Guidelines for the empiric use of antimicrobials in adults

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Feidhmeannacht na Seirbhíse Sláinte
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GENERAL GUIDANCE

1. **NB: The prescriber should always check prescribing information such as cautions, contraindications, interactions and side effects when considering antimicrobial therapy. Ensure information on antimicrobial prescribing, including risks and side effects associated with antimicrobial treatment, is available to patients or their legal guardians.**[1]

2. Where possible indicate intended duration of therapy at point of initial prescribing. Review IV antimicrobial therapy daily.

3. Document indication for therapy and intended duration in medical record. Note these guidelines are intended for empiric therapy. Rationalise when microbiology results become available. **It is the responsibility of the person/team ordering laboratory tests to follow up on the results to guide appropriate clinical management of the patient.**

4. Piperacillin-tazobactam and co-amoxiclav provide **good anaerobic cover**. Concurrent metronidazole is **NOT** required unless there is gross faecal contamination – e.g. faecal peritonitis. Treatment of aspiration pneumonia does **NOT** require addition of metronidazole to either of these antibiotics.

5. Some antibiotics e.g. **ciprofloxacin, levofloxacin, sodium fusidate** and **metronidazole** have **excellent oral bioavailability** and the oral route should be used where possible. IV formulations of these should **only** be used if the patient is **not absorbing or unable to have oral medications.**

6. Oral switch – consider when patient is afebrile and infection parameters are settling for 48 hours and normal oral absorption. Generally **NOT** appropriate in **meningitis, endocarditis, febrile neutropenia** or **acute osteomyelitis/septic arthritis.**

7. For oral switch guidelines see pg 34. Oral switch is usually to PO formulation of same antibiotic where available, **except IV benzyl penicillin to PO amoxicillin** as oral absorption of penicillin is very poor.

8. **Penicillin allergy: obtain & document proper history**. If IgE mediated allergic reaction (e.g. anaphylaxis, angioneurotic oedema, immediate urticaria) avoid all beta-lactams. If rash only, a cephalosporin may be considered. Erythromycin is often **NOT** a good substitute.

9. Flucloxacillin and other betalactams such as co-amoxiclav, piperacillin-tazobactam, cephalosporins and meropenem **do not cover MRSA**.

10. Risk of *Clostridium difficile* associated with all antibiotic use. Particular risk with all fluoroquinolones (e.g. levofloxacin and ciprofloxacin), clindamycin and cephalosporins.

11. **Note that sodium fusidate acid and rifampicin should never be used as monotherapy**

12. Note on Macrolides (eg erythromycin, clarithromycin): This class of antibiotics has a number of side effects, interactions and contraindications that should be taken into account when prescribing. Caution should be particularly exercised in patients with cardiac history and the elderly.

Restricted/Reserve Antimicrobials:

A Cochrane review has found that reserving access to selected antimicrobials is the most effective component of any Antimicrobial Stewardship Programme.[10]

Below is the list of Restricted and Reserve antimicrobials for the SE Acute Hospitals.

These antimicrobials should only be prescribed when this is in line with the recommendations of this guideline or following discussion with the Clinical Microbiologist.

Indication for therapy and any discussions/advice from the Clinical Microbiologist should be documented accurately in patient's medical record.

Restrictions are in place which limit access to these Antimicrobials. Please refer to *South East Acute Hospitals Guidelines for use of Reserve and Restricted Antimicrobials* for details.

Restricted Antimicrobials

IV Piperacillin/Tazobactam
IV Ceftazidime
IV Ceftriaxone
IV/PO Ciprofloxacin
IV/PO Levofloxacin
IV Chloramphenicol
IV/PO Clindamycin
IV Teicoplanin
IV Vancomycin
IV Meropenem
IV Amikacin

***Reserve Antimicrobials**

IV Cefotaxime
IV/PO Ofloxacin
IV Colistin
IV/PO Linezolid
IV Daptomycin
IV Tigecycline
PO Fidaxomicin
IV Ceftaroline
IV/PO Fosfomycin
IV Aztreonam
IV Cefazolin
IV Ertapenem
IV/PO Tedizolid
IV/PO Moxifloxacin

Antifungals

Liposomal Amphotericin B
Anidulafungin
Caspofungin
Voriconazole
Posaconazole

* Reserve antimicrobials should only be prescribed when recommended by a Consultant and following discussion with the Clinical Microbiologist.

