ANTIBIOTIC GUIDELINES FOR ADULTS IN SHROPSHIRE HOSPITALS

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

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

Contents

1. GUIDELINES

These should be used as the definitive antibiotic guidance that supplements other clinical guidelines on the intranet. If in doubt about antibiotic therapy, please discuss with Consultant Microbiologist ext. 1161 (RSH). Contact via switchboard out of hours. **Empirical guidelines** (section1) apply when the organism and its susceptibility is not known. **Definitive preferences** for when the organism and its susceptibility is known are given separately in section 2.
These guidelines are intended for adults only. Different antibiotics may be needed for children.

- **General Principles**

The general principles of antibiotic prescribing are summarised in figure 1
1. Antibiotics must be reviewed when microbiology results are available. Always review antibiotic use when results and/or clinical picture confirm, narrow or preclude a diagnosis of infection.
2. Always write the diagnosis of what infection is being treated in the notes and on the drug card. Avoid non-specific terms such as chest infection or sepsis.
3. Intravenous therapy must be reviewed by 48-72 hours & consider change to oral agents. Stop antibiotics altogether if there is no clear evidence of infection - to reduce the risk of C.difficile. the outcome of the decision should be documented in the notes.
4. Oral follow on is not always necessary. Oral follow on after iv antibiotics should be dictated by microbiology results. Intravenous to oral switch after 48 hours is desirable if the intravenous line is removed to reduce the risk of line-associated infection and there is no broadening of the antibiotic spectrum used. There is no virtue in continuing antibiotics if they are not needed..
5. Use higher doses in patients weighing >70Kg , particularly if using flucloxacillin or other penicillins.
6. All doses quoted are for adults with normal renal function and weight.
7. Gentamicin and tobramycin dosing must be precise and is worked out on a basis of 7mg/Kg once daily. If a lower dose is given, and interpretations for 7mg/Kg applied, ototoxicity and nephrotoxicity may result because drug clearance will falsely be assumed to be normal. DO NOT USE 5mg/Kg. **Increase dose intervals for Gentamicin and Vancomycin in renal impairment.** Renal function must be checked within 24 hours of starting vancomycin or gentamicin and dose changed if abnormal. **Avoid use of vancomycin with gentamicin because of synergic nephrotoxicity.** Consultant microbiologists can advise on alternatives.
8. Metronidazole is unnecessary and undesirable with Co-amoxiclav, Piperacillin/tazobactam, Clindamycin, Meropenem or, Ertapenem as these all cover anaerobes.
9. Topical Mupirocin should be used only in accordance with the MRSA integrated care pathway.
10. Tetracyclines and quinolones. Avoid giving milk/antacids/iron which stop their absorption. Doxycycline is deliberately advised at 100mg bd because this regimen has proved effective in MRSA clearance and treatment, loading doses are often accidentally omitted and because it is a non-toxic dose in chlamydia infection and patients without established renal impairment. Intravenous doxycycline is a specially imported unlicensed preparation: use oral doxycycline whenever possible. Avoid tetracyclines (including doxycycline) during breast-feeding, or under the age of 12 years.
11. In pregnancy avoid tetracyclines (e.g. doxycycline), quinolones (e.g. ciprofloxacin), aminoglycosides, mupirocin and high dose metronidazole. Avoid trimethoprim in the first trimester and nitrofurantoin at term.

- **Duration of treatment**

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

- **Allergy**

Establish and record details of drug allergies prior to prescribing antimicrobial treatment. Some patients report they are allergic to agents but further questioning can reveal that they do not have a true allergy. Diarrhoea and nausea are features of intolerance not true allergy. Pharmacists can help with queries and assist in obtaining information from the GP. Allergy information is also recorded on SEMA, in clinical portal and e-script. On the wards, allergy alerts are visible on PSAG boards:

Hovering over the Medical alert symbol will highlight registered allergies

Any life threatening allergies or drug reactions should be emailed to sath.allergyalerts@nhs.net for registering on SEMA

Patients with a history of anaphylaxis, laryngeal oedema, bronchospasm, hypotension, local swelling, urticaria or pruritic rash, occurring immediately after a penicillin are potentially at increased risk of immediate hypersensitivity to beta-lactams and should not be prescribed a beta-lactam antibiotic (e.g. penicillin, flucloxacillin, cephalosporins, carbapenems). Remember co-amoxiclav (augmentin) and piperacillin/tazobactam contain a penicillin. Patients with non-severe reaction to penicillin may receive cephalosporins or carbapenems. However, a percentage of patients with severe penicillin allergy (variously estimated as 2-10%) are allergic to cephalosporins and meropenem or ertapenem.
For further information see appendix 1.

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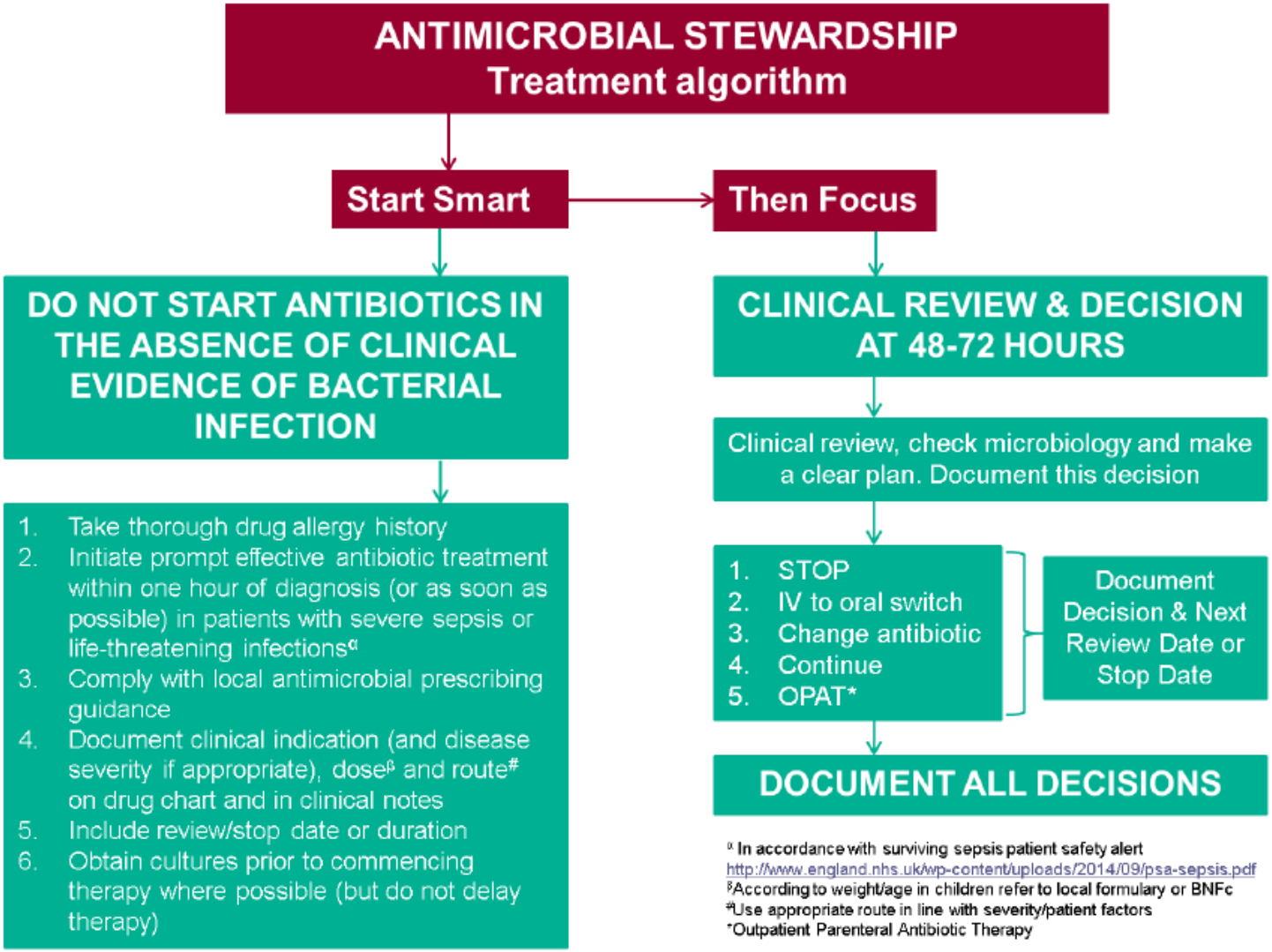
Figure 1: Antimicrobial Stewardship (AMS) – Treatment algorithm



Oral Follow-on

IV antibiotics should only be initiated

- In patients with severe symptoms
- Where the oral route of administration is contraindicated or compromised
- Where no suitable oral alternatives are available

The following agents have excellent bioavailability and should be given orally unless contraindicated (e.g. severe vomiting, nil by mouth, impaired GIT absorption)

- Clindamycin
- Ciprofloxacin
- Chloramphenicol
- Doxycycline
- Fluconazole
- Linezolid
- Metronidazole
- Rifampicin
- Sodium fusidate

Stopping IV therapy

IV antibiotics MUST be reviewed daily. Consider stopping when:

- Clinical improvement
  - E.g. apyrexial >24h, no unexplained tachycardia, improving wcc and crp
- Able to take medication by mouth/NG/PEG
  - Considerations: e.g. vomiting, NBM, unconscious, malabsorption
- No specific indications for long-term IV antibiotics
  - Endocarditis or intravascular infection
  - Meningitis / encephalitis / brain abscess
  - Osteomyelitis/ septic arthritis/ bone or joint infection
  - Infected implants/prostheses/graft tissue
  - Complex skin and soft tissue infection, deep abscesses (not drained)
  - Bronchiectasis, cystic fibrosis, empyema
  - Bacteraemia due to organisms requiring long-term IV therapy, e.g. S. aureus, (MSSA or MRSA), Candida spp
  - Immunocompromised patients (e.g. HIV, neutropenia, immunosuppressants or cytotoxics)
  - Patients receiving IV therapy on specific Microbiology advice

IV to Orals

Review any positive cultures
Oral follow on is not always necessary. Sometimes iv therapy should just be stopped with no subsequent oral antibiotics

IV ANTIMICROBIAL	ORAL ANTIMICROBIAL
Amoxicillin 500mg - 1g TDS	Amoxicillin 500mg - 1g TDS
Benzylpenicillin 1.2 - 2.4g QDS	Amoxicillin 500mg - 1g TDS
Ciprofloxacin 400mg BD	Ciprofloxacin 500mg BD *Ciprofloxacin 750mg BD for Pseudomonal infections or deep seated infection or large patients*
Clarithromycin 500mg BD	Clarithromycin 500mg BD
Clindamycin 600mg-1.2g QDS	Clindamycin 300 - 450mg QDS (or 600mg TDS) *In severe infections 600mg QDS may be used (unlicensed dose)*
Flucloxacillin 1g - 2g QDS	Flucloxacillin 500mg - 1g QDS
Metronidazole 500mg TDS	Metronidazole 400mg TDS
Vancomycin IV 1g BD	Consider if sensitive: Doxycycline 200mg bd Clindamycin 300 - 450mg QDS (or 600mg TDS)

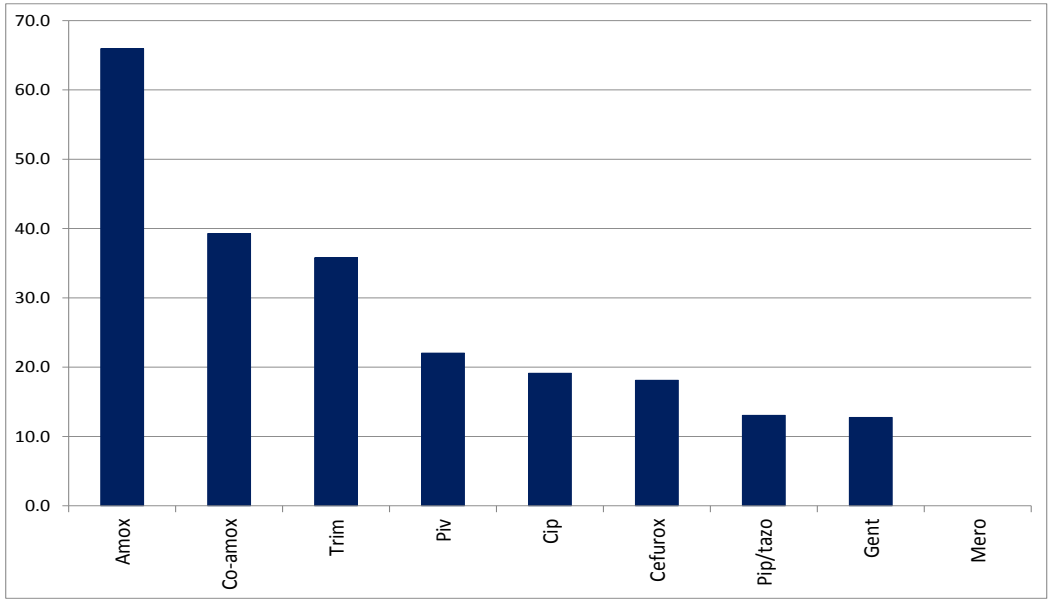
CONDITION	**ORAL ANTIMICROBIAL**
Abdominal/biliary infections	Often no oral follow on required
Gram-negative infection UTI	• Amoxicillin • Trimethoprim. • Nitrofurantoin (urines only) • Pivmecillinam +/- Co-amoxiclav • Cephalexin • Ciprofloxacin
Respiratory tract infection	Amoxicillin, doxycycline

