

MicroGuidance (Hospital Adult)

When male and female are stated within this policy, it refers to sex assigned at birth

Antibiotic 'rules' of thumb are broad generalisations which can be used before sensitivity results are available. There are always exceptions & patterns are less predictable now than ever before.

Practice points

- Sensitivity testing of the causative organism is important for deep or invasive infections and/or those not responding to treatment. Please send relevant samples – especially blood cultures wherever possible BEFORE antibiotics are given.
- Check to see if the patient has a previous positive ALERT organism like an ESBL, MRSA, CPE, VRE etc. This may influence your initial empiric treatment.
- Some microorganisms are difficult to isolate and methods such as 16S rDNA PCR (for bacteria) and/or 18S rDNA PCR (for fungal species) may be required.
- Therapeutic drug monitoring is required for gentamicin & vancomycin ([refer to protocol, click here to access](#))
- Check to see if patients have travelled abroad – especially recently (within 12 weeks): they may be at risk of different infections or infections with different resistance patterns to local patterns – especially if they had hospital treatment outside Scotland.
- Patient not improving?** Check: correct antibiotic(s), dose, and route. Have you got source control or is there an abscess, deep infection, medical device with biofilm or new infection or selection out of resistant strains?
- Some antibiotics are restricted** e.g. meropenem ([refer to protocol, click here](#))
- Antimicrobial Susceptibility Testing**
Reporting of antibiotic susceptibility is changing in line with EUCAST recommendations. Antibiotics will be reported as 'I' as well as the more familiar 'S' and 'R'.

Before you call MICRObiology for advice please have the following details to hand:

Main complaint & history; current & recent antibiotic history
Initial assessment & Investigations; radiology, samples to determine infection focus
CRP, WCC; results & trends
Renal function; allergy
Observations (NEWS, SEPSIS 6, CURB65 etc)

[Link for Hospital Antibiotic Guidance](#)

[Link for Antibiotic website](#)

You must contact Public Health and Infection Prevention & Control for certain infections the list is here:

[Link for Microbiology Handbook](#)

All positive blood cultures are phoned to medical staff: no need to contact laboratory – when we know – you do!

Think about placement (single room?), your personal protective equipment (PPE) for patients with rash, fever, cough, diarrhoea.

[Link for Infection Prevention & Control](#)

- Gram negative 'coliforms' (eg *E. coli*, *Klebsiella*, *Enterobacter*, *Proteus*) & *Pseudomonas aeruginosa* are usually sensitive to gentamicin. Amoxicillin only covers 47% of *E. coli*: when you stop gentamicin you might not have good coliform cover. Check sensitivities.
- Co-trimoxazole covers about 65% of *E. coli*.
- Extended Spectrum Beta Lactamases (ESBL) are resistant to most penicillins (including co-amoxiclav, piperacillin-tazobactam & aztreonam).
- Temocillin, pivmecillinam (& meropenem) usually have cover for ESBLs.
- Temocillin & ertapenem do not cover pseudomonas.
- Pip-tazobactam, co-amoxiclav (& meropenem) have anaerobic cover so metronidazole is not needed.
- Temocillin & aztreonam have **no** anaerobic or gram positive cover
- Carbapenem - resistant enterobacteriales (CRE) are resistant to penicillins, cephalosporins, pip-tazobactam, temocillin, carbapenems & often other classes of antibiotics – aztreonam, gentamicin, ciprofloxacin, co-trimoxazole. Early detection (screening/single room of those having healthcare from outside Scotland & screening patients from other Scottish hospitals), strict adherence to standard & transmission based infection prevention and control precautions & prudent prescribing including of meropenem must be in place to reduce impact of spread of these virtually untreatable bacteria.

- Anaerobes are generally sensitive to metronidazole (and co-amoxiclav, clindamycin, pip-tazobactam & meropenem)

- Gram positives like *Staph aureus* (MSSA, MRSA), streps & enterococci are sensitive to vancomycin (except VREs): use restricted to penicillin allergy or penicillin resistant strains
- MRSA is resistant to all beta-lactams (penicillins, flucloxacillin, pip-tazobactam, cephalosporins & meropenem)
- VRE are resistant to vancomycin & meropenem
- Beta-haemolytic streps (groups A C G) are sensitive to penicillin & flucloxacillin

CENTRAL NERVOUS SYSTEM

Meningitis [refer to protocol, click here to access](#)
Meningitis: pneumococcus, meningococcus & if ≥60 years: *Listeria*
Encephalitis: herpes simplex

Send blood cultures, throat swab (bacterial transport medium)/viral throat swab (viral transport medium), EDTA for bacterial PCR and CSF where safe to do so.