MRSA
(Meticillin Resistant Staphylococcus aureus)

Infection with MRSA should be suspected if:

- Patient has previously been colonized with MRSA. (Please check patient notes, laboratory results and any currently in use/appropriate Infection Control alerts such as Laboratory SIF code, IPMS Infection Control alert, etc.)
- Recent hospitalization (within 12 months)
- Transfer from another hospital or long term care facility.
- Other situation where increased clinical suspicion of MRSA (Please refer to most recent edition of: Policy on Control and Prevention of Meticillin Resistant Staphylococcus aureus (MRSA) in Acute Hospitals in the HSE/SE for additional information)

If MRSA infection is suspected, consider including a glycopeptide (Vancomycin or Teicoplanin, see page 30-31) in the empiric treatment regimen.

MRSA eradication: Please refer to most recent edition of: Policy on Control and Prevention of Meticillin Resistant Staphylococcus aureus (MRSA) in Acute Hospitals in the HSE/SE.

Start Smart, Then Focus

An Antibiotic Care Bundle for Hospitals

Day 1: Start Smart...

1. Start antibiotics only if there is clinical evidence of bacterial infection
   - If there is evidence of bacterial infection, prescribe in accordance with your local antibiotic guidelines and appropriately for the individual patient (see notes below)

2. Obtain appropriate cultures before starting antibiotics

3. Document in both the drug chart and medical notes:
   - Treatment indication
   - Drug name, dose, frequency and route
   - Treatment duration (or review date)

4. Ensure antibiotics are given within four hours of prescription
   - Within 1 hour for severe sepsis or neutropenic sepsis

When deciding on the most appropriate antibiotic(s) to prescribe, consider the following factors:
- History of drug allergy (document allergy type: minor (rash only) or major (anaphylaxis, angioedema))
- Recent culture results (e.g. is patient colonised with a multiple-resistant bacteria?)
- Recent antibiotic treatment
- Potential drug interactions
- Potential adverse effects (e.g. *C. difficile* infection is more likely with broad spectrum antibiotics)
- Some antibiotics are considered unsafe in pregnancy or young children
- Dose adjustment may be required for renal or hepatic failure

Consider removal of any foreign body/indwelling device, drainage of pus, or other surgical intervention

For advice on appropriate investigation and management of infections, consult your local infection specialist(s) (microbiologist, infectious disease physician and/or antimicrobial pharmacist)

...then Focus (Day 2 onwards)

At 24-48 hours after starting antibiotics, make an **Antimicrobial Prescribing Decision**

- Review the clinical diagnosis
- Review laboratory/radiology results
- Choose one of the five options below
- Document this decision

Options

1. Stop antibiotic(s)
   - no evidence of bacterial infection, or infection resolved
2. Switch from intravenous to oral antibiotic(s)
   - if patient meets criteria for oral switch
3. Change antibiotic(s)
   - narrower spectrum, if possible; broader spectrum, if indicated
4. Continue current antibiotic(s)
   - review again after further 24 hours
5. Outpatient parenteral antibiotic therapy
   - consult with local OPAT team

Developed by the RCPI Hospital Antimicrobial Stewardship Working Group (2012)
Adapted, with permission, from the UK Department of Health "Start Smart, Then Focus" hospital antimicrobial stewardship programme

Evaluation and Management of a patient with suspected Sepsis

1 Consider Sepsis

Sepsis =Known or Suspected Infection & Systemic Inflammatory Response Syndrome (SIRS)
Defined as the presence of 2 or more of the following:

Temperature >38°C or <36°C

Respiratory Rate >20 breaths per min

PaCo2 <4.3 kPa

Heart Rate >90 beats per min

White Cell Count > 12 or <4

2 Intervention - Action within one hour

COMPLETE SEPSIS SIX

1. High Flow Oxygen
2. Lactate Check
3. Fluid Challenge
4. Urine output measurement
5. CULTURES*
6. Antimicrobial Therapy