Antibiotic Resistance Rates in Shropshire

Antibiotic Resistance Rates (%) of Common Organisms Jun19-May20

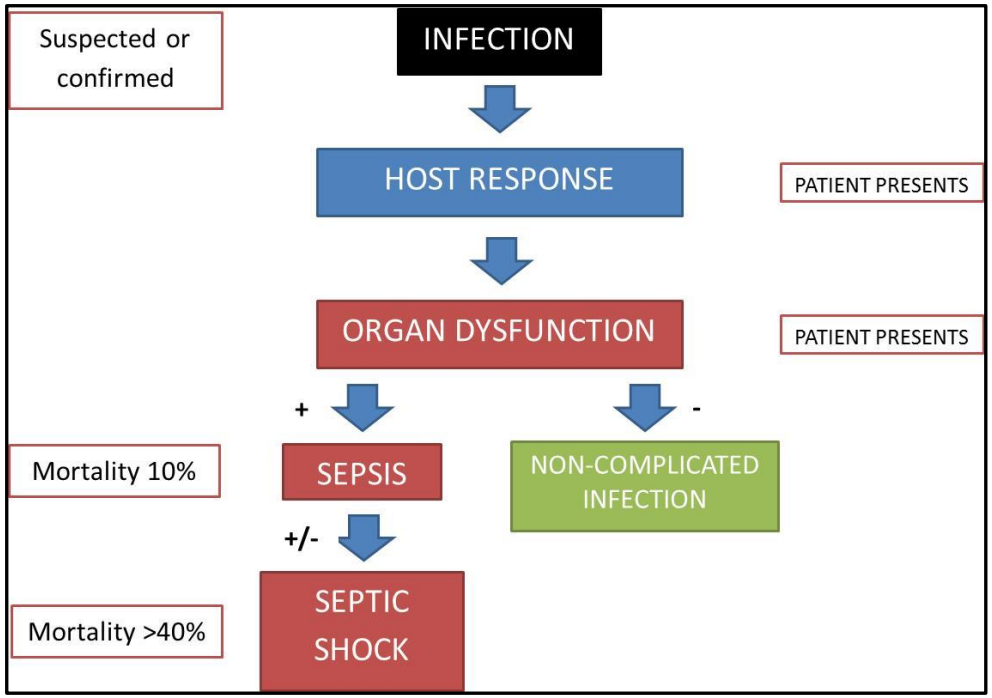
	Streptococcus pneumoniae	Haemophilus influenzae	Group A Streptococcus	S. aureus (excludes screens)
Amoxicillin	-	23.1	-	-
Co-amoxiclav	-	7.1	-	-
Penicillin		-	0.0	-
Doxycycline	19.5	1.4	14.6	10.2
Erythromycin	14.8	-	6.7	17.9
Flucloxacillin	-	-	0.0	4.7

Resistance Rates of Gram Negative Organisms in Blood Cultures Jun19-May20



Sepsis

Definition: life threatening organ dysfunction due to a dysregulated host response to infection



High risk/Red flag criteria

- Altered mental state (GCS ≤ 13 or VPU or delirium)
- Respiratory rate ≥ 25 breaths/ min
- New requirement for oxygen (> 40% FiO2) to maintain saturation ≥ 92% (or ≥ 88% in COPD
- Heart rate ≥ 130 beats/min
- Systolic BP≤ 90 mmHg
- Not passed urine in previous 18 hours
- Mottled or ashen appearance
- Cyanosis of skin, lips or tongue
- Non-blanching rash of skin
- Lactate > 2mmol/L

Moderate to high risk criteria (Amber)

- History from accompanying person/letter of new onset of altered behaviour or mental state
- History of acute deterioration of functional ability
- Impaired immune system (illness or drugs including oral steroids)
- Respiratory rate: 21-24 breaths/min
- Heart rate: 91-130 beats/min OR new onset arrhythmia
- Systolic BP: 91-100 mmHg
- Trauma/surgery/procedure in last 6 weeks
- Tympanic temperature < 36°C
- Signs of potential infection

2. Empirical Guidelines

Sepsis		
Follow the sepsis pathway and implement Sepsis Six **All regimes are empirical and must be reviewed by 48h with results**		
Septic shock/red flag sepsis **No obvious source** (otherwise treat primary site of infection) Sepsis criteria	**PRESCRIBERS** Flucloxacillin 1g qds iv (1.5g qds if >80Kg, 2g qds if >100kg) AND Gentamicin 7mg/kg iv od AND metronidazole 500mg iv tds **Known renal impairment/suspected AKI/age >80y** Piperacillin/tazobactam* 4.5g tds (bd if eGFR <20ml/min) AND a single dose Gentamicin 2mg/kg **Previous history MRSA** Piperacillin-tazobactam* 4.5g tds AND Vancomycin iv **Penicillin allergy or history ESBL** Meropenem 1g tds **Severe penicillin allergy** Vancomycin iv AND Aztreonam 1g tds AND metronidazole 500mg tds iv	**PATIENT GROUP DIRECTIONS*** (Senior Nurses – First Dose antibiotics) **PGD1**: **No known allergy to Penicillins, Tazobactam or Gentamicin (or related antibiotics)** Single dose 120mg Gentamicin iv followed by Piperacillin/tazobactam 4.5g iv **PGD2:Known allergy to Penicillins, Tazobactam or Gentamicin (or related antibiotics)** Ciprofloxacin 400mg iv followed by Vancomycin 1G iv ** then Metronidazole 500mg iv *In all cases • Urgently call the On-Call doctor to attend within 1 hour. • Take Microbiological samples BEFORE initiating antibiotics. **PGD2 only: If the On-call doctor has not attended within an hour call again and initiate Vancomycin 1G over 1 hour.
Sepsis, non-red flag Sepsis criteria	Benzylpenicillin 1.8g qds and Gentamicin 7mg/kg iv **Renal impairment/ age>80y** Known stable CKD: Piperacillin/tazobactam* 4.5g tds (bd if eGFR <20ml/min) AND a single dose Gentamicin 2mg/kg **Omit gentamicin in known/suspected AKI** **Severe penicillin allergy** Vancomycin iv AND Aztreonam 1g tds AND metronidazole 500mg tds iv	For use in unwell patients with unclear source, otherwise treat primary site of infection. *if piperacillin/tazobactam unavailable see appendix 4
Fever >38C in neutropenia **Associated with shock or history of ESBL or penicillin allergy**	Piperacillin/tazobactam 4.5g qds* Meropenem 1g tds **Severe penicillin allergy**: Vancomycin AND Aztreonam 2g 6-8hly AND Metronidazole 500mg tds	Add glycopeptide if history of MRSA or clinical features of line infection See also 'Policy for immediate management of febrile neutropenia in adult haematology and oncology patients'

Coronavirus (COVID-19)

Covid-19 is due to the virus SARS-CoV-2. The most common symptoms are recent onset of a new continuous cough, fever or anosmia, though other symptoms can also occur.

- All hospital in-patients should be tested for COVID-19

Adjunctive antimicrobial therapy for suspected/confirmed COVID-19 in adult patients

Principles

- If **sepsis** follow sepsis empirical therapy guidelines.
- Current data suggests that bacterial co-infection is uncommon (<10%). Do not start antibiotics unless there is evidence of pneumonia or a high clinical suspicion of bacterial infection.
- Calculate the CURB-65 score and document the score.
- Short courses are used with regular review of results/progress.
- Secondary bacterial infection of viral pneumonitis is difficult to exclude in more severe cases and empirical antibacterials are often given.
- **For patients in whom COVID-19 infection is confirmed and there are no indications of a secondary bacterial infection, empirical antibiotics should be stopped.**

Mild pneumonia:

Amoxicillin 500mg (use 1g if over 70kg) tds po

Penicillin allergy: Clarithromycin 500mg bd po

Total duration of treatment: 7 days

Severe pneumonia:

Benzylpenicillin 1.8g qds iv or amoxicillin 1g tds iv

Penicillin allergy: Clarithromycin 500mg bd or consider iv vancomycin if recent clarithromycin

Limited nursing availability: Ceftriaxone 1g daily

Additional considerations:

- Review if patient has been randomised to a clinical trial – some trial arms are antibiotic therapy.
- Influenza treatments are given during the "flu" season where indicated by national guidance

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Ear Nose and Throat		
Sore throats, simple coughs, colds are mostly viral.		
Quinsy or severe tonsillitis	Benzylpenicillin 1.2g qds if penicillin-allergic: Clarithromycin 500mg bd iv	Duration: 7-10 days Add metronidazole 500mg tds iv if not responding
Acute Sinusitis	Antibiotics are NOT normally indicated Amoxicillin 500mg tds or Doxycycline 100mg bd Systemically unwell Cefuroxime 1.5g tds iv AND Metronidazole 500mg tds iv	Do not routinely offer antibiotics as most resolve in 14 days. Consider antibiotics if several of : purulent nasal discharge, nasal blockage, severe localised pain, fever, marked deterioration in symptoms A nasal decongestant may also be required
Extracranial complications of otitis media e.g. mastoiditis, orbital cellulitis	Cefuroxime 1.5g tds iv AND Metronidazole 500mg tds iv Oral follow-on Co-amoxiclav 375mg (625mg if >100Kg) tds po If penicillin-allergic: Doxycycline 100mg bd po/iv	Contact microbiology if patient immunocompromised. Erythromycin and clarithromycin are less active against *Haemophilus influenzae* and are not recommended by the microbiologists Duration:10-14days
Intracranial complications of otitis media e.g. intracranial abscess, sinus thrombosis	Ceftriaxone 2g bd iv AND Metronidazole 500mg tds iv If severe penicillin allergy: Vancomycin AND Metronidazole 500mg tds AND Ciprofloxacin 200mg bd iv	Followed by co-amoxiclav 375 (625 mg if >100Kg) tds po as oral follow-on Discuss any need for oral follow-on with microbiologist
"Malignant" Otitis externa (necrotising osteitis)	Ceftazidime 2g tds AND stat dose gentamicin 7mg/kg* If severe penicillin allergy Ciprofloxacin 400mg bd iv/750mg bd po AND stat dose gentamicin 7mg/kg* *impaired renal function/ age>80y use 2mg/kg gentamicin	Review when Pseudomonas susceptibilities available. If susceptible, oral ciprofloxacin 500-750 mg bd prolonged course (circa 6-12 weeks).
Pyogenic infection of cervical nodes, cyst, or oesophago/tracheal related neck mass	Cefuroxime 1.5g tds iv AND Metronidazole 500mg tds iv If penicillin-allergic: Metronidazole 500mg tds iv AND Vancomycin iv AND Ciprofloxacin 200mg bd iv.	

Respiratory tract Infection		
Exacerbation COPD	**Not severe**: Doxycycline 100mg po bd 5 days **Severe:** Doxycycline 100mg bd po or iv. Amoxicillin 1g tds iv if previous Doxycycline	Not all cases are due to bacterial infection, consider antibiotics only if there is a history of more purulent sputum production. If there are clinical or radiological signs of pneumonia present, follow pneumonia advice.
Exacerbation of Bronchiectasis	Doxycycline 100mg bd po/iv If previous doxycycline: Amoxicillin 1g tds po/iv **Severe** Ceftazidime 2g iv tds +/- Tobramycin 7mg/Kg/once daily Impaired renal function or age >80y: Ceftazidime 1g iv tds 14 day course standard	*Haemophilus influenzae* common. Resistance to amoxicillin/co-amoxiclav is increasing Review with sensitivities Often associated with mucoid *Pseudomonas aeruginosa.* May require amendment according to previous results. When susceptibilities are available antibiotics may be changed to Ciprofloxacin 750mg po bd if susceptible. Frequent recurrent exacerbations may require nebulised use of inhaled Colistin or Tobramycin/Gentamicin as suppressive regimens

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Community Acquired Pneumonia

Enquire about bird contact/recent travel. Organise a chest Xray. Urinary antigen detection will only be performed if there is radiological pneumonia.

1. Always put the CURB65 score on urinary antigen requests. Score 1 each for age>65y, respiratory rate >30/min, diastolic BP <60 or systolic BP <90mmHg, urea >7mmol/l and acute confusion.
2. Send urine for pneumococcal antigen. If detected use benzyl-penicillin iv/ oral amoxicillin/doxycycline. Pneumococcal antigen is positive in 20% of CAP however a negative test does not rule out pneumococcal pneumonia. The test is unhelpful in COPD.
3. Request Legionella antigen if clinically suspected (travel history with overnight stay abroad or in the UK in last 18 days, leukaemia/lymphoma or transplant patient or known current outbreak) or if severe pneumonia (CURB65 score 2 or more at all ages or >3 aged 65 years, multilobar involvement, ITU/HDU admission).

Duration of treatment

Five days treatment is proposed for mild/moderate pneumonia, 7-10 days treatment is proposed for undefined severe pneumonia. This should be extended to 14 to 21 days where *Staph aureus* or Gram-negative enteric bacilli (such as Klebsiella or Pseudomonas) pneumonia is confirmed and 6 weeks treatment may be needed for lung abscesses.

