicle accumulates in renal failure and can enhance nephrotoxicity</p>

References:

- Summary of Product Characteristics of individual antimicrobials
- British National Formulary 55, March 2008
- Renal Drug Handbook 3rd Edition 2009 (edited by Caroline Ashley and Aileen Currie)
- The Sanford Guide to Antimicrobial Therapy 38th Edition

APPENDIX 7: ADULT INTRAVENOUS ANTIMICROBIAL ADMINISTRATION GUIDELINES

Generic name (<i>Proprietary name</i>)	Reconstitution	Compatible with	Administration details	Comments
Aciclovir 250mg and 500mg vials	Mayne Pharma brand does not need reconstitution. Zovirax® brand: Add 10ml of sterile water for injection (WFI) or normal saline (NS) to reconstitute each 250mg vial to give 25mg/ml solution. Shake well to ensure complete dissolution. Use reconstituted vial immediately.	Sodium chloride 0.9% (Normal saline-NS)	Intermittent IV infusion over at least 1 hour. Doses of 250 and 500mg should be diluted with 100ml of NS. Doses of 500-1000mg should be diluted with 250ml of NS. Infusion concentrations should not exceed 5mg/ml	Reconstituted solution should not be refrigerated as precipitate will form. Maintain adequate hydration of the patient. To avoid excessive dosage in obese patients, doses should be calculated using ideal body weight for height.
Amikacin 100mg and 500mg vials	Already in solution	NS & Glucose 5% (G5)	IV injection -give slowly over 2-3 minutes. (Bolus not recommended for once daily dosing). IV infusion -dilute to 2.5mg/ml with compatible infusion fluid and infuse over 30 minutes. Diluted solutions should be used immediately.	Monitor plasma concentrations and renal function. Ensure patient is well hydrated.

(NS = Sodium chloride 0.9% / normal saline; G5 = glucose 5%, WFI = water for injection)

ADULT INTRAVENOUS ANTIMICROBIAL ADMINISTRATION GUIDELINES (cont'd)

Generic name (<i>Proprietary name</i>)	Reconstitution	Compatible with	Administration details	Comments
Amoxicillin 500mg vial (<i>Amoxil</i> [®])	Add 10ml of WFI to 500mg vial. Reconstituted vials should be used immediately.	NS (preferred infusion fluid), G5 & Hartmann's	IV injection -give slowly over 3-4 minutes Intermittent IV Infusion -dilute to desired volume (e.g. 50-100ml) with compatible infusion fluid and give over 30-60 minutes.	Rapid IV administration may result in seizures. A transient pink colour or opalescence may appear on reconstitution.
Amphotericin Liposomal (<i>AmBisome</i> [®]) 50mg vials	Add 12ml of WFI provided to each 50mg vial to give a 4mg per ml solution. Shake vigorously for at least 30 seconds immediately after the addition of water and ensure complete dispersion. Reconstituted solution is stable for 24 hours if refrigerated. Calculate the amount of liposomal Amphotericin required for further dilution. Withdraw the calculated volume of reconstituted solution into a sterile syringe. Using the 5-micron filter provided, add the required dose to infusion fluid.	G5 only Recommended final concentration of 0.20-2mg/ml. IV line must be flushed with Glucose 5% before and after infusion. If this is not possible Amphotericin should be administered through a separate line.	IV infusion only. Administer dose over 30-60 minutes and over 2 hours for doses greater than 5mg/kg/day Prior to the administration of the first dose, a test dose of 1mg should be administered slowly for up to for up to 10 minutes and the patient carefully observed for 30 minutes after. If tolerated, the rest of the prescribed dose can be administered.	Incompatible with saline, saline solutions or other drugs so avoid solution with Amphotericin as they may result in precipitation. Do not use reconstituted solution if there is any sign of precipitation.