(*blood, wounds, sputum, urine, CSF, invasive line sites etc. as appropriate)

3. Assess patient to determine possible Source

- Urinary Tract
- Skin, soft tissue, bone, joint
- Abdominal, pelvic
- Respiratory Tract infection
- Intravascular catheter or prosthetic device
- Travel history
- Recent antibiotic treatment

4. Antimicrobial Therapy

Source Known	Source Unknown	
****Refer to relevant section of this guideline for empiric therapy****	**ASSESS FOR RISK OF RESISTANT ORGANISMS**[22] (ref Irish MDRO guidelines) 1. Check MDRO Flag on IPMS/Health Care Record/WRLAB 2. Check previous Microbiology results	
	Stable	**Unstable - Life Threatening Sepsis**
	Piperacillin/Tazobactam (Tazocin) 4.5g tds +/- gentamicin ***If hypotensive or severe infection add gentamicin,** see page 26-27 for dose & monitoring. PEN ALLERGY: Teicoplanin, Gentamicin, Metronidazole MRSA See page 5 of guidelines for risk factors for MRSA Add vancomycin (or teicoplanin if patient already on gentamicin), see page 31 for dosing.	**Piperacillin/Tazobactam** 4.5g tds + **amikacin**, Refer to page 28-29 for dosing & monitoring of amikacin. PEN ALLERGY: Teicoplanin, Amikacin, Metronidazole MRSA See page 5 of guidelines for risk factors for MRSA Add vancomycin (or teicoplanin if patient already on gentamicin), see page 31 for dosing.

5. Refer to **Adult Sepsis Management Algorithm** (Opposite page), NEWS Score & National Sepsis Guidelines[14]

6. Rationalise antimicrobial therapy when results of Blood cultures and Microbiology results available.

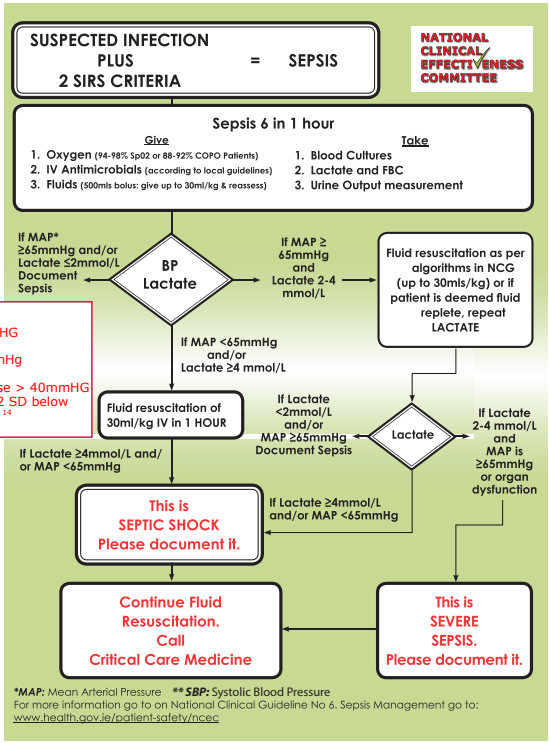
Adult Sepsis Management Algorithm

Feidhmeannacht na Seirbhíse Sláinte
Health Service Executive

NATIONAL CLINICAL EFFECTIVENESS COMMITTEE

Adult Sepsis Management Algorithm

Guidance to be read in conjunction with National Clinical Guideline No. 6 Management of Sepsis in Ireland [14]



MAP: Mean Arterial Pressure ***** SBP:*** Systolic Blood Pressure
For more information go to on National Clinical Guideline No 6. Sepsis Management go to:
www.health.gov.ie/patient-safety/ncec