IN AN UNWELL PATIENT WITH AN UNCERTAIN DIAGNOSIS, **gentamicin 7mg/kg (stat dose of 2mg/kg if impaired renal function) can be added until the diagnosis is clearer.**

Mild (CURB65 score less than 2)	Amoxicillin 500mg tds (If >80kg double dose) OR Doxycycline 100mg bd 5 days po or iv	Use po if possible. If previous amoxicillin treatment failure use doxycycline and vice versa
Moderate or Severe (CURB65 score ≥2 if <65y, ≥3 if >65y)	Benzylpenicillin 1.8g qds AND Clarithromycin 500mg bd iv/po.	If pneumococcal urinary antigen positive use Benzylpenicillin alone. **Stop macrolide** if no risk factors for legionella pneumonia or negative legionella urinary antigen Up to 30% may be viral even outside 'winter viral season' and may account for lack of response to antibacterials
Penicillin allergy **Severe pneumonia with severe allergy to penicillin *(breathing difficulties or collapse) and needs iv treatment***	Doxycycline 100mg bd po/iv or Cefuroxime 1.5g tds and Clarithromycin 500mg bd po/iv if previous Doxycycline Vancomycin iv AND Ciprofloxacin 500mg bd po/400mg bd iv	Doxycycline can be used for oral follow-on.

Severe pneumonia requiring HDU/ITU or outreach review	Benzylpenicillin 1.8g qds AND Clarithromycin 500mg bd iv/po. If previous benzylpenicillin and clarithromycin: Vancomycin iv AND Ciprofloxacin 500mg bd po/400mg bd iv	
Confirmed Legionella: Positive urinary antigen test:	**Low/Moderate severity**: Ciprofloxacin 750mg bd po or Azithromycin 500mg od po **Severe/Life-threatening**: Ciprofloxacin 750mg bd po or 400mg bd iv. Add a 2nd agent for the first few days - Aziththromycin 500mg od po/iv OR Rifampicin 600mg bd iv/po.	Send sputum and/or pleural fluid for legionella culture. This is essential to tracing the origin of the case. Clinicians should be alert to the potential small risk of cardiac electrophysiological abnormalities with quinolone-macrolide combinations Treat for minimum 7-10 days (5-10 days if azithromycin used), can be extended to 14 or 21 days depending on clinical judgement
Aspiration pneumonia	Amoxicillin 1g tds OR Doxycycline 100mg bd 5 days po or iv	Often is chemical pneumonitis and need for metronidazole not well established. Consider Cefuroxime 1.5g tds if recent antibiotics but be aware of increased risk of C.difficile

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Hospital Acquired Pneumonia		
Pneumonia > 5 days after admission is considered to be hospital acquired. Macrolide not normally required Duration of treatment: 5 days treatment is proposed for pneumonia. This should be extended to 14 to 21 days where *Staph aureus* or Gram-negative enteric bacilli (such as Klebsiella or Pseudomonas) pneumonia is confirmed and 6 weeks treatment may be needed for lung abscesses. **IN AN UNWELL PATIENT WITH AN UNCERTAIN DIAGNOSIS**, **gentamicin 7mg/kg (stat dose of 2mg/kg if impaired renal function) can be added until the diagnosis is clearer.**		
Mild/Moderate **Severe** (CURB65 score >2 in young patients, >3 if >65y) and not ventilator-associated	Amoxicillin 500mg tds po or iv (If>80kg double dose) OR Doxycycline 100mg bd 5 days - po or iv Amoxicillin 1g tds iv or Doxycycline 100mg bd po/iv 7-10 days If has had recent antibiotics for >5days, Piperacillin/tazobactam* 4.5g tds or Penicillin allergy Non-severe: Cefuroxime 1.5g tds Severe: Vancomycin AND Ciprofloxacin 500mg bd po/400mg bd iv	Viral infection common even in in-patients. Consider influenza if it is known to be circulating in the community. Previous influenza immunisation does not exclude influenza.
Ventilator associated pneumonia. Empirical Pseudomonas infection Ventilated patient with MRSA isolated from respiratory samples	Piperacillin/tazobactam* 4.5g tds iv or Meropenem 1g tds iv if penicillin allergic Severe allergy: Vancomycin AND Ciprofloxacin 400mg bd iv Ciprofloxacin 400mg bd iv, if ciprofloxacin-resistant consider Ceftazidime 2g tds or piperacillin/tazobactam* 4.5g tds. Add linezolid 600mg bd	Review any recent microbiology to guide choice of empirical agent. Narrow therapy when new sputum sample results available. Review therapy after 5 days and every 3 days thereafter that antibiotics are continued. Also add if suspected/confirmed penicillin resistant pneumococcus or if recent multiple courses of antibiotics

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*if piperacillin/tazobactam unavailable see appendix 4

<table>
<tr><th colspan="3">Treatment of influenza and associated respiratory tract infections in an influenza outbreak</th></tr>
<tr><td colspan="3">Infection control advice and guidance as to which samples to take are detailed in other policies available on the intranet.

<u>Clinical diagnosis of influenza</u>
Fever >38C or History of fever AND 2 or more of the following:
Cough (NOT just sore throat) or painful Tracheitis (85%), Rhinorrhea or blocked nose (60%), Limb muscle or joint pain (53%) or severe tiredness (80%), Headache (65%), Chills (70%), loss of appetite (60%), sore throat (50%). Diarrhoea and vomiting has been reported in US cases but significance is uncertain.

<u>High risk groups</u>
Pregnancy (including up to two weeks post-partum); age over 65 years; chronic cardiac, pulmonary, renal, hepatic or neurological disease; Diabetes mellitus; immunosuppression; morbid obesity (BMI ≥ 40)</td></tr>
<tr><td>Antiviral Treatment
For patients clinically suspected or confirmed influenza on testing</td><td>Adult (inc pregnant women) - Oseltamivir (Tamiflu) 75mg bd orally for 5 days for those aged >13 years old.
Renal impairment – eGFR 31-60ml/min 30mg bd for 5 days. eGFR 11-30ml/min Oseltamivir 30mg od for 5 days. eGFR ≤10 ml/min 30mg stat dose. HD – 30mg stat then 30mg after every HD session for 5 days
Severe immunosuppression – Oseltamivir 75mg bd po for 10 days. If dominant circulating strain H1N1 or poor clinical response, use Zanamivir (Relenza) by inhalation 10mg bd for 5 days. If unable to take zanamivir then give oseltamivir</td><td>Antivirals are not required in previously healthy individuals with uncomplicated influenza
If required, ideally should be administered within 12-48h of onset of symptoms but can be started later if patient requires ITU admission or has complicated influenza. Treatment after 48 hours is an off-label use of oseltamivir and clinical judgement should be used. The commonest adverse effect of oseltamivir is nausea in about 10% of patients. This can be managed with anti-emetic medication.

Previous influenza immunisation does not exclude influenza</td></tr>
<tr><td>Post exposure prophylaxis</td><td>Adult (inc pregnant women) – Oseltamivir 75mg od for 10 days
Renal impairment – eGFR 31-60ml/min 30mg od for 10 days. eGFR 11-30ml/min Oseltamivir 30mg every 48h for 10 days. eGFR ≤10 ml/min 30mg stat dose, repeated after 7 days. HD-30mg stat then 30mg after alternate sessions for 10 days
Severe immunosuppression – Oseltamivir as above. If strain in index case or dominant circulating strain has a high risk of resistance then Zanamivir 10mg od by inhalation for 10 days.</td><td>Not routinely recommended unless high risk group. Only use if can be started within 48h of last contact (36h for Zanamivir) unless specifically advised</td></tr>
</table>

Influenza not complicated by influenza-related pneumonia	Previously well adults with acute tracheo-bronchitis complicating influenza, in the absence of pneumonia, do not routinely require antibiotics. If required, the preferred choice is Amoxicillin 500mg tds po alternative is Doxycycline 100mg bd po	Antibiotics should be considered in those previously well adults who develop worsening symptoms (recrudescent fever or increasing dyspnoea). Patients at high risk of complications or secondary infection should be considered for antibiotics in the presence of lower respiratory features.
Influenza associated Pneumonia **Mild:** CURB65 score <2 for >65 and 1or less for <65 year AND no lung cavitation or abscesses AND only single lobe involved: **Moderate:** CURB65 score 2-3 if >65 years, 1-2 if <65 years **Severe:** CURB65 score > 3 if >65 years OR >2 if <65 years OR multiple lobes involved. No lung cavitation (other than emphysema) and no abscesses.	Amoxicillin 500mg tds OR Doxycycline 100mg bd 5 days po or iv (po preferable). Use doxycyline if treatment failure on amoxicillin Cefuroxime 1.5g tds iv Cefuroxime 1.5g tds iv AND linezolid 600mg bd If severe penicillin allergy: linezolid 600mg bd AND ciprofloxacin 400mg bd iv	This is unlikely to be staphylococcal pneumonia and can be adequately treated with oral antibiotics. If the patient is improving and pneumococcal antigen is positive then Benzylpenicillin 1.8g qds with amoxicillin 500mg tds follow-on OR, if penicillin- allergic doxycycline 100 mg bd or iv. If not responding to antibiotic therapy then discuss with a microbiologist.
Influenza associated Lung cavitation or abscesses:	Flucloxacillin 1.5g qds (2g qds if >100Kg) AND Clindamycin 1.2g qds AND Ciprofloxacin 400mg bd iv. If penicillin allergic or known MRSA carrier, substitute Linezolid 600mg bd for flucloxacillin. Clindamycin is included to cover the possibility of Panton-Valentine-leucocidin-producing staphylococcal pneumonia.	High likelihood of S.aureus infection. Seek confirmation by sputum Gram film and culture, early bronchoscopy or abscess aspiration if possible. Consider immunoglobulin 2g/Kg single dose if very unwell/features of TSS. In order to supply immunoglobulin the pharmacist will require a clinician request form to be signed by the consultant/SpR. Forms can be obtained from the pharmacist. Review antibiotics at 48-72 hours when culture results available.

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Urinary tract Infection		
It is essential to send a urine sample as antibiotic resistance is common. A guide to diagnosing UTI can be found on the intranet here If urine culture performed in preceding week, treatment should be based on most recent susceptibilities **NEVER use penicillin alone for the empiric treatment of severe UTI**		
Mild community acquired UTI	**Lower UTI:** Nitrofurantoin 50mg qds (or MR 100mg bd) OR Trimethoprim 200mg bd OR Pivmecillinam 400mg tds (duration: 3 days women, 7 days men) Or Fosfomycin 3g po stat **Upper UTI:** Trimethoprim 200mg bd OR Ciprofloxacin 500mg bd or Cephalexin 500mg bd (7 days)	Nitrofurantoin is not recommended in patients with renal impairment (eGFR<45ml/min) as there is increased risk of treatment failure due to inadequate urine concentration. Nitrofurantoin is ineffective in upper UTIs Review with urine results
Pregnant **Oral** **Severe or parenteral therapy required**	Cephalexin 500mg bd 7 days Or Amoxicillin 500mg tds 7 days if known to be susceptible Cefuroxime 1.5g tds iv until able to take oral drugs Severe penicillin allergy – discuss with microbiology	If penicillin-allergic and post 1st trimester can use Trimethoprim 200mg bd. Nitrofurantoin should be avoided at term (>36/40) ESBL organisms rare in this group of patients
Severe urinary infections (? septicaemia or T>38.5) **Renal impairment – GFR<40ml/min or age >80y**	Amoxicillin 1g tds iv AND Gentamicin 7mg/kg Penicillin-allergic use Gentamicin 7mg/Kg alone Stat dose of gentamicin 2mg/kg AND Piperacillin/tazobactam* 4.5g tds (bd if <20ml/min) Penicillin allergic: Ertapenem 500mg od Severe penicillin allergy: Aztreonam eGFR 10-30ml/min - 1g then 500mg tds eGFR <10ml/min – 1g then 250mg tds	Do not routinely use ciprofloxacin or cephalosporins. Modify treatment to orals when susceptibilities available. Total duration (iv+po): 7-10 days *if piperacillin/tazobactam unavailable see appendix 4
Patients with catheters	For symptomatic patients follow UTI treatment guidelines.	Therapy is **NOT** indicated for asymptomatic patients. Treatment may occasionally be advised for clearance/suppression of MRSA carriage

		Do not routinely use prophylactic antibiotic for catheter changes unless history of catheter change associated UTI or trauma.
Known History ESBL/AmpC (Check PAS/EPR)	Gentamicin 7mg/kg od If gentamicin resistant strain - Ertapenem 1g od iv or Meropenem 1g tds	Pivmecillinam 400mg tds **plus** co-amoxiclav 375mg tds 5 days is an oral option for mild infections if susceptible (check urine result) Or Fosfomycin 3g po stat (in males give second 3g dose after 72 hours)
Post operative infection after cystectomy	Flucloxacillin 1g qds AND gentamicin 7mg/kg If there is a history of ESBL or MRSA use Ertapenem 1g od AND Vancomycin iv	
Epididymo-orchitis	**<40y** Ceftriaxone 500mg iv/im single dose AND Doxycycline 100mg bd 14 days Severe penicillin allergy: Doxycycline 100mg bd AND Ciprofloxacin 500mg bd po for 14 days **>40y** Ciprofloxacin 500mg bd po for 14 days	Acquired via ascending infection so always send an MSU and in sexually active men <40y also send sample for Chlamydia. Orchitis is usually viral so consider mumps.
Acute Prostatitis	Ciprofloxacin 500mg bd for 28 days OR Trimethoprim 200mg bd for 28 days. If iv treatment required: Amoxicillin 1g tds iv AND Gentamicin 7mg/kg**,**	When clinically improved adjust therapy according to urine sensitivities**.**

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Skin and Soft Tissue Infections

- Flucloxacillin will cover streptococci as well as staphylococci– no need to add Benzylpenicillin or Amoxicillin. Always consult microbiologist if neutropenic (re clostridial sepsis).
- Remember to treat co-existing eczema or tinea to reduce risk of recurrence.
- Patients with a past history of MRSA colonisation should be commenced on vancomycin empirically pending culture results.
- Anaerobes are common around ulcers on legs, sebaceous cysts, deep pressure sores or on the abdominal wall and will require Metronidazole addition if the patient does not initially respond.
- Limb-threatening infections in diabetics with foot ulceration involves any of: cellulitis, lymphangitis, deep ulcer with purulent discharge, fever or rigors.
- Bilateral leg cellulitis is RARE. Lipodermatosclerosis can be misdiagnosed as cellulitis as legs can be red, warm and tender. However patient is not usually unwell and it does not respond to antibiotics. Consider dermatology advice.
- Duration and location of treatment: Treat for 7 to 14 days. High dose therapy for >7 days may be necessary to achieve adequate levels. It is possible to manage selected patients with cellulitis with daily parenteral antibiotics at home or as outpatients. Such home regimens are not suitable for hospital use because of heightened risk of C.difficile (ceftriaxone) or expense (teicoplanin). Intravenous vancomycin should not be administered at home.