(NS = Sodium chloride 0.9% / normal saline; G5 = glucose 5%, WFI = water for injection)

ADULT INTRAVENOUS ANTIMICROBIAL ADMINISTRATION GUIDELINES (cont'd)

Generic name (<i>Proprietary name</i>)	Reconstitution	Compatible with	Administration details	Comments
Anidulafungin 100mg vial (<i>Ecalta</i> ®)	Reconstitute each vial with 30ml WFI and allow to stand for up to five minutes	NS & G5	IV infusion - add 100mg (30ml) to 100ml infusion fluid and 200mg (60ml) to 200ml to give a concentration of 0.77mg/ml. Administer at a maximum rate of 1.4ml/min (i.e. 100mg over at least 90 minutes and 200mg over at least 180 minutes).	Discard the solution if any particular matter or discoloration are present.
Benzylpenicillin 600mg vials (<i>Crystapen</i> ®) 1 mega unit = 600mg	Add 4-10ml WFI or NS to each vial and use immediately	NS & G5	IV injection -give slowly at a rate not greater than 300mg/minute Intermittent IV infusion -dilute each 600mg vial with 10ml WFI or NS then further dilute with 100ml infusion fluid. and administer over 30-60 minutes	For high doses, give slowly to avoid electrolyte imbalance (2.8mmol of sodium per 1g Benzylpenicillin sodium salt).
Caspofungin 50 & 70mg vials (<i>Cancidas</i> ®)	Allow vial to reach room temperature. Add 10.5ml WFI and mix gently to dissolve. Then withdraw 10ml to provide the full 50mg or 70mg dose. For a dose of 35mg, withdraw 5ml from the 70mg vial, or 7ml from the 50mg vial.	NS & Hartman's	IV infusion only -dilute the required dose in 250ml of compatible infusion fluid and give over 60 minutes. Doses of 50mg or less may be diluted in 100ml if required in fluid restricted patients.	Incompatible with glucose solutions. Do not use hazy, precipitated or discoloured solutions.
Cefotaxime 500mg, 1g, 2g vials (<i>Claforan</i> ®)	Add 2ml WFI to 500mg vial. Add 4ml WFI to 1g vial. Add 10ml WFI to 2g vial. Shake well to dissolve and use immediately.	NS or G5	IV injection -give slowly over 3-5 minutes IV infusion -1-2g diluted in 100ml of compatible infusion fluid and administered over 30-60 minutes	

(NS = Sodium chloride 0.9% / normal saline; G5 = glucose 5%, WFI = water for injection)

ADULT INTRAVENOUS ANTIMICROBIAL ADMINISTRATION GUIDELINES (cont'd)

Generic name (<i>Proprietary name</i>)	Reconstitution	Compatible with	Administration details	Comments
Ceftazidime 500mg, 1g and 2g vials (<i>Fortum</i> ®)	Add 5ml WFI to 500mg vial. Add 10ml WFI to 1g and 2g vials.	NS & G5	IV injection -give slowly over 3-5 minutes. IV infusion - After reconstitution, dissolve contents then insert a second needle to relieve internal pressure in the vial. Dilute further in a compatible infusion fluid of 50-100ml. Mix well and give over 30 minutes.	
Ceftriaxone 1g and 2g vials (<i>Rocephin</i> ®)	Add 10ml WFI to each vial.	NS & G5	IV injection -give 1g slowly over 2-4 minutes. IV infusion - Add 2g to 50ml of infusion fluid and give over at least 30 minutes.	Ceftriaxone must not be mixed or administered simultaneously with calcium containing solutions (e.g. Hartmann's) or products, even via different infusion lines. Calcium-containing solutions or products must not be administered within 48 hours of the last administration of Ceftriaxone. Do not give with total parenteral nutrition.
Cefuroxime 750mg, 1.5g vials (<i>Zinacef</i> ®)	Add 7ml WFI to 750mg and 15ml WFI to 1.5g vials	NS, G5 & Hartmann's	IV injection -give slowly over 3-5 minutes. IV infusion - dilute reconstituted solution in 50-100ml of compatible infusion fluid and administer over 30 minutes.	

(NS = Sodium chloride 0.9% / normal saline; G5 = glucose 5%, WFI = water for injection)

ADULT INTRAVENOUS ANTIMICROBIAL ADMINISTRATION GUIDELINES (cont'd)