Further information

www.health.gov.ie/patient-safety/ncec
www.hse.ie/sepsis
www.hse.ie

Tús Áite do Shábháilteacht Othar
Patient Safety First

	Condition	Antibiotic	Comments
Septicaemia/ Systemic Sepsis	Assess patient re possible focus of infection –e.g. urinary tract, skin/soft tissue, abdominal, chest, neurological., community or hospital acquired, travel history, recent antibiotic therapy, presence of prosthetic devices, intravascular catheters, etc. **Watch for hypotension**	**Initial empirical therapy if no obvious source: Piperacillin-tazobactam 4.5g IV TDS.** Consider adding gentamicin if haemodynamically unstable / severe infection. Consider need for additional gram positive cover e.g vancomycin(or teicoplanin if patient is already on gentamicin) *Penicillin allergy:* Gentamicin, metronidazole plus teicoplanin **Severe sepsis** (life threatening) use amikacin **instead of** gentamicin, especially if multi-drug resistance suspected. Levels must be monitored. (See page 28-29 for dosing).	**Consider if patient at risk for infection due to MRSA , if so, add vancomycin.** Consider other **multiresistant organisms eg ESBL, VRE, CRE.** Check previous laboratory results Ensure blood cultures taken. **See individual infection treatment guidelines for appropriate therapy.** Refer to NEWS Score of the adult patient observation chart and Sepsis Six. **Rationalise with results of blood culture ID and sensitivities**

CONSIDER SEPSIS

Sepsis = Known or Suspected Infection & Systemic Inflammatory Response Syndrome (SIRS)

Defined as the presence of 2 or more of the following

Temperature > 38°C or < 36°C
Respiratory Rate > 20 breaths per min
$PaCO_2$ < 4.3 kPa
Heart Rate > 90 beats per min
White Cell Count > 12 or < 4

Diagnosed Sepsis

Intervention: Action within One Hour COMPLETE SEPSIS SIX

1. High Flow Oxygen
2. Lactate Check
3. Fluid Challenge
4. Urine Monitoring
5. Cultures*
6. Antimicrobial Therapy

(* blood, wounds, invasive line sites, sputum, urine etc as appropriate)

See also National Sepsis Guideline on page 12 and 13.

Adapted from: HSE Adult Patient Observation Chart. [12]

	Condition	Antibiotic	Comments
Neutropenic sepsis[9] Please also refer to section on severe sepsis (life threatening) on previous page	Neutropenia = Neutrophil Count < 1.0 Severe Neutropenia = Neutrophil Count < 0.5 Fever = Temperature > 38°C	**Initial Empiric therapy: Piperacillin-tazobactam 4.5g QDS IV.** Add gentamicin if complications (e.g. hypotension, pneumonia or antimicrobial resistance suspected or critically ill). Consider adding vancomycin or teicoplanin for specific clinical indications e.g. suspected CVC-related infection or complications as above. *Penicillin allergy (Not Severe reaction/ anaphylaxis):* Ceftazidime 2g TDS IV plus vancomycin or teicoplanin. *Severe reaction/anaphylaxis to penicillin:* Ciprofloxacin plus gentamicin plus teicoplanin	**At least 2 sets of blood cultures recommended** from each lumen of CVC and peripheral **OR** peripheral X 2 if no CVC is present. Culture of urine, stool, CSF, skin and respiratory specimens should be guided by clinical signs / symptoms **but should not be performed routinely.** **Persistent fever after 4 days of antibiotic therapy: consider adding empiric antifungal agent.** Consider need for viral testing &/or antiviral therapy if clinical indication
Sepsis in Pregnancy	**Refer to Septicaemia/ Systemic Sepsis on p10.** Clinical features suggestive of sepsis in pregnant women: Fever/Rigors, Diarrhoea/ Vomiting, Rash, Abdominal/ Pelvic Pain and Tenderness, Offensive Vaginal Discharge, Cough, Urinary Symtoms.[11]	**Initial empirical therapy: Piperacillin-tazobactam 4.5g IV TDS.** Consider adding gentamicin 3-5mg / kg once daily[11] (use booking weight) if haemodynamically unstable / severe infection. Consider need for additional gram positive cover e.g vancomycin (or teicoplanin if patient is already on gentamicin) Add clindamycin if invasive Group A Strep Infection suspected. Severe sepsis (life threatening) use meropenem 1-2g TDS.	Refer to NEWS/MEOWS Score and Sepsis Six. Relevant imaging studies should be performed promtly. Inform Consultant Obstetrician **Refer to Critical Care Team and seek expert advice from microbiologist when severe sepsis is suspected.** Refer to RCOG Guideline: Bacterial Infection in Pregnancy for further detailed guidance.[11]