Mild wound infection/cellulitis	Flucloxacillin 500mg qds po (1g qds if weight >70Kg, 1.5g qds if >100kg) 5-7days OR, **if penicillin allergic:** Doxycycline 100mg bd po 5-7 days.	Use Doxycyline if history of MRSA.
Severe wound infection/cellulitis	Flucloxacillin 1g qds iv (1.5g qds if >70Kg, 2g qds if >100kg). **If penicillin allergic or hx MRSA:** Vancomycin iv Consult microbiologist if poor response after 72 hours	Review patients after 72 hours for oral follow on with oral flucloxacillin 1-1.5 g qds or doxycycline 100mg bd to finish 7-14 day course. For iv management out of hospital: Ceftriaxone 2g iv once daily - do NOT use in hospital because of the risk of C.difficile. If penicillin allergic teicoplanin 800mg loading dose then 400mg iv od
Mastitis	Flucloxacillin 500mg qds po (1g qds if weight >100kg) 7-10 days OR, **if penicillin allergic:** Erythromycin 500 mg qds po 7-10 days.	Breastfeeding – see 'Management of Mastitis/Breast Abscess SOP' (Women and Children care group) Non-lactating patients >35y with no obvious cause should be investigated once infection resolved

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

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Animal or Human Bites, Deep/dirty Wounds		
Includes animal or human bites or extensive scratches on face or upper limb, deep dirty punctures, farmyard/garden injuries, closed oral wounds, perineal or perianal wounds, after debridement: Antibiotics after animal bites are given to prevent anaerobic, staphylococcal & Pasteurella infection. This is pre-emptive therapy rather than true prophylaxis. **Remember to give Tetanus immunoprophylaxis using tetanus toxoid +/- immunoglobulin as appropriate**		
Not requiring admission	Co-amoxiclav 375-625 mg tds po	Duration: 5 days
Penicillin allergic	• animal bites**:** oral Metronidazole 400mg tds AND Doxycycline 100mg bd; • deep dirty punctures and oral wounds: oral Metronidazole 400mg tds AND Doxycycline 100mg bd • perianal and perineal wounds: Metronidazole 400mg tds alone.	Antibiotics are generally not needed if the wound is more than 2 days old and there is no sign of infection.
If parenteral treatment required for severe animal bites and scratches or oral wound:	Metronidazole 500mg tds AND 1.5g Cefuroxime tds, (not iv co-amoxiclav). If penicillin-allergic: Metronidazole 500mg tds AND Doxycycline 100 mg bd iv	
If parenteral treatment required for punctures, severe perianal and perineal wounds	Benzylpenicillin 1.2g qds, Metronidazole 500mg tds and Gentamicin 7mg/Kg od iv. If penicillin-allergic: Metronidazole 500mg tds AND Doxycycline 100 mg bd iv	
Bat bites from anywhere and animal bites from overseas	Discuss rabies prophylaxis with on-call virologist at Heart of England Hospital, Birmingham	
Human bites	As for animal bites	Also consider Blood-borne virus prophylaxis (See Infection control policy on exposure to blood borne viruses).
Limb Trauma	See Orthopaedic prophylaxis section	

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Septic Arthritis/Osteomyelitis		
Septic arthritis - native joint	Flucloxacillin 1.5 - 2g qds iv alone. If penicillin allergic, Vancomycin iv AND Sodium fusidate 500mg tds po. In diabetics/patients with rheumatoid arthritis where Gram negative septic arthritis is more likely, add gentamicin to flucloxacillin initially until culture results available & ertapenem to vancomycin and sodium fusidate.	Continue iv flucloxacillin or vancomycin therapy for at least 10 days. Sodium fusidate is better given po and is not normally required if flucloxacillin is used Consult microbiologist re duration and oral follow-on. Four weeks therapy is recommended for septic arthritis.
Infected joint replacement	Vancomycin iv until two weeks after implant removed if coagulase-negative Staph infection or culture negative histological positive infection. If infection with other organisms (e.g. S aureus, Enterococcus, Gram negative species) at least 6/52 treatment is required post joint removal and the antibiotic regime should be discussed with a Consultant Microbiologist	If implant is conserved in situ infection is unlikely to resolve but consult microbiologist re antibiotic choice for 6-12 months suppressive therapy.
Acute osteomyelitis	If staphylococcal, treat as for native joint septic arthritis	A microbial diagnosis from deep samples is normally advisable. Spinal, post traumatic, or chronic osteomyelitis may not be staphylococcal: consult microbiologist. Minimum 6 weeks antibiotics required.
Foot osteomyelitis or ulceration in diabetics.	Flucloxacillin 1g qds (1.5g qds if >80Kg, 2g qds if >100Kg) AND Metronidazole 400mg tds AND Ciprofloxacin 750mg bd po. If penicillin allergic or MRSA positive, Use iv Vancomycin instead of flucloxacillin	Deep culture is more reliable than superficial swabs and will permit rationalisation of initial therapy.

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

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Abdominal Infection		
Biliary sepsis	Amoxicillin 1g tds iv AND Gentamicin once daily 7mg/kg iv AND Metronidazole 500mg tds iv **Renal impairment/age >80y** – as for lower abdominal sepsis **Penicillin allergy:** Gentamicin 7mg/Kg iv od AND Metronidazole 500mg tds iv Renal impairment/age >80y – Ciprofloxacin 400mg bd iv/750 mg bd po AND Metronidazole 500mg tds iv	If patient is being discharged to complete antibiotic course then oral Ciprofloxacin 750mg bd can be prescribed on the TTOs.
Lower abdominal sepsis/post op colon surgery or severely ill	Amoxicillin 1g tds iv AND Gentamicin 7mg/kg iv AND Metronidazole 500mg tds iv for 5 days. **Renal impairment GFR <40ml/min/ age >80y** Piperacillin/tazobactam* 4.5g tds iv (bd if <20ml/min) **Penicillin allergy** Vancomycin iv AND Ciprofloxacin 400mg bd iv AND Metronidazole 500mg tds iv **ITU/HDU** Piperacillin/tazobactam* 4.5g tds if admitted from community OR Meropenem 1g tds if penicillin allergic or re-operation/previous antibiotics	**NEVER use penicillin and metronidazole without gentamicin in the empiric treatment of abdominal sepsis** Oral follow on is not usually required. If oral antibiotics are thought necessary, contact microbiology. **Do not** prescribe penicillinV + metronidazole alone Reduce meropenem and piperacillin/tazobactam doses in impaired renal function
Diverticulitis	IV treatment required – treat as for lower abdominal sepsis	Not severe/oral follow-on: Metronidazole alone often sufficient Alternatively Co-amoxiclav 625mg tds or Metronidazole +trimethoprim 200mg bd for 5 days
Pancreatitis with CT evidence of pancreatic necrosis	Meropenem 500mg tds iv for 10-14 days If antibiotics prolonged for >10 days, give antifungal prophylaxis with Fluconazole (loading dose of 400mg then 200mg od iv/po).	Antibiotics only recommended with >30% necrosis and signs suggestive of infection. Gentamicin & vancomycin penetrate pseudocyst fluid and fat necrosis poorly and should not be used unless there are other sites of infection.

*if piperacillin/tazobactam unavailable see appendix 4

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

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

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Infectious diarrhoea		
Antibiotic therapy is NOT routinely indicated for bacterial infection. Rehydration is the mainstay of treatment. Send stool samples to microbiology with full clinical details, e.g. travel history Enquire whether the patient has had recent antibiotic therapy and consider *Clostridium difficile.* Antibiotics may be indicated if there are systemic signs of infection, at the extremes of age or immunosuppression. Salmonella and Campylobacter have high rates of resistance to ciprofloxacin. Discuss with microbiology if severe/systemic signs of infection.		
Giardia	Metronidazole 2G daily for 3 days or 400mg tds for 5 days	
Entamoeba histolytica	Metronidazole 800mg tds for 5 days followed by Diloxanide furoate 500mg tds for 10 days	
Shigella dysenteriae or flexneri	Ciprofloxacin 500mg bd for 5 days	

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Gynaecological and Obstetric infection.		
Higher doses may be required in pregnancy reflecting increased volume of distribution		
Post-operative pelvic cellulitis, vault haematoma and fever	Flucloxacillin 500 mg qds po/iv (1.5g qds, if weight >80Kg, 2G qds if >100kg) AND Metronidazole 400mg tds (or 500mg tds iv). If penicillin allergic, Clindamycin 600mg tds iv OR 300mg qds po alone.	
Chorioamnionitis or intrapartum fever	Benzylpenicillin 1.8g qds AND *Gentamicin 5mg/Kg od AND Metronidazole 500mg tds If penicillin allergic, Clindamycin 600mg qds AND 5mg/Kg *Gentamicin may be omitted according to clinical judgement	If on this regime and requires C-section then additional antibiotics are not required Can be continued post-delivery if necessary, however If well, there is usually no need for antibiotics post-delivery.
Pelvic abscess, Septic abortion	Benzylpenicillin 1.8g qds AND Metronidazole 500mg tds AND Gentamicin 7mg/Kg once daily. If penicillin allergic, Clindamycin 600mg tds AND Gentamicin 7mg/Kg once daily.	
Pelvic inflammatory disease and salpingitis	**Inpatient/pyrexia/suspected tubo-ovarian abscess or pelvic peritonitis** Ceftriaxone iv 2g od AND Doxycycline po/iv 100mg bd followed by Doxycycline 100mg bd AND metronidazole 400mg bd to complete 14 days **Outpatient** Ceftriaxone im 500mg(single dose), Doxycycline 100mg bd AND metronidazole 400mg bd for 14 days	IV therapy should be continued until 24h after clinical improvement. If severe penicillin allergy consider omitting Ceftriaxone and giving Ciprofloxacin 200mg iv/500mg po bd with doxycycline and metronidazole (NB >10% quinolone resistance in gonococcus). Consider treatment of partner(s)
Post partum fever/infection	**Mild:** Co-amoxiclav 375mg tds (625mg if >100Kg) mg tds po OR Clindamycin 300mg qds po(450mg qds if >100kg) **Severe:** Cefuroxime 1.5g tds iv AND Metronidazole 500mg tds Severe penicillin allergy: Clindamycin 600mg qds AND Gentamicin 5mg/Kg once daily.	
Infected Caesaran wounds/ perineal tear/episiotomy	Co-amoxiclav 375mg tds (625mg if >100Kg) OR Clindamycin 300mg qds (450mg qds if >100kg)	

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Infective Endocarditis		
All suspected cases of endocarditis must be discussed with a Consultant Microbiologist when starting treatment. Take blood cultures 20ml x3 before starting antibiotics. If necessary all can be taken within 2 hours but separate venepunctures are essential. **These are empirical guidelines, when bacteriology results available discuss definitive treatment with microbiologist.** If patient is clinically stable wait for the results of blood cultures before starting antibiotics. If culture negative, investigate for Coxiella and Bartonella Vancomycin monotherapy is inadequate for endocarditis. Gentamicin and Vancomycin doses must be modified according to renal function and levels		
Indolent presentation	Benzyl penicillin 1.2g iv 4 hourly AND Gentamicin 1mg/kg* tds iv	Amoxicillin 2g 4hourly can be used instead of benzyl penicillin *Round to nearest 20mg. Typical starting dose is 80mg tds. Use bd if >70y
Acute presentation	Flucloxacillin 2g qds iv AND Gentamicin 1mg/kg* tds iv **History of MRSA or Penicillin allergy**: Vancomycin iv AND Gentamicin 1mg/kg* tds iv **History of ESBL**: Vancomycin iv AND Meropenem 2g tds iv	Increase dose of flucloxacillin to 2g 4hourly if weight>85kg *Round to nearest 20mg. Typical starting dose is 80mg tds. Use bd if >70y
Prosthetic Valve or Intracardiac device	Vancomycin AND Gentamicin 1mg/kg* tds AND Rifampicin 600mg bd po/iv	*Round to nearest 20mg. Typical starting dose is 80mg tds. Use bd if >70y