Generic name (<i>Proprietary name</i>)	Reconstitution	Compatible with	Administration details	Comments
Chloramphenicol 1g vial (Kemicetine Succinate®)	Add 9.2ml of WFI or sodium chloride 0.9% to each vial to give 100mg per ml solution (NB: reconstitution of other brands may differ; check package insert or contact pharmacy for more information)	NS & G5	IV injection (preferred) – give reconstituted solution directly into vein over at least 1 minute. IV infusion – administer over 30 minutes in suitable volume of compatible infusion fluid (concentration not exceeding 20mg/ml).	Unlicensed medicine in Ireland. IV injection preferred to infusion in order to attain high levels. Do not use cloudy solutions.
Ciprofloxacin 200mg in 100ml 400mg in 200ml (Ciproxin® & Hospira)	Already in solution	N/A	IV infusion – Administer 200mg over 30-60 minutes and 400mg over 60 minutes	Keep in original container to protect from light until required for use. Each 100ml of solution contains 15.4mmol of sodium. Patient should be well hydrated to prevent crystalluria.
Clarithromycin 500mg vial (Klacid®)	Add 10ml WFI	NS & G5	IV infusion – Add reconstituted solution to 250ml of compatible infusion fluid and administer over 60 minutes into large proximal vein.	Not to be administered as a bolus. Monitor injection site for inflammation or phlebitis. Do not administer to patients receiving cisapride, pimozone, terfenadine or ergotamine.

(NS = Sodium chloride 0.9% / normal saline; G5 = glucose 5%, WFI = water for injection)

ADULT INTRAVENOUS ANTIMICROBIAL ADMINISTRATION GUIDELINES (cont'd)

Generic name (<i>Proprietary name</i>)	Reconstitution	Compatible with	Administration details	Comments
Clindamycin 300mg in 2ml amp or 600mg in 4ml amp (<i>Dalacin C[®]</i>)	Already in solution, must be further diluted before administration	NS & G5	IV infusion - doses up to 900mg may be given in 50-100ml and doses of 900mg or more in 100ml of infusion fluid . Give over 10-60 minute at rate not exceeding 30mg/min.	Concentration should not exceed 18mg/ml. Not more than 1200mg of clindamycin should be given in a one hour period.
Co-amoxiclav 600mg & 1.2g vials (<i>Augmentin[®]</i>) Amoxicillin/clavulanic acid	Add 10ml WFI to 600mg vials and 20ml WFI to 1.2g vials	NS & Hartmann's	IV injection -give slowly over 3-4 minutes. IV infusion -dilute 600mg in 50ml and 1.2g in 100ml of compatible infusion fluid and administer over 30-40 minutes.	Vials must be used within 20 minutes of reconstitution.
Colomycin 0.5 and 1 million unit vials	Add 10ml of NS or WFI	NS or WFI	Intermittent IV infusion – dilute to 50ml with compatible fluid and infuse over 30 minutes	
Co-trimoxazole 480mg/5ml amps (<i>Septrin[®]</i>) Sulphamethoxazole /trimethoprim	Already in solution	G5 (preferable) NS (not for the more concentrated dilution)	Intermittent IV Infusion - dilute in compatible infusion fluid as follows: 5ml (480mg) in 125ml, 10ml (960mg) in 250ml, 15ml (1440mg) in 500ml, 20ml (1920mg) in 500-1000ml, 25ml (2400mg) in 500-1000ml. Shake well to ensure thorough mixing. Dilute immediately before use and administer over 60 to 90 minutes.	For fluid restricted patients: each 5ml amp may be diluted with 75ml with G5 and administered over a maximum of 60 minutes. Other diluents should not be used. Monitor the infusion carefully and discard if it becomes cloudy or if crystals form.

(NS = Sodium chloride 0.9% / normal saline; G5 = glucose 5%, WFI = water for injection)

ADULT INTRAVENOUS ANTIMICROBIAL ADMINISTRATION GUIDELINES (cont'd)