Early Detection and Treatment of Sepsis Saves Lives

SEPSIS GUIDE

(Non-Pregnant Adults)

IRELAND

1 IS SEPSIS SUSPECTED?

Is the National Early Warning Score Triggering Sepsis Screening?

NEWS ≥ 4 (5 on supplementary O_2)

NEWS Key (IRL)

Score ▶	3	2	1	0	1	2	3
Respiratory Rate (bpm)	≤ 8		9-11	12-20		21-24	≥25
SpO_2 (%)	≤ 91	92-93	94-95	≥96			
Inspired O_2 (F_iO_2)				Room Air			Any O_2
Systolic BP (mmHg)	≤ 90	91-100	101-110	111-249	≥250		
Heart Rate (BPM)		≤ 40	41-50	51-90	91-110	111-130	≥131
AVPU				A			V P U
Temp (°C)	≤35.0		35.1-36.0	36.1-38.0	38.1-39.0	≥39.1	

Use clinical judgement. Escalate care regardless of the score if you are concerned about a patient.

2 ARE ANY *2 OR MORE* MODIFIED SIRS CRITERIA PRESENT?

- Respiratory rate > 20 (bpm)
- Heart rate > 90 (bpm)
- WCC < 4 or > 12 x 109/L
- Temperature < 36 or > 38.3 (°C)
- Acutely altered mental status
- Bedside glucose > 7.7mmol/L (in the absence of diabetes mellitus)

+ INFECTION SUSPECTED

If Yes: THIS IS SEPSIS

Note: Some groups of patients, such as older people, may not meet the modified SIRS criteria, even though infection is suspected.

Where this occurs, check for signs of organ dysfunction and raised biomarkers such as C-reactive protein (CRP)

3

SEPSIS SIX – AIM TO COMPLETE WITHIN 1 HOUR

TAKE 3

1. **Blood cultures** before giving antibotics
   Do not delay antibiotic administration >1 hour if blood cultures are difficult to obtain. Send samples from potentially infected sites eg.sputum, urine, wounds, IVC/CVC. Consider source control.
2. **Lactate** and **FBC**.
3. **Urine output** measurement.

GIVE 3

4. **O_2** (94-98% SpO_2 or 88-92% in COPD patients).
5. **IV fluid resuscitation** (500ml bolus – give up to 30ml/kg) & reassess (target systolic BP > 90 / MAP > 65). *Monitor response to IV fluids and titrate to effect.*
6. **IV antibotics** according to local guidelines.

Laboratory tests must be requested as EMERGENCY and aim to have results available and acted on within the hour

4

SEVERE SEPSIS

Look for signs of organ dysfunction:

- Systolic BP < 90 or Mean Arterial Pressure < 65 or Systolic BP more than 40 below patient's normal
- New need for oxygen to achieve saturation > 90%
- Lactate > 2 mmol/L (following administration of fluid bolus)
- Urine output < 0.5ml/kg for 2 hours – despite adequate fluid resuscitation
- Acutely altered mental status
- Glucose > 7.7 mmol/L (in the absence of diabetes)
- Creatinine > 177 micromol/L
- Bilirubin > 34 micromol/L
- PTR > 1.5 or aPTT > 60s
- Platelets < 100 x 109/L

Any organ dysfunction: THIS IS SEVERE SEPSIS
Registrar or Consultant to review immediately.