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Liver		
Patients with liver failure are at risk of renal failure and biochemical markers of this may not be reliable. They may be infected with a wide range of organisms and re-infection is not uncommon. In the presence of ascites, samples should be taken to assess if spontaneous bacterial peritonitis is present. Gentamicin use should be avoided in patients with cirrhosis and ascites. Defined localised infections e.g. pneumonia should be treated with the antibiotic regimen usually used.		
Liver failure with signs of non-localised systemic infection	Piperacillin/tazobactam* 4.5g tds or Meropenem 500mg tds if penicillin allergic In acute hepatic failure where liver transplantation may be planned ADD Fluconazole 400mg od.	Add Vancomycin if the patient is on ciprofloxacin, or has signs of soft tissue sepsis.
Spontaneous bacterial peritonitis	If bowel sounds normal and "well": Ciprofloxacin 750mg bd po If ill or obtunded: Piperacillin/tazobactam* 4.5G tds iv or Meropenem 500mg tds iv until susceptibilities available when rationalise (usually to ciprofloxacin 750mg bd po).	Take ascitic sample before starting antibiotics After a verified episode of SBP give prophylaxis – see prophylaxis section
Hepatic encephalopathy (established, or incipient after gastrointestinal bleed)	Antibiotic prophylaxis in this situation is not recommended. Use antibiotics only for features of sepsis.	Discuss Rifaximin use with Gastroenterologist/ Hepatologist

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*if piperacillin/tazobactam unavailable see appendix 4

Malaria

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

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Dental Infections		
This guidance is not designed to be a definitive guide to oral conditions. It is for the management of acute oral conditions pending being seen by a dentist or dental specialist.		
Acute necrotising ulcerative gingivitis	Metronidazole 400mg tds 3 days Chlorhexidine or hydrogen peroxide (spit out after use) until oral hygiene possible	Commence metronidazole and refer to dentist for scaling and oral hygiene advice Use in combination with antiseptic mouthwash if pain limits oral hygiene
Pericoronitis	Amoxicillin 500mg tds 3 days Metronidazole 400mg tds 3 days Chlorhexidine or hydrogen peroxide (spit out after use) until oral hygiene possible	Refer to dentist for irrigation & debridement. If persistent swelling or systemic symptoms use metronidazole. Use antiseptic mouthwash if pain and trismus limit oral hygiene
Dental abscess	Amoxicillin 500mg 5 tds days or Clarithromycin 500mg bd 5 days Add Metronidazole 400mg tds 5 days if the infection is severe or spreading (lymph node involvement, or systemic signs ie fever or malaise).	When prescribing an antibiotic, explain to the person that: • Antibiotic therapy is prescribed to reduce the spread of infection. It is *not* a substitute for dental treatment. • Regular analgesia should be taken to relieve the symptoms.

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Antifungal Guidelines		
Empirical antifungal treatment for non Haematology/Oncology patients		
Candidaemia	Empirical therapy 1st line: Fluconazole 800mg day1 then 400mg od 2nd line: Caspofungin 70mg day1 then 50mg od If has had azole therapy this admission or known to be colonised with non-albicans species of Candida then use 2nd line therapy. Caspofungin can be used empirically in patients on ITU with yeast in blood cultures awaiting identification.	If associated with a central line then this should be removed. Fundoscopy to rule out endopthalmitis and investigations to rule out infective endocarditis are recommended. Repeat blood cultures should be performed 5-7 days after starting treatment. Definitive therapy: Guided by microbiology on identification of organism. Duration: Minimum 14 days after first negative blood culture. Can switch to oral/ng if patient improving
Deep localised infection	Consult microbiology for treatment of infective endocarditis, prosthetic joint infections, etc.	
Urinary candidiasis	Treatment not usually required Urinary catheter – usually represents colonisation of catheter. Removal/change of catheter recommended	
Oropharyngeal Candidiasis	1st line: Nystatin oral suspension 1ml qds 2nd line: Fluconazole 50-100mg od Duration – 7 days	Identify risk factors e.g. immunosuppression, dentures, broad spectrum antibiotics, inhaled/systemic steroids. Consider HIV test

3. DEFINITIVE TREATMENT

– switching from empirical treatment once susceptibilities are reported.

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

Remember START SMART, THEN FOCUS

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

Infections Commonly Requiring >5 DAYS Antibiotic Prescription

- **Skin and musculoskeletal infection**

Line Associated Infections

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

Cellulitis:

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

Septic arthritis/Osteomyelitis

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

Erysipelas:

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

- **Chlamydial infection**

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

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

- **Bacterial Meningitis**

See section in empirical guidelines for appropriate agents.

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

Pneumococcal: 10 days iv.

Listeria: 21 days

Immunocompromised – consult microbiologist

- **Infective Endocarditis**

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

- **Gastrointestinal infections**

Typhoid, paratyphoid and systemic salmonella infection.
More than 5 days therapy and prolonged iv antibiotics are usually required. Consult microbiology.
Clostridium difficile.
10-14 days therapy with oral metronidazole or vancomycin is recommended for first C difficile infections unless the patients diarrhoea and illness has settled earlier. Prolonged therapy may be needed in recurrence (see antibiotic guidelines)

- **Infections in neutropenia**

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

- **Urinary Tract Infection in pregnancy**

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

ADVICE ON AGENTS OF CHOICE FOR FOLLOW-ON IN ADULTS

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

Abdominal/biliary infections:
Usually no oral follow on required.

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

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

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

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

If no microbiology available:
Oral cephalosporins should be AVOIDED in respiratory tract infections. Oral cefuroxime axetil produces a higher incidence of C.difficile diarrhoea. Cephalexin has a narrower spectrum than cefuroxime and is only useful in UTI. Amoxicillin or doxycycline alone is the appropriate usual follow-on in RTIs that need antibiotics. Clarithromycin or erythromycin resistance is commoner than doxycyline resistance in pneumococci, and clarithromycin should only be used if Legionella infection is diagnosed by urinary antigen tests. For suspected Mycoplasma infection send nose and throat swabs in viral transport medium for Mycoplasma PCR and use doxycycline.
Oral co-amoxiclav has a similar spectrum to iv cefuroxime and metronidazole but should not be used indiscriminately – outbreaks of C difficile associated with over-use are recorded. Metronidazole is not required if this agent is being used. It occasionally is useful as a single antibiotic for oral follow-on where mixed faecal flora or mixtures of Staph. aureus (not MRSA), streptococci and anaerobes are causing infection. It may also be useful as an alternative to doxycycline in Haemophilus infections confirmed as resistant to amoxicillin.
Flucloxacillin or, in penicillin allergy, doxycycline are useful for wound infections/cellulitis infections. Erythromycin resistance is now commoner than tetracycline resistance. It is not necessary to give penicillin with flucloxacillin, as flucloxacillin will cover streptococci.
Remember to avoid giving milk/antacids/iron with doxycycline or ciprofloxacin.
Nitrofurantoin is useful for lower UTI ONLY. Trimethoprim resistance is increasing especially in elderly medical patients so the sending of samples is essential. Ciprofloxacin is useful in upper UTI in the presence of trimethoprim resistance and when intravenous antibiotics are no longer indicated.

Specific Organisms

MRSA

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

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

ESBL (Extended Spectrum B lactamase) and AmpC producing coliforms

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

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

Carbapenemase-Producing Enterobacteriaceae (CPE)

The emergence of CPE is a major public health concern. They are Gram- negative organisms resistant to carbapenems (e.g. ertapenem and meropenem) and can also exhibit resistance to multiple other agents including cephalosporins, aminoglycosides and quinolones. Treatment options are usually extremely limited. Discuss all cases of suspected infection with microbiology.

Vancomycin-resistant Enterococci (VRE):

VRE are an increasing problem. Often they are colonising only and do not require antibiotics. Infections with VRE are difficult to treat and require consultant microbiologist advice. Appropriate agents will be reported including linezolid or daptomycin according to the site of infection.

4. Prophylaxis Guidelines

Antibiotic prophylaxis should be single dose unless otherwise specified. After that it becomes treatment for an established infection.
Prophylaxis at surgery should be given intravenously (unless otherwise specified) at or shortly after induction or intraoperatively after cultures are taken in the case of prosthetic infection. Prophylaxis after surgery is usually ineffective. If oral prophylaxis is used it should be given at least 1.5 hours before the procedure.
Cephalosporin and quinolone use is reduced to avoid selection for resistant organisms especially ESBL, AmpC, MRSA & C difficile.
Gentamicin causes less C.difficile infection than cephalosporins, quinolones or ertapenem.

PROPHYLAXIS in medical conditions

Bacterial Endocarditis	Preventive dentistry to treat existing dental sepsis should always be undertaken when a new diagnosis of cardiac congenital or valvular disease is made and before insertion of orthopaedic or other prostheses. **The importance of maintaining good oral health** should be emphasised for all patients. The following are regarded as being at risk of infective endocarditis ○ acquired valvular heart disease with stenosis or regurgitation ○ valve replacement ○ structural congenital heart disease, including surgically corrected or palliated structural conditions, but excluding isolated atrial septal defect, fully repaired ventricular septal defect or fully repaired patent ductus arteriosus, and closure devices that are judged to be endothelialised ○ previous infective endocarditis ○ hypertrophic cardiomyopathy. Antibiotic prophylaxis against infective endocarditis is **not recommended routinely** (NICE 2016): • for people undergoing dental procedures • for people undergoing non-dental procedures at the following sites ○ upper and lower gastrointestinal tract ○ genitourinary tract; this includes urological, gynaecological and obstetric procedures, and childbirth ○ upper and lower respiratory tract; this includes ear, nose and throat procedures and bronchoscopy. Chlorhexidine mouthwash should not be offered as prophylaxis against infective endocarditis to people at risk of infective endocarditis undergoing dental procedures **Any episodes of infection** in people at risk of infective endocarditis should be investigated and treated promptly to reduce the risk of endocarditis developing.

	Patients should be made aware of the symptoms that may indicate infective endocarditis and when to seek expert advice as well as the risks of undergoing invasive procedures, including non-medical procedures such as body piercing or tattooing.	
Prosthetic Joints	Comparable to the changes in guidance concerning dental procedures and risk of infective endocarditis, there is no evidence of benefit and antibiotic prophylaxis is not routinely recommended for patients with joint prostheses. However, it is important to maintain good oral hygiene and to avoid dental sepsis.	
Neutropenia: to prevent bacteraemia	Ciprofloxacin 250mg bd (with microbiological monitoring of rectal swab for ciprofloxacin resistant Gram negatives). Ciprofloxacin prophylaxis should be stopped when the patients WBC rises to $0.5x10^9$/l. Antifungal prophylaxis will also be required – discuss with haematologist, oncologist or microbiologist	
Spontaneous bacterial peritonitis	Ciprofloxacin 500mg od Consult microbiologist if breakthrough on this regime	Use after first confirmed episode to reduce incidence of recurrence. It can also be used in patients with severe liver disease and no prior history of SPB if ascitic fluid albumin content is <10g/l.

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PROPHYLAXIS in endoscopy		
Prevention of infective endocarditis following diagnostic or therapeutic endoscopy	Not recommended Patients with ongoing cholangitis (or other infections for which therapeutic endoscopy is indicated as part of their management plan) should already be on antibiotics. Additional doses are not required.	The possibility of infective endocarditis should be considered in patients with known cardiac risk factors who develop symptoms and signs of infection during the weeks following an endoscopic procedure. Such patients should undergo prompt investigation and appropriate treatment.
Cholangitis and bacteraemia prophylaxis in ERCP	Benzylpenicillin 1.2g AND Gentamicin 120mg (single dose) If penicillin allergic, Gentamicin alone. Ciprofloxacin 750mg orally 1.5 hours pre-procedure and with follow-on for 48-72 hours is occasionally useful but resistance rates to ciprofloxacin are now 20% more than when these regimens were first advocated.	**Routine prophylaxis for ERCP is not necessary**, but is recommended: when complete biliary drainage unlikely to be achieved (eg, sclerosing cholangitis and/or hilar cholangiocarcinoma) patients with a history of liver transplantation; patients with pancreatic pseudocyst; patients with severe neutropenia (<0.5x10^9/l) and/or advanced haematological malignancy.
EUS guided fine needle aspiration of cystic lesions in or near pancreas, or drainage of cystic cavity	Ciprofloxacin 750 mg orally single dose	
PEG insertion	Flucloxacillin 1G AND Metronidazole 500mg iv at induction of anaesthesia pre-insertion. **Penicillin allergy:** Cefuroxime 1.5G AND Metronidazole 500mg iv. **Severe penicillin allergy** (angioedema or urticaria) or **MRSA**: Teicoplanin 400mg AND 500mg Metronidazole iv.	To prevent insertion site sepsis. Only single doses are required.