Generic name (<i>Proprietary name</i>)	Reconstitution	Compatible with	Administration details	Comments
Daptomycin 350 & 500mg vials (<i>Cubicin</i> [®])	Add 7ml NS to 350mg vial and 10ml NS to 500mg vial. Gently rotate vial without shaking. Allow to stand for at least 10 minutes then rotate gently to dissolve.	NS	Intermittent IV infusion- dilute required dose in 50ml of NS and administer over 30 minutes. IV injection: give slowly over 2 minutes	Can interfere with assay for prothrombin time and INR - take blood sample immediately before dose. Monitor creatine phosphokinase before and regularly during treatment (at least once weekly).
Erythromycin 1g vials (<i>Erythrocin</i> [®])	Add 20ml of WFI to each 1g vial	NS	Intermittent IV infusion- dilute with 250ml of NS and infuse over at least 1 hour. Concentration should not exceed 5mg/ml.	Causes thrombophlebitis unless well diluted Must be given as an infusion over a minimum of one hour as rapid infusion is associated with arrhythmias and hypotension. Longer infusion periods should be used in patients with risk factors or previous evidence of arrhythmias.
Flucloxacillin 250mg, 500mg & 1g vials (e.g. <i>Floxapen</i> [®])	Add 5ml WFI to 250mg vials Add 10ml to 500mg vials and 15ml-20ml to 1g vials	NS & G5	IV injection- give slowly over 3-4 minutes Intermittent IV infusion- dilute in 100ml of compatible infusion fluid and give over 30 minutes	

(NS = Sodium chloride 0.9% / normal saline; G5 = glucose 5%, WFI = water for injection)

ADULT INTRAVENOUS ANTIMICROBIAL ADMINISTRATION GUIDELINES (cont'd)

Generic name (<i>Proprietary name</i>)	Reconstitution	Compatible with	Administration details	Comments
Fluconazole 200mg in 100ml (e.g. <i>Diflucan</i> ®)	Already in solution	N/A	Intermittent IV infusion- Each 200mg (100ml) should be infused over 10-20 minutes. Max infusion rate: 20mg per minute.	Each 100ml bag contains 15mmol sodium.
Ganciclovir 500mg vials (<i>Cymevene</i> ®)			Do not administer via rapid or bolus IV injection	Since ganciclovir is considered a potential teratogen and carcinogen in humans, caution should be exercised in its handling .Avoid inhalation or direct contact of the powder contained in the vials or direct contact of the reconstituted solution with the skin or mucous membranes.
Gentamicin 80mg/2ml (e.g. <i>Genticin</i> ®)	Already in solution	NS & G5	IV injection- give slowly over at least 3 minutes. (Bolus not recommended for once daily dosing). Intermittent IV infusion- Dilute to 100ml of compatible infusion fluid and administer over 20 to 120 minutes.	See aminoglycoside dosing and monitoring section. Once daily dose should be given by IV infusion. Monitor plasma concentrations and renal function- dose adjustments required in renal impairment Flush line before and after administration due to compatibility issues with other drugs, especially penicillin-based injectables
Linezolid 600mg/300ml infusion bag (<i>Zyvox</i> ®)	Already in solution	N/A	Intermittent IV infusion- over 30-120 minutes	Protect from light in protective overwrap until required for use. Monitor complete blood counts weekly.Approximately 100% bioavailability so should be given by mouth where possible.

(NS = Sodium chloride 0.9% / normal saline; G5 = glucose 5%, WFI = water for injection)

ADULT INTRAVENOUS ANTIMICROBIAL ADMINISTRATION GUIDELINES (cont'd)

Generic name (<i>Proprietary name</i>)	Reconstitution	Compatible with	Administration details	Comments
Meropenem 500mg & 1g vials (<i>Meropenem</i> [®])	Add 10ml WFI to 500mg vial. Add 20ml WFI to the 1g vial. Allow to stand until solution is clear	NS & G5	IV injection -give slowly over at least 5 minutes Intermittent IV infusion -dilute in 50-200ml of compatible infusion fluid and administer over 15-30 minutes	There is limited evidence to support giving a 2g dose as an IV bolus – an IV infusion is recommended for a 2g dose.
Metronidazole 500mg/100ml infusion bags (<i>Flagyl</i> [®])	Already in solution	N/A	Intermittent IV infusion -administer over 20 minutes	Infusion rate should be 5ml/min. Has very low pH so should not be given as an IV push.
Moxifloxacin 400mg in 250ml bottle (<i>Avelox</i> [®])	Already in solution	N/A	Intermittent IV infusion - administer over an hour	Avoid rapid IV injection.
Pipercillin-tazobactam (<i>Tazocin</i> [®]) 4.5g vials	Add 10ml WFI to 2.25g Add 20ml WFI to 4.5g	NS & G5	IV injection -give slowly over 3-5 minutes Intermittent IV infusion -dilute in at least 50ml of compatible infusion fluid and give over 20-30 minutes	
Rifampicin 600mg vial (+ 10ml diluent) (<i>Rifadin</i> [®])	Add the diluent provided and shake vigorously for 30 seconds	G5 (preferred) & NS	Intermittent IV infusion -dilute in 500ml of compatible infusion fluid and administer over 2-3 hours	Infusion must be completed within 6 hours. Avoid extravasation. Will colour all secretions.