Reassess frequently in *1st hour*. Consider other *investigations and management*

5

SEPTIC SHOCK

Look for signs of septic shock (following administration of fluid bolus)

- Lactate > 4 mmol/L
- Hypotensive (Systolic BP < 90 or MAP < 65)

If either present: THIS IS SEPTIC SHOCK
Critical care consult required

- Consultant referral
- Consider transfer to a higher level of care
- Critical care consult requested

A critical care review may be requested at any point during this assessment, but is required for patients with Septic Shock. In a hospital with no critical care unit, a critical care consult must be made and transfer to a higher level of care considered, if appropriate, following the consult.

	Condition	Antibiotic	Comments
Urinary Tract Infections[3]	**Lower urinary tract infection** (uncomplicated)/ UTI in females.	First line: **Nitrofurantoin MR 100mg BD PO for 5 days** Second line: Co-Amoxiclav 625mg TDS PO for 3 days	Nitrofurantoin is not appropriate if creatinine clearance is < 50 ml/min, use co-amoxiclav (If not allergic to penicillin (discuss if needed)) In pregnancy nitrofurantoin may also be used but it should be avoided at term.
	Hospital acquired or recurrent UTI or complicated UTI/UTI in men.	Refer to recent culture results. If septicaemic: as for pyelonephritis	Patients with recurrent UTIs may have resistant organisms. **Use 7-10 days treatment in males.**
	Catheter associated UTI	For patients with catheter associated UTIs, antibiotics are unlikely to resolve the UTI unless the catheter is removed. If systemic sepsis suspected treat as per Pyelonephritis.	
	Pyelonephritis	**Piperacillin-tazobactam 4.5g TDS for 10-14 days.** *Penicillin allergy;* gentamicin (see page 26 for dosing regimen) and review at 48 hours.	Send blood cultures and MSU. **Rationalise therapy as soon as possible. Check culture and antimicrobial sensitivity results.**
	Prostatitis	**Ciprofloxacin 500-750mg BD PO for 2-6 weeks.**	Relapse common. Follow up advised. Check antimicrobial sensitivity where possible.

COMMUNITY ACQUIRED PNEUMONIA

Based on "British Thoracic Society guidelines for the management of community acquired pneumonia in adults: Update 2009."[4]

These guidelines are **not** aimed at:

(a) Patients with known predisposing conditions such as cancer or immunosuppression admitted with pneumonia to specialist units such as oncology, haematology, palliative care, infectious disease units or AIDS units

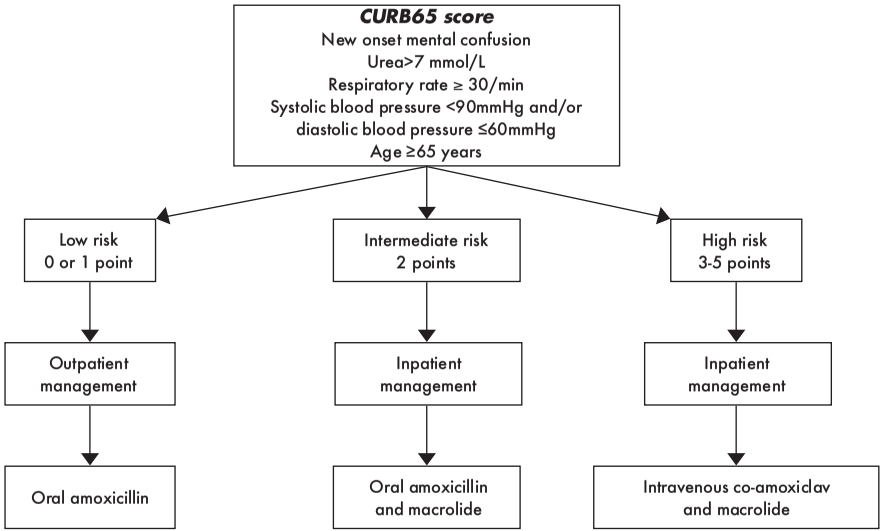
(b) Adults with non pneumonic LRTI, including illnesses labelled as acute bronchitis, acute exacerbations of COPD or "chest infections"

	Condition	Antibiotic	Comments
Respiratory Tract Infections	**Community Acquired Pneumonia**		**Community Acquired Pneumonia:** Assess severity using **CURB-65** score as per BTS guidelines: **C**onfusion (new onset) **U**rea >7mmol/L **RR**≥30/min **BP** - hypotensive: SBP <90mmHg or DBP ≤60mmHg **Age** ≥ 65 years CURB-65 score should be used with caution in younger patients as it may underestimate severity in these patients.