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Prophylaxis in Surgery

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

MRSA

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

See IPC MRSA policy for screening and decolonisation regimes

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Abdominal surgery		
Gastric or unobstructed small intestinal surgery or biliary surgery	Amoxicillin 1g AND Gentamicin 2mg/kg (to nearest 20mg) single doses. If penicillin-allergic omit Amoxicillin and give Gentamicin 2mg/kg (to nearest 20mg) single dose alone.	For bariatric surgery increase Amoxicillin dose to 2g
Elective laparascopic cholecystectomy	**Not** routinely required in low risk patients High risk – as for gastric surgery	High risk: age > 60 years, diabetes, acute colic, jaundice, acute cholecystitis/ cholangitis, immunosuppressed, pregnant, bile spillage
Colorectal or obstructed small intestinal surgery:	Amoxicillin 1g AND Gentamicin 2mg/kg (to nearest 20mg) mg AND Metronidazole 500mg. If peritonitis is present at operation because of perforation maintain the Amoxicillin and metronidazole but give an evening dose of 7mg/kg gentamicin daily (for patient over 80 years old use the regimen for renal impairment instead) and continue all therapy for up to 5 days (see therapy section). **Penicillin-allergy:** EITHER just omit the Amoxicillin from the colorectal regimen (preferred) OR Substitute Clindamycin 600mg for Amoxicillin and Metronidazole Omission of the Amoxicillin means that enterococcal or group F streptococcal systemic infection is not covered but these are rare.	To prevent bacteraemia and abdominal abscess.
Appendicectomy:	Amoxicillin 1g AND Gentamicin 2mg/kg (to nearest 20mg) mg AND Metronidazole 500mg.	To prevent abdominal abscess. For complicated cases/ significant lower abdominal sepsis see therapy section
Pancreatitis	Meropenem 500mg tds iv for 10-14 days If penicillin allergic, Ciprofloxacin 400mg bd iv	Only recommended with >30% necrosis
Herniorrhaphy with mesh insertion	Amoxicillin 1g AND Gentamicin 2mg/kg (to nearest 20mg) If penicillin-allergic, omit benzylpenicillin	To prevent local sepsis:

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

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Urological Surgery		
Antibiotics are not given routinely on catheter removal even in the presence of a prosthetic implant.		
Endoscopic surgery (TURP or TURBT), retropubic prostatectomy, DVU, Cystoscopy with biopsy - procedures causing a urothelial breach or TVT insertion	Gentamicin 120-160mg	To prevent Gram-negative bacteraemia:
Upper tract endoscopic surgery	Gentamicin 120-160mg AND Amoxicillin 1g. If penicillin allergic: and no enterococci in urine, omit amoxicillin: if enterococci in urine, Gentamicin 120mg AND Teicoplanin 400mg.	To prevent Gram-negative and enterococcal bacteraemia
ESWL	Trimethoprim 200mg or Gentamicin 120-160mg AND Amoxicillin 1g. See above for penicillin allergy	Routine prophylaxis is not recommended however should be considered in complicated cases e.g. internal stent, nephrostomy, infected stones
Nephrectomy or Pyeloplasty	Gentamicin 120-160mg	To prevent Gram-negative bacteraemia
Open urological surgery involving opening bowel inc. ileal conduit and enterocystoplasty or in patients with MRSA	Vancomycin 1g AND Meropenem 500mg.	To prevent bacteraemia and abdominal abscess (Meropenem is used instead of Ertapenem to cover Pseudomonas and enterococci in addition which are more likely in these patients.)
Transrectal prostatic biopsy	Gentamicin 7mg/kg* iv and Metronidazole 1g pr Ciprofloxacin 750mg bd po for 48h, 1st dose prior to procedure *if eGFR<40ml/min give 2mg/kg	Contact microbiology if known ciprofloxacin resistant organism in urine. If admitted with sepsis post-procedure, give Meropenem 1g tds pending culture results
Transrectal prostate injection	Gentamicin 3mg/kg iv (rounded to nearest 20mg	
Transperineal prostate biopsy	Fosfomycin 3g sachet po single dose prior to procedure	

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Urology		
Urodynamics	Not routinely required if no growth from pre-op urine **Spinal injuries:** Gentamicin 2mg/kg (to nearest 20 mg) single dose **Non-spinal injuries patients with history of repeated UTI or significant voiding dysfunction:** Gentamicin 7mg/kg. **If ESBL producing organism currently or in past:** Gentamicin 7mg/kg iv or Ertapenem 1g iv if resistant If pre-operative urine indicates gentamicin resistance, contact microbiology.	May be considered in known urinary tract abnormality, immunosuppression, >70y, urinary catheter (indwelling or intermittent) Stat dose 2h prior to procedure: Oral Trimethoprim 200mg or Ciprofloxacin 750mg, depending on previous susceptibility. Alternative: Fosfomycin 3g Routine prophylaxis for endocarditis is not recommended in the current NICE guidelines, however, the risk of endocarditis is increased in at-risk patients if there is established urosepsis at the time of procedure
Traumatic catheterisation	**History of MRSA** : Vancomycin 1g bd iv **History of ESBL in urine**: 7mg/kg Gentamicin iv or if gentamicin resistant 1g od Ertapenem iv **Other Gram-negative organism in urine**: 7mg/kg Gentamicin, unless organisms resistant	IF any one of: •more than 2 attempts at catheterisation •instrumentation •resultant ongoing haematuria •removal of catheter with balloon inflated send a urine for culture and give antibiotic until cultures available and treatment can be rationalised.

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Gynaecological Surgery		
Cystoscopy	See urological surgery	
Hysterectomy (abdominal or vaginal), laparotomy, Major vaginal surgery	Metronidazole 500mg iv at induction AND Gentamicin 2mg/kg (to nearest 20mg) AND benzylpenicillin 1.2g at induction. If penicillin-allergic, OMIT Benzylpenicillin with NO substitution i.e. use Metronidazole AND Gentamicin	To prevent bacteraemia and abdominal abscess
Vaginal surgery	Metronidazole 500mg iv at induction	To prevent anaerobic infection
Termination of pregnancy	Metronidazole 500mg iv at induction AND Azithromycin 1g po post-op. Azithromycin can be omitted if patient is chlamydia negative by NAT testing.	To prevent anaerobic infection and chlamydial spread
Obstetrics		
Caesarean section	Cefuroxime 1.5g AND Metronidazole 500mg iv Severe penicillin allergy - Teicoplanin 400mg AND Metronidazole 500mg iv	To prevent wound infection and post-partum fever If already on antibiotics for chorioamnionitis or intrapartum fever, additional agents are not required
To prevent Group B streptococcal neonatal infection **Or IAP preterm labour** **Or IAP preterm PROM once in established labour**	Benzylpenicillin 3g in 100ml saline over 30 minutes & then 1.8g four hourly until delivery. Penicillin allergy: Non-severe – Cefuroxime 1.5g loading then 750mg 8 hourly (1.5g if >100kg) Severe – Vancomycin 1g bd. In planned caesarean section with intact membranes, antibiotics as for Caesarean section	a) Past history of Group B streptococcal infection in previous neonate b) UTI or positive genital culture in this pregnancy with Group B streptococcus c) History of GBS colonisation and opting for IAP Add gentamicin 5mg/kg od if intrapartum fever ≥ 38°C or suspected chorioamionitis.
Manual removal of placenta or 3rd and 4th degree tear	Cefuroxime 1.5g AND Metronidazole 500mg iv Single dose. For 3rd and 4th degree tears continue with Co-amoxiclav 375mg (625mg if >100Kg) tds po 48 hours. If penicillin allergic, oral follow on with Erythromycin 500mg tds AND Metronidazole 400mg tds	To prevent local infection
Assisted vaginal delivery	Cefuroxime 1.5g AND Metronidazole 500mg iv single dose Omit antibiotics if severe penicillin allergy	Give within 6h of delivery

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

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

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Interventional Radiology		
All doses are single iv doses. If patient is already on antibiotic treatment additional therapy may not be required. If performing percutaneous procedures and patient has history of MRSA add Vancomycin 1g (or Teicoplanin 400mg)		
Nephrostomy or stent insertion.	Gentamicin 2mg/kg (to nearest 20mg) History of ESBL: Ertapenem 1g	If in-patient check that has not already received a treatment dose of gentamicin
Nephrostomy change	Usually not required	
Biliary intervention	Amoxicillin 1g AND Gentamicin 120mg (single dose) If penicillin allergic, Gentamicin alone.	If in-patient check that has not already received a treatment dose of gentamicin
Tunnelled line insertion	Not routinely recommended	
Percutaneous gastrostomy	Flucloxacillin 1g iv Penicillin allergic or hx MRSA: Teicoplanin 400mg	
Percutaneous abscess drainage (intra-abdominal)	May already be on antibiotics. If pt stable then diagnostic samples before antibiotics preferable. If signs of sepsis then start treatment as for intra-abdominal infection.	

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

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Prophylaxis Post-Splenectomy		
The following is a summary.		
Antibiotic prophylaxis	**Not penicillin allergic** Advise penicillin V continuously from hospital discharge until at least 16 years old or at least 2 years post splenectomy for patients >16y. Adult dose is 500mg bd. **Penicillin allergic** The evidence of benefit is less good. Adults – consider no prophylaxis, or erythromycin 500mg bd Children – consider erythromycin. All patients should carry a supply of appropriate antibiotics for emergency use and advised to seek urgent medical advice if develop symptoms and/or signs of infection	Life long prophylactic antibiotics should be offered to patients considered at continued high risk of pneumococcal infection (aged <16 years or > 50 years, inadequate serological response to pneumococcal vaccination, a history of previous invasive pneumococcal disease, and splenectomy for underlying haematological malignancy particularly in the context of on-going immunosuppression) Patients not at high risk should be counselled regarding the risks and benefits of lifelong antibiotics and may choose to continue or discontinue prophylaxis.
Immunisation	The following are recommended (irrespective of age) see 'Immunisation against infectious disease (DoH)' for full details (green book) Pneumococcal Hib/MenC Meningococcal ACWY conjugate vaccine Influenza.	Ideally patients should be vaccinated four to six weeks before elective splenectomy. Where this is not possible, they can be given up to two weeks before surgery. If it is not possible to vaccinate at least two weeks before surgery, or a patient has an emergency splenectomy, vaccination should be delayed until at least two weeks after the operation to obtain a better response.
Other advice	• Take appropriate precautions to avoid malaria • Note risk of multiresistant pneumococci abroad eg Spain • Antibiotic prophylaxis for animal bites • Take precautions to avoid tick bites in areas where babesiosis endemic e.g. North America • Carry a medic-alert disc	

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5. Antibiotic Dosing and Levels

General instructions: all assays

Please use the red-topped clotted tubes.
Avoid writing ambiguous terms (e.g. 1200) and use the 24h clock i.e. 2359, 1150.
When requesting assays, if not ordered electronically, write the following minimum information on a blue BACTERIOLOGY form:

Time the level was taken e.g. 01/02/18 9.30a.m.
Time the last dose was given e.g. 31/01/18 2200
Prescribed regimen e.g. 1G bd.
Patient details.

Without this information the assay will not normally be done as it cannot be safely interpreted. Information on the form will be reported. If this is inaccurate the interpretation may be incorrect.

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

- There is no antibiotic assay facility at Telford or Oswestry: it is in Shrewsbury. Careful attention to transport times is essential. On weekdays batches of assays are carried out morning and afternoon. DO NOT ring the BMS or duty consultant microbiologist out of hours for results – they do not have access. If an assay result is unavailable, follow the instructions in the policy for the relevant agent. At Oswestry sometimes results fail to reach the EPR because the computer link between the sites fails and the IT staff on call must be contacted to restore the link.
- On Saturdays and Sundays samples are picked up from the Telford laboratory for transport to Shrewsbury twice a day (morning and early afternoon). At Oswestry a single taxi to take levels from all wards should be arranged.

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Adult Vancomycin Use and Dosing

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

Recommended target pre-dose concentration (ref: BNF):
• 10–15 mg/L for standard infection
• 15–20 mg/L for deep-seated infections (e.g. osteomyelitis, endocarditis or pneumonia due to *Staphylococcus aureus*)

Dosage:
Check the patient's plasma creatinine and weight before administering vancomycin.
Once the patient is on vancomycin, plasma creatinine MUST be measured at least twice weekly.
Vancomycin must be administered slowly (no faster than 10mg/min) to prevent infusion-related toxicities e.g. Red man syndrome (flushing, erythema, pruritis and less frequently, hypotension, angioedema, chest pain). It is related to the release of histamine and is not a true allergic reaction.

Loading dose

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

Maintenance dose

eGFR >50ml/min: 15mg/kg rounded to nearest 250mg twice daily
eGFR is 30-50ml/min: give an initial loading dose then continue at 500mg bd. Check level pre 3rd /4th dose
eGFR <30ml/min (not on dialysis)– give loading dose then check level the following day and wait for the result. Give next dose when level <15mg/l or according to microbiology advice. Dosage interval can vary from daily to every 5 days.