ENT

Epiglottitis: *Haemophilus influenzae*, streptococci
Tonsillitis: Group A streptococci
Sinusitis: pneumococcus
Acute otitis media: pneumococcus, *Haemophilus influenzae*

See ENT specialist guidelines [refer to protocol, click here to access](#)

LUNG

CAP [refer to protocol, click here to access](#)

CAP Mild/moderate: pneumococcus, *Haemophilus influenzae*
CAP Severe: as above but possible coliforms and atypicals such as *Legionella*, *Mycoplasma*, *Chlamydia pneumoniae*, *Coxiella* : Remember *Staph aureus* pneumonia post influenza and the PVL producing strains of *Staph aureus* that can produce severe pneumonia in children and young adults especially please contact micro/make clear on form to add extra tests for this

Acute exacerbation of COPD: pneumococcus, *Haemophilus influenzae*

HAP: pneumococcus, *Haemophilus influenzae* and coliforms. *Legionella* can be hospital acquired.

Send blood cultures, clotted blood for atypical bacteria (acute & convalescent), throat swab in viral transport medium, sputum for bacterial culture, BAL or tracheal aspirates as indicated clinically (suitable for PCR for *Legionella* and PCR for PCP if induced sputum cannot be done), urine (white topped sterile universal) for *Legionella* antigen serogroup 1 (95% of cases).

ENDOCARDITIS [refer to protocol, click here to access](#)

Native valve acute : *Staph aureus*: take 2 sets blood cultures & start antibiotic within the hour
Native valve subacute : viridans streptococci, enterococci : 3 sets blood cultures 6 hours apart if patient stable
Prosthetic valve, MRSA (resistant to flucloxacillin and all beta lactams); coagulase negative staphylococci

CVC RELATED INFECTION

Samples: Send blood cultures taken from peripheral site & line using strict aseptic technique. Swab exit site if infected then commence antibiotics & other investigations. Consider removal of line and if so send tip.

INTRA-ABDOMINAL INFECTION (not infectious diarrhoea such as *E coli* O157, *Campylobacter* etc)

Clostridioides difficile: [refer to protocol, click here to access](#)

Peritonitis/biliary tract sepsis/intraabdominal: polymicrobial coliforms, anaerobes & enterococci

Spontaneous bacterial peritonitis: coliforms +/- anaerobes, sometimes *Strep pneumoniae*: [refer to protocol, click here](#)

Samples: Send blood cultures, pus or other intra-abdominal samples as appropriate

Special notes for *E coli* O157/STX 1/2

[Click here for HPS resources](#)

- Notify Health Protection & Infection Prevention and Control on suspicion
 - Discuss children with bloody diarrhoea/HUS/confirmed O157 with on call paediatric doctor. Discuss adults who are unwell with possible/confirmed HUS with Infectious Diseases
 - HUS is more common in under 5s and over 65s. Most develop 6-8 days post onset of symptoms- unlikely after >14 days
 - It is more common in those with bloody diarrhoea or who are unwell
- Faeces for culture & reference laboratory tests
Haematology: FBC, film for fragmented blood cells for suspected HUS or confirmed O157
Biochemistry: U&E, LDH, CRP for baseline assessment

URINARY TRACT

Female uncomplicated lower UTI: coliforms, enterococci

Male (no catheter): coliforms, enterococci

Complicated infections such as pyelonephritis, uresepsis: coliforms, *Pseudomonas aeruginosa*, enterococci

Samples: Send blood cultures and urine for culture if complicated infection, or male. Uncomplicated UTIs in females do not always require urine culture unless recurrent infection. DO NOT send catheter urine samples unless you consider this to be a source of infection and the patient has signs or symptoms of infection. They will nearly always yield bacteria, treatment does not improve outcome & may lead to side effects (& *C difficile*). [Click here](#) for guidance on catheter associated UTI

SKIN & SOFT TISSUE [refer to protocol, click here to access](#)

Cellulitis: *Staph aureus*, group A & other beta-haemolytic streptococci

Diabetic foot acute: *Staph aureus*

Diabetic foot acute on chronic polymicrobial: *Staph aureus*, coliforms & anaerobes

Advice on wound care can be accessed here. [Refer to protocol, click here to access.](#)

Samples: If severe or systemic infection take blood cultures. Swab wounds having removed superficial debris; Flora on surface of wound may be different to that causing infection. Wound swabs cannot distinguish between infection and colonisation. Previous exposure to antibiotics may select out coliforms and *Pseudomonas* in particular. Colonisation does not need or respond to antibiotic treatment.

SEPTIC ARTHRITIS/OSTEOMYELITIS [refer to protocol, click here to access](#)

Staph aureus

Send blood cultures (before antibiotics where possible), joint aspirates/washouts & bone samples. Consider any distant foci of infection

Antibiotic rules

- Pneumococci & meningococci are usually sensitive to penicillin
- Ceftriaxone is chosen because of the need for high CSF levels to be maintained & the ease of dosing (twice a day).
- Provides better cover for the rare strain that may have borderline sensitivity to penicillin
- Listeria* is resistant to cephalosporins but sensitive to amoxicillin: high dose & frequent dosing (4 hourly) needed for high CSF levels. Amoxicillin is used instead of Ampicillin for this indication in Tayside.
- Herpes simplex is sensitive to IV acyclovir- oral is not appropriate