(NS = Sodium chloride 0.9% / normal saline; G5 = glucose 5%, WFI = water for injection)

ADULT INTRAVENOUS ANTIMICROBIAL ADMINISTRATION GUIDELINES (cont'd)

Generic name (<i>Proprietary name</i>)	Reconstitution	Compatible with	Administration details	Comments
Teicoplanin 200mg & 400mg vials (with diluent) (<i>Targocid</i> [®])	Add the diluent provided slowly and roll the vial gently until dissolved. Do not shake. If foam forms allow to stand for 15 minutes until foam subsides. A full dose of 200mg or 400mg is obtained by withdrawing 3ml from the vial.	NS, G5 & Hartmann's	IV injection -give slowly over 3-5 minutes Intermittent IV infusion -dilute in 50-100ml of compatible infusion fluid and administer over 30 minutes.	Teicoplanin should be administered with caution to patients with known hypersensitivity to vancomycin since cross reactivity may occur
Tigecycline 50mg vials (<i>Tygar</i> [®])	Add 5.3ml of infusion fluid (NS or G5) to vial and swirl gently to dissolve. Withdraw 5ml (50mg) from the vial; further dilution required before administration.. For immediate use.	NS & G5	Intermittent IV infusion -dilute required dose in 100ml of infusion fluid and administer over 30-60 minutes	If infusion line is being used for other active substances it must be flushed with NS or G5 before and after infusion. The reconstituted solution should be yellow to orange in colour; if not, the solution should be discarded.
Tobramycin 80mg/2ml	Already in solution	NS & G5	IV injection -give slowly over at least 3 minutes. (Bolus not recommended for once daily dosing). Intermittent IV infusion -Dilute in 50-100ml of compatible infusion fluid and administer over 20 to 60 minutes	See aminoglycoside dosing and monitoring section. Once daily dose should be given by IV infusion. Monitor plasma concentrations and renal function-dose adjustments required in renal impairment.

(NS = Sodium chloride 0.9% / normal saline; G5 = glucose 5%, WFI = water for injection)

ADULT INTRAVENOUS ANTIMICROBIAL ADMINISTRATION GUIDELINES (cont'd)

Generic name (<i>Proprietary name</i>)	Reconstitution	Compatible with	Administration details	Comments
Vancomycin 500mg & 1g vials	Add 10ml WFI to 500mg vial Add 20ml WFI to 1g vial	NS & G5	Intermittent IV infusion- dilute each 500mg in at least 100ml of compatible infusion fluid and administer at a rate not faster than 10mg/min	See Vancomycin monitoring appendix for dosing and administration advice. Administer at rate not faster than 10mg/min to avoid rapid infusion-related reactions including 'red-man' syndrome. Avoid extravasation as may cause tissue necrosis..
Voriconazole 200mg vials (<i>Vfend</i> [®])	Add 19ml WFI to each vial to produce a solution of 10mg/ml solution. Further dilution is required before administration.	NS, G5 & Hartmann's	Intermittent IV infusion- dilute dose in a compatible infusion fluid to a concentration between 0.5-5mg/ml. Administer at a rate not exceeding 3mg/kg/hour.	Discard vial if vacuum does not pull diluent into the vial. In patients with renal impairment, the IV vehicle may accumulate and enhance nephrotoxicity. The oral route is preferred in these patients.

(NS = Sodium chloride 0.9% / normal saline; G5 = glucose 5%, WFI = water for injection)

References

1. Summary of Product Characteristics (SPCs) for individual agents: www.medicines.ie and www.medicines.org.uk
 2. British Medical Association: British National Formulary 60 :The Pharmaceutical Press September 2010.
 3. Trissel LA. Handbook on injectable drugs. 15th ed. Bethesda: American Society of Hospital Pharmacists, 2009
- UCL Hospitals Injectable Medicines Administration Guide. 2nd ed. Pharmacy Department, University College London Hospitals 2007

ANTIMICROBIAL PRESCRIBING TIPS

Audits on antimicrobial use have highlighted the following points:

LRTIs:

- Piperacillin-tazobactam should not be used for the empiric treatment of community acquired pneumonia (its spectrum of cover is too broad for community acquired pneumonia).
- Ciprofloxacin should not be used to treat community acquired lower respiratory tract infections (LRTIs), and should not be used as a sole agent for empiric treatment of hospital acquired LRTIs as it has poor activity against *S. pneumoniae*.