Timing of doses and levels:
Trough vancomycin levels are used to check that dosing is adequate. Peak levels can be predicted from trough levels if the dosage is known, and are unnecessary. **Vancomycin doses should not be held back waiting for levels** to be reported unless recommended by the microbiologist in advance because of previous toxic levels. Patients are at risk of inadequate antibiotic dosing and poor outcome of their infection if nursing or medical staff hold back doses and the risk of toxicity with vancomycin is minimal unlike gentamicin. Bacteria start regrowing quickly if the level falls below 5mg/l.
With normal renal function, take the blood into a red-capped tube as a trough level immediately before the third or fourth dose is given. Remember to use electronic ordering which prompts you for information or fill in a blue (NOT purple) form.
For twice daily dosage schedules it is critical that the blood is taken after the normal interval between doses i.e. 12 hours. It is best to organise doses once the patient has received an initial dose on a 10am/10pm schedule so that bloods are not taken inadvertently after a dose by phlebotomists.
With bd dosing it is safe to advance doses by up to 6 hours to bring them into line with a 10pm/10 am dosing schedule but DO NOT send levels before such a brought-forward dose. **If the patient is on a 12hourly dosage, levels must not be taken <10hrs after the last dose, or if on 24 hourly dosage less than 20.5 hours after the last dose.**

Trough level Results:

Result	Action
<10mg/l or <15mg/l for deep-seated infection	• Check that previous doses have been given as prescribed. Low levels can result from samples being taken too late or doses missed • If timing and sample are correct then increase dose/reduce dosing interval as advised by microbiology on the result
10-15mg/l or 15-20mg/l for deep-seated infection	• Continue current therapy
>15mg/l or >20mg/l for deep-seated infection	• Check that the dose prescribed and timing of the level are correct. High levels can result from samples being taken too early • Check where the sample was taken from. Falsely high levels may occur as a result of taking blood from the line vancomycin was given through • If timing and sampling are correct then omit dose/reduce dose/increase interval as advised by microbiology on the result

Progressively rising vancomycin levels may indicate renal impairment even with normal plasma creatinine and in this instance the microbiologists may recommend that the dosage interval or dose is changed even if the level is in range.
Low levels may select for vancomycin hetero-resistance in Staphylococcus aureus with Minimum Inhibitory Concentrations above 1mg/l. This resistance is associated with treatment failure in serious infection and alternative antibiotics are indicated. Blood and joint isolates have their MICs tested.

Gentamicin use, dosing and levels in adults

Why use Gentamicin?

• Gentamicin offers a good spectrum of activity for abdominal and urinary infection and prophylaxis with no risk of C difficile, unlike quinolones, carbapenems and cephalosporins. A minority of MRSA are gentamicin resistant and unlike cephalosporins and quinolones there is no evidence that gentamicin selects for MRSA. Gentamicin is not useful for chest infection –follow medical guidelines.

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

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

Prescribing gentamicin

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

• **Doctors must check the patient's recent plasma creatinine before prescribing Gentamicin.** Avoid gentamicin if the creatinine is >150mmol/l or eGFR <40ml/min). NB eGFR may be unreliable in emaciated patients and in the elderly and creatinine clearance may need to be calculated. Avoid gentamicin in elderly patients (>80y), check the guidelines for alternative regimens

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

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

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

Males: IBW(kg) = (0.9 X height in cm) - 88

Females: IBW(kg) = (0.9 X height in cm) - 92

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

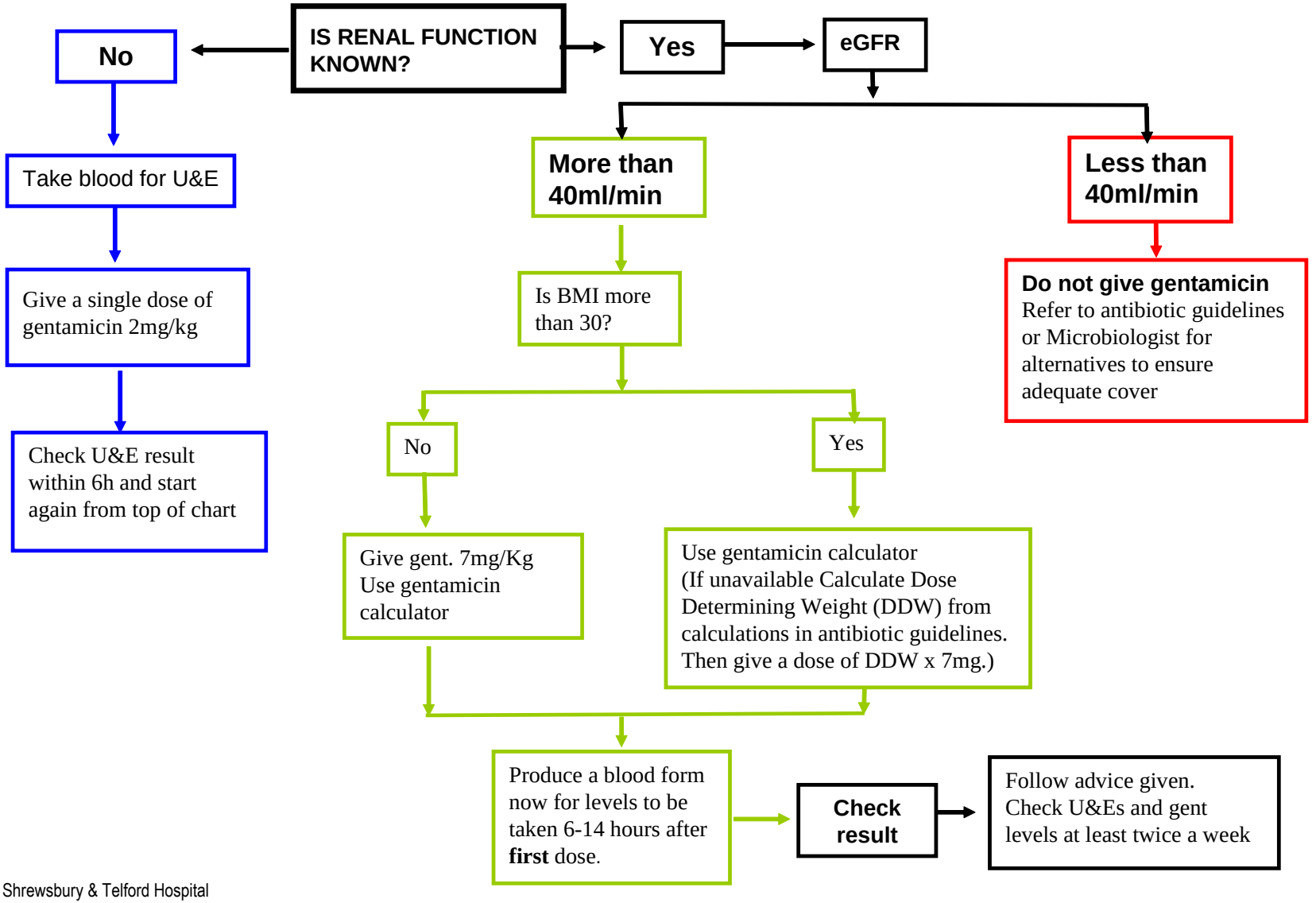
DDW= IBW + 0.4(ABW-IBW)

(ABW=actual body weight)

If emaciated the patient must be weighed.

• **Avoid courses longer than 5-7 days unless advised by microbiology**

How to calculate correct initial gentamicin dose regimen*



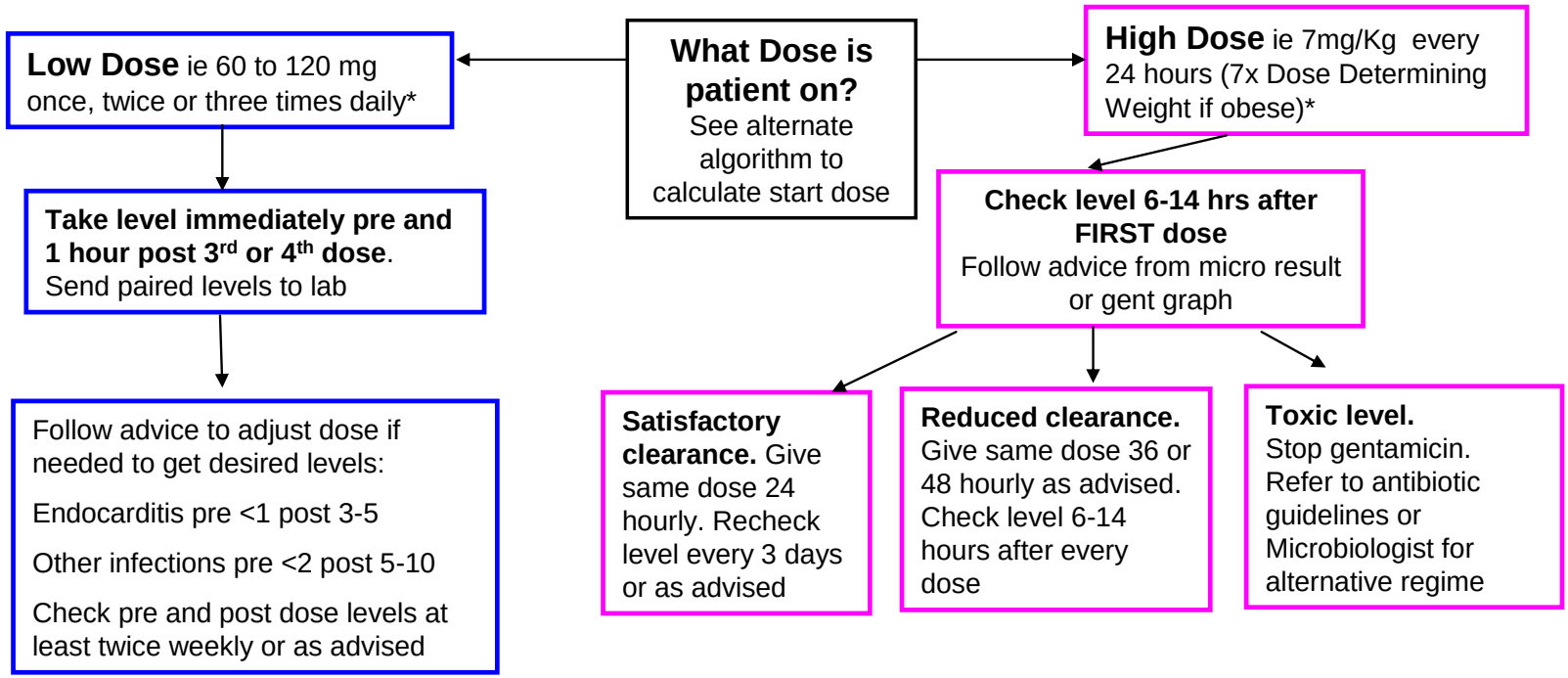
Shrewsbury & Telford Hospital

Version 3. August 2013

*Lower doses are used in the treatment of INFECTIVE ENDOCARDITIS – seek Microbiologist advice

Gentamicin in Adults 2 – ongoing management and monitoring

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



Levels not taken or not available: Check dose is correct.
Can have up to 5 doses without initial levels but ensure pre & post dose levels are taken around dose being given.
If 6th dose or more without any level –Take predose level when dose due but withhold gentamicin until result back. Send Datix.

Level not done or not available. Check dose is correct.
If renal function normal (eGFR>60 or Creatinine <110 in last 48h) patient can have ONE more dose 24 hrs after first.
ENSURE level taken 6-14 hrs post 2nd dose.
If eGFR 40-60 give ONE more dose 48hrs after first (ie omit one dose). ENSURE level taken 6-14h after 2nd dose.
If eGFR <40 or already had 2nd dose without level - seek Microbiologist advice. Send Datix.

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

Monitor renal function at least 2x weekly if patient on gentamicin.
Avoid giving with other nephrotoxic drugs.
Prolonged courses increase the risk of ototoxicity

Version 3 Feb 2014
Shrewsbury & Telford Hospital

Cautions with once daily Gentamicin dosing:

Lower dose required:

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

Changed volume of distribution

- Major burns (>20%)-Use tds schedule
- Ascites

Risks of ototoxicity increased

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

Insufficient information

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

Gentamicin Ototoxicity

Vestibular and ototoxicity is suggested by any of; dizziness, unsteadiness, new hearing loss, bobbing oscillopsia, true vertigo +/- nystagmus. It is independent of drug concentration, however to reduce risk, avoid

- courses longer than 7 days unless advised by microbiology
- repeated courses during the same admission
- if there is a family history of early onset deafness
- if there is current/history vestibular dysfunction or hearing loss

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

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

Measuring gentamicin (or tobramycin) serum levels

- **Take levels usually after the first dose of 7mg/kg gentamicin or tobramycin.** If the patient has had intermediate lower doses of gentamicin e.g. surgical prophylaxis then antibiotic will last some 6 hours before a 7mg/Kg dose can be given. Levels should be postponed to after the first 7mg/Kg dose. It is more convenient to give once daily gentamicin at 10pm to facilitate checking levels. However if gentamicin is required earlier in the day in an unwell patient, do not delay giving the dose. You must ensure that arrangements are in place to take levels at the appropriate time.