Antibiotic rules

- All beta-haemolytic streptococci (groups A B C & G) are usually sensitive to penicillin
- Pneumococci & meningococci are usually sensitive to penicillin but amox has better absorption when given orally
- Most (77%) *Haemophilus influenzae* are sensitive to amoxicillin (not penicillin). Commonest resistance is beta-lactamase production. Life threatening illnesses like epiglottitis are therefore treated with ceftriaxone for high tissue levels, ease of dosing and better empiric cover for those that are amoxicillin resistant
- Most (97%) *Haemophilus influenzae* are sensitive to doxycycline. It is well absorbed & distributed.
- 87% of pneumococci are sensitive to doxycycline

Antibiotic rules

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- Pneumococci are usually sensitive to penicillin but amoxicillin has better absorption when given orally
- Most (97%) *Haemophilus influenzae* are sensitive to doxycycline. It is well absorbed & distributed
- 87% of pneumococci are sensitive to doxycycline
- Co-amoxiclav provides cover for most *Haemophilus influenzae* & coliforms for those with severe infection (not ESBLs or CPEs though)
- Doxycycline is used for atypical cover (not used for *Legionella*)
- Levofloxacin** (use restricted to severe CAP protocol) has good cover against MSSA, *Haemophilus influenzae*, pneumococci, coliforms & legionella
- Clarithromycin has atypical cover but doxycycline is preferred

Antibiotic rules

- Endocarditis may need high doses (= iv), prolonged duration (4-6 weeks), bactericidal (killing rather than slowing growth) to penetrate vegetations, eliminate bacteraemia and reduce risk of septic emboli
- For acute presentation *S aureus* is targeted with high dose flucloxacillin as valve destruction & emboli are a risk
- Indolent presentation Enterococci/streps more likely: synergistic amox/gent (1mg/kg bd) pending culture results
- Coagulase negative staphylococci have unpredictable sensitivity to flucloxacillin, MRSA is resistant, so synergistic combination of vancomycin, gentamicin (1mg/kg bd) & rifampicin (started 3-5 days after vancomycin) is used to ensure cover, killing & penetration
- Most Enterococci are sensitive to amoxicillin but testing is required
- Staph aureus* bacteraemias are treated with 2 weeks IV therapy
- Line removal will be required especially for fungal, coliform, *Pseudomonas*, *Staph aureus* CVC infection

Antibiotic rules

- Anaerobes are generally sensitive to metronidazole
- Coliforms are generally sensitive to gentamicin and most to aztreonam
- Only 47% of *E coli* are sensitive to amoxicillin; when you stop gentamicin you may not have adequate Gram negative cover
- Most Enterococci are sensitive to amoxicillin but testing is required
- 65% of *E coli* are sensitive to co-trimoxazole
- Enterococci may be sensitive to co-trimoxazole, but testing is required: they rarely cause infection without coliforms
- ESBLs are resistant to most penicillins & cephalosporins including aztreonam, co-amoxiclav & pip-tazobactam
- Most ESBLs are sensitive/intermediate to temocillin (& meropenem available on infection specialist advice only)
- Sensitivity of ESBLs to co-trimoxazole is unpredictable

Antibiotic rules

- Only 47% of *E coli* are sensitive to amoxicillin
- Coliforms are generally sensitive to gentamicin and most to aztreonam
- 65% of *E coli* are sensitive to trimethoprim (which can be used as a single agent rather than co-trimoxazole in uncomplicated UTI)
- Nitrofurantoin has no kidney tissue penetration & is not excreted in urine in renal impairment. So not used for anything other than uncomplicated lower UTIs in females & males
- Fosfomycin can be used for oral treatment of ESBLs where pivmecillinam, co-trimoxazole, nitrofurantoin or other agents can't be used. [Refer to protocol, click here to access.](#)

Antibiotic rules

- Flucloxacillin will cover beta-haemolytic streptococci (A C & G); so penicillin is not required in addition. Group B streptococci are NOT reliably treated with flucloxacillin
- Doxycycline will cover most *Staph aureus* (including MRSA) & beta-haemolytic streptococci
- Co-trimoxazole will cover 67% of coliforms
- Co-trimoxazole will cover 98% of *Staph aureus* (including MRSA)
- Consider MRSA cover if patient is known to be positive until sensitivity results are back

Antibiotic rules

- Flucloxacillin will cover beta-haemolytic streptococci (A C & G); so penicillin is not required in addition. Group B streptococci are NOT reliably treated with flucloxacillin
- Need high doses (iv), prolonged duration (4-6 weeks), bactericidal (killing rather than slowing growth) to penetrate joint and tissue, eliminate bacteraemia & reduce risk of septic emboli

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Severe Systemic Infection Source Unknown: take blood cultures and other samples as appropriate

Amoxicillin + gentamicin + metronidazole (consider flucloxacillin/vancomycin if staphylococcal infection suspected e.g. PWID) Penicillin allergic: vancomycin + gentamicin + metronidazole