UTIs:

- Ciprofloxacin and trimethoprim should not be used for empiric treatment of urinary tract infections due to concerns regarding resistance.

Warfarin drug interactions:

- INR must be closely monitored and warfarin doses adjusted for patients on warfarin and antimicrobials, particularly macrolides (clarithromycin, erythromycin).

Monitoring levels:

- Gentamicin, vancomycin, tobramycin, streptomycin and amikacin levels must be monitored appropriately and where possible, doses should not be held unnecessarily, as this will lead to a reduced treatment response and promote antibiotic resistance.

Vancomycin IV:

- to ensure adequate serum concentrations are achieved, a loading dose is recommended in all patients, followed by 15mg/kg q12h iv. See Appendix 3, p54-55 for more information on dosing and monitoring vancomycin.

Teicoplanin:

- should be dosed according to patient weight. A standard dose is 6mg/kg (round up to the nearest 200mg): i.e. patients <80kg: use 400mg q24h. Patients >80kg: use 600mg q24h. In certain infections, the dose will need to be increased to 10-12mg/kg q24h. Seek advice. Don't forget the loading dose (q12h for first 3 doses, then q24h thereafter).

IV to PO switch:

- Use oral treatment where possible for the following antimicrobials: ciprofloxacin, metronidazole, clarithromycin, moxifloxacin, linezolid, fluconazole, rifampicin, clindamycin.

Reviewing treatment:

- Always document indication for antimicrobial and proposed duration of treatment.
- Always review cultures daily, and use the results try to streamline to a narrow spectrum agent where appropriate. Seek advice if unsure
- Review need for antimicrobial therapy **DAILY**. Prolonged therapy can lead to resistance and serious adverse effects, e.g. *C. difficile*.
- Respect the restricted antimicrobial policy: it is there to ensure that we preserve the usefulness of the limited antimicrobials that we have available.

If in doubt, always seek advice!

Penicillin Allergy

All drug allergies must be specified on medication charts (with the patient's reaction). In TRUE penicillin allergy* ALL penicillins, cephalosporins and other beta lactam antibiotics should be avoided.

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

In cases of **INTOLERANCE** to penicillin (e.g. gastrointestinal upset) or 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.

If in doubt, seek advice from Microbiology (ext. 22504) or Pharmacy (ext. 22146)

CONTRA-INDICATED

Antibiotics to be avoided in penicillin allergy:

Amoxicillin, Ampicillin, Flucloxacillin, Benzylpenicillin
Co-amoxiclav (e.g. Augmentin® / Pinaclav®)
Phenoxyethylpenicillin (Calvapan®)
Piperacillin-tazobactam (Tazocin®)
Extencilline®
Temocillin (Negaban®), Ticarcillin (Timentin®)

CAUTION

Avoid if serious penicillin allergy (e.g. anaphylaxis/ angioedema)

Use with caution if non-severe allergy (e.g. minor rash only)

Antibiotics to be avoided or used with caution in penicillin allergy:

Cephalosporins:

Cefaclor, Cefadroxil, Cefalexin (Keflex®), Cefamandole, Cefixime (Suprax®), Cefotaxime (Claforan®), Cefpodoxime, Cefradine (Velosef®), Cefprozil (Fortum®), Ceftriaxone (Rocephin®), Cefuroxime (Zinacef®)

Other beta lactam antibiotics:

Aztreonam, Imipenem (Primaxin®), Meropenem, Ertapenem, Doripenem

CONSIDERED SAFE

Antibiotics safe in penicillin allergy:

(not a complete list)

Amikacin	Metronidazole	Ciprofloxacin
Moxifloxacin	Clarithromycin	Nitrofurantoin
Clindamycin	Rifampicin	Colistin
Sodium fusidate	Doxycycline	Teicoplanin
Erythromycin	Tobramycin	Gentamicin
Trimethoprim	Linezolid	Vancomycin