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

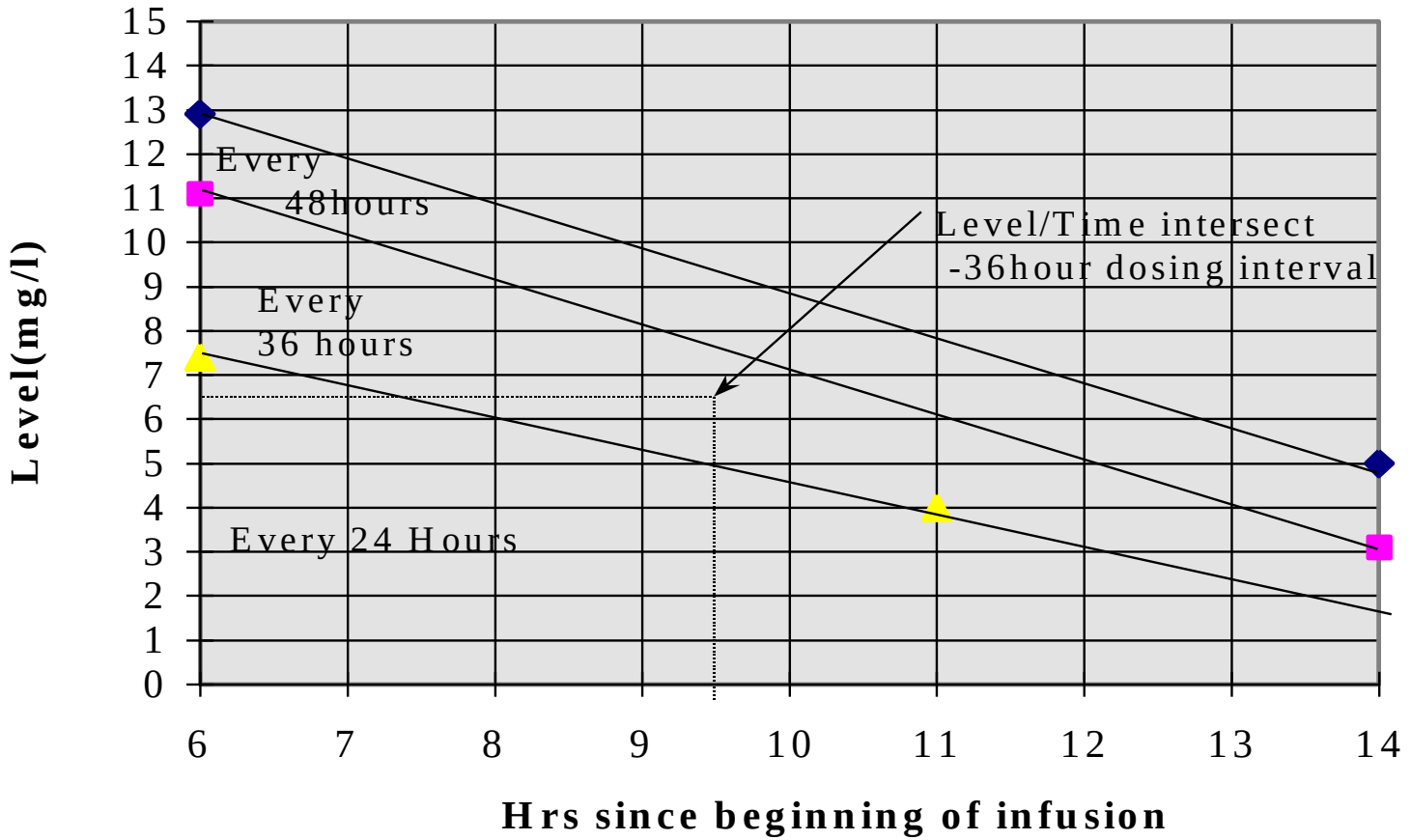
Using the assay results.

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

Males: Creatinine clearance = 1.23 X ((140-Age) X Weight(kg)) / Serum creatinine(umol/l)
Females: Creatinine clearance = 1.03 X ((140-Age) X Weight(kg)) / Serum creatinine(umol/l)

If renal function normal (eGFR >60ml/min or Cr <110 umol/l) give a further dose after 24h. **Ensure that levels are taken after the 2nd dose.**
If eGFR 40-60 ml/min give dose after 48h. **Ensure that levels are taken after the 2nd dose.**
If eGFR <40ml/min or has had a 2nd dose without levels then seek microbiology advice

Hartford nomogram for 7mg/Kg/day gentamicin dosage



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

Assays should be taken at least once every 3 days or daily if renal function changes or the dose is changed. Plasma creatinine must be measured minimum twice weekly. The microbiologist will advise on assays that are abnormal and will often recommend when to take the next level on assay reports.
Prolonged courses of gentamicin are associated with an increased risk of side-effects. Courses should generally be limited to 5 days unless advised by a microbiologist.

Prescribing gentamicin at 1mg/kg bd/tds.

Sepsis: Courses no longer routinely advised. Use 7mg/kg regime if normal renal function. If renal impairment check antibiotic policy for alternative regimen or contact microbiology. May occasionally be advised by the microbiologists if no other options available. Give 2 doses then take a level pre-3rd dose and 1h after the dose has been given. Aim for a pre-dose of <2mg/l and a post-dose of 5-10mg/l (in severe infections aim for at least 8mg/l). The microbiologist will normally suggest if any dosage adjustment is required.
Infective endocarditis: Current BSAC guidelines recommend an initial dose of 1mg/kg tds however 80mg bd is usually sufficient in elderly patients. Target pre-dose level is lower at 1mg/l and recommended 1 hour post dose level is between 3 and 5mg/l. Caution is needed in the second week and subsequently as gentamicin toxicity associated with renal impairment is not uncommon.

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Teicoplanin assays

The pharmacokinetics of teicoplanin are less predictable than vancomycin.
Contrary to the manufacturers view, professional microbiology guidelines in the UK recommend that antibiotic assays for treatment of severe infection should always be performed.
A loading period is essential in the first 24 hours of therapy to ensure adequate levels and should not be forgotten. The manufacturers recommend that three doses of 400mg are given 12 hours apart and thereafter 400mg is given every 24hrs. An alternative is to give an initial dose of 800mg followed by 400mg every 24 hours.
No local assay service is available and samples are sent away which normally gives a 48 –72 hour turnaround for results. Sending assays on Friday and Saturday should be avoided.
Use in renal failure is not recommended as no local assay service is available and the delay in sending samples away compromises correct dosing.
The spectrum of coagulase negative staphylococci covered by teicoplanin is less than vancomycin.
Vancomycin is recommended instead of teicoplanin for inpatient use except when gentamicin is being used, when evidence of less nephrotoxicity related to the combination of teicoplanin and gentamicin as against vancomycin and gentamicin may mean teicoplanin use is preferred but please always consult microbiology before prescribing teicoplanin.
Trough levels of teicoplanin should be measured once the patient has had 2 teicoplanin doses 24 hours apart. Use a plain red topped tube.
Levels are not always required with short courses in patients with normal renal function. However they are advised in renal impairment, obesity and those not responding to treatment to ensure appropriate levels. Use in severe renal failure is not recommended as no local assay service is available and the delay in sending samples away compromises correct dosing.
Pre-dose blood levels exceeding 10mg/l are associated with good outcomes in general infections but special situations warrant higher levels. Levels of >20mg/l are required for good prognosis in endocarditis and we would recommend similar levels are achieved when treating prosthetic joint infection.

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Itraconazole and voriconazole levels

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

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

No local service is provided and these assays are sent away and batched so a 48 hour to 7 day delay in reporting assays is usual.
Trough therapeutic levels of itraconazole should be maintained above 0.5ug/l.(500-1000ng/ml).
Voriconazole trough levels in the 1-5mg/l range are to be expected.

Other antibiotic assays

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

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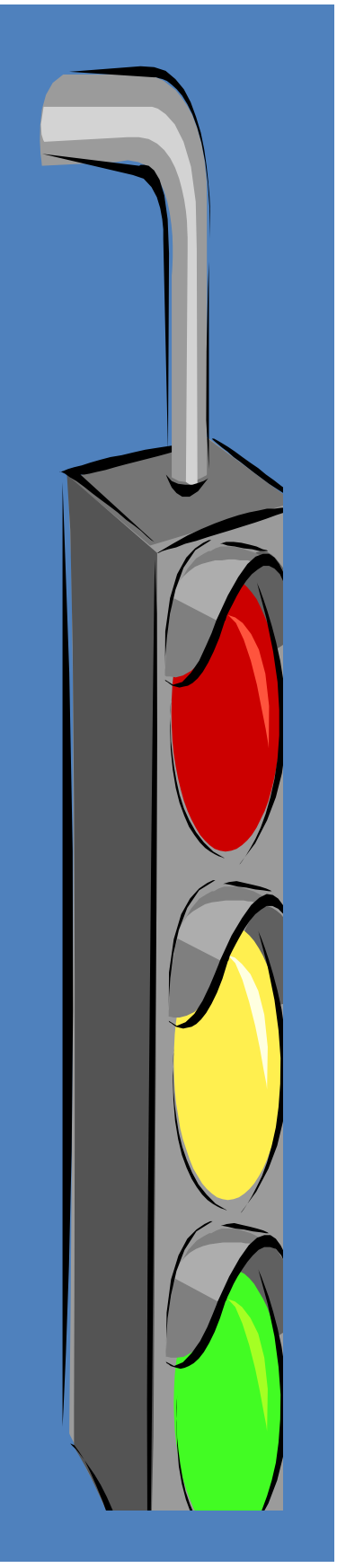
Appendix 1

PENICILLIN ALLERGY ALERT



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

Remember

Record allergies carefully in the notes and on the drug chart.
Check with the patient and the allergy section of the drug chart prior to all drug administration.
In TRUE penicillin allergy ALL penicillins, cephalosporins and other beta-lactam antibiotics should be avoided.

Contraindicated (In severe infection seek pharmacy or microbiology advice)

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

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

Cefaclor	Ceftazidime	Ertapenem
Cefalexin	Ceftriaxone	Imipenem
Cefixime	Cefotaxime	Meropenem
Cefradine	Cefuroxime	

Considered Safe

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

For further information contact an antibiotic pharmacist or ward pharmacist.
Produced by Shola Olowosale (pre-registration pharmacist, 2009-10 PRH)

Appendix 2 - **Restricted Antibiotics – Adults**

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

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

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

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

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Appendix 3 – IV Antibiotics that may be used in an out-patient setting.

Intravenous antibiotic therapy can be administered in an out-patient setting in a stable patient. This can be provided via Shropshire community services or by DAART.
The choice of agent depends on the condition and any microbiology results. Generally the agent chosen should be administered once daily though twice daily dosing can sometimes be accommodated.
Protocols already exist for cellulitis and are being developed for other conditions. Specialist teams may have their own protocols. In all cases it is important that patients are reviewed regularly.
Seek microbiology advice on choice of agent if a protocol does not exist.
Remember that iv therapy may not be necessary if adequate doses of antibiotics are given or with agents with good bioavailability.

Potential Agents and Common Uses

Ceftriaxone 1g-4g daily
- Cellulitis
- Pneumonia

Teicoplanin 12mg/kg loading then 6-12mg/kg daily
- Cellulitis
- Bone and joint infection

Ertapenem 1g daily
- UTI

Daptomycin 4-6mg/kg daily
- Cellulitis

Ceftazidime 3g-6g daily
- Bronchiectasis

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Appendix 4 -Alternative Antibiotics During Piperacillin/Tazobactam Shortage

The below recommendations are ONLY to be used where piperacillin/tazobactam would have been the treatment recommended in the current antibiotic policy. Note piperacillin/tazobactam is seldom the first line choice. First choice regimes should be as in the main antibiotic policy.

Indication	1st Choice	2nd Choice
Hospital Acquired Pneumonia	Cefuroxime	Vancomycin and Ciprofloxacin (oral unless NBM)
Urinary Tract Infections with renal impairment	Single dose gentamicin 2mg/kg then Ciprofloxacin (use oral unless NBM)	History of ESBL Meropenem or Ertapenem
Sepsis with renal impairment or Sepsis in >80y	Single dose gentamicin 2mg/kg then Flucloxacillin*, Metronidazole and Ciprofloxacin (use oral unless NBM)	History of ESBL Meropenem or Ertapenem *Use vancomycin if penicillin allergic
Abdominal Infection with renal impairment	Amoxicillin*, Metronidazole and Ciprofloxacin (use oral unless NBM)	*Use vancomycin if penicillin allergic
Neutropenic Sepsis	Piperacillin/tazobactam unless no stock available in which case use Meropenem	Severe penicillin allergy – as per guidelines

Please discuss with Microbiology/Pharmacy if you have any questions

Doses

Amoxicillin 1g tds (consider up to 2g tds if >100kg)

Cefuroxime 1.5g tds

Ciprofloxacin po 500mg bd (od if GFR<30ml/min)

Ciprofloxacin iv 400mg bd, (od if GFR<30ml/min)

Ertapenem 1g od (500mg od if GFR <30ml/min)

Flucloxacillin iv 1g qds (consider up to 2g qds if >100kg)

Meropenem 1g tds

Vancomycin – as per antibiotic guidelines

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