	Condition	Antibiotic	Comments
Community Acquired Pneumonia	**Low severity** (CURB65 = 0-1) <3% mortality	**Amoxicillin 500mg tds PO. (IV if PO administration not possible.)** *Penicillin allergy:* clarithromycin 500mg BD or doxycycline 200mg OD PO loading dose then 100mg OD PO.	No microbiological tests required. **7 days** appropriate antibiotic therapy is recommended.
	Moderate Severity (CURB65 = 2) 9% mortality	**Amoxicillin 500mg-1.0g tds PO plus clarithromycin 500mg bd PO.** **(IV if PO administration not possible.)** *Penicillin allergy:* PO doxycycline	Microbiology: Send blood cultures, sputum, urine for pneumococcal antigen. **7 days** appropriate antibiotic therapy is recommended.
	High severity (CURB65 = 3-5) 15 - 40% mortality	**Co-amoxiclav 1.2g tds IV plus clarithromycin 500mg bd IV.** **(If legionella strongly suspected consider adding levofloxacin)** *Penicillin allergy (NOT IgE mediated reaction /anaphylaxis):* cefuroxime 750mg-1.5g tds IV plus clarithromycin 500mg bd IV. *Severe IgE mediated reaction/anaphylaxis to penicillin:* levofloxacin 500mg PO/IV OD **(12 hourly if severe).**	Microbiology: Send blood cultures, sputum (requesting legionella culture), urine for pneumococcal antigen and legionella antigen, CRP. Consider switch to PO antibiotics as soon as clinical improvement occurs and patient is apyrexial for 24 hours. **7-10 days** appropriate antibiotics is proposed. This may need to be extended to **14-21 days** according to clinical judgement.
	Legionellosis	**Levofloxacin 500mg PO/IV OD (12 hourly if severe) Discuss with Microbiologist.**	IV route to be used if oral absorption unreliable. Early oral switch where possible.

BTS-recommended therapy for Community Acquired Pneumonia

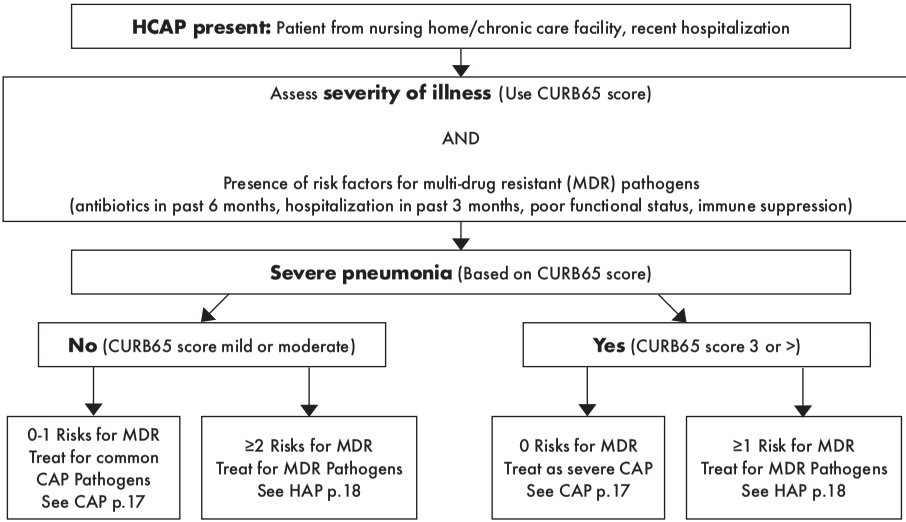
(Taken from J Antimicrob Chemother 2012; 65: page 612) [4]



CURB-65 score should be used with caution in younger patients as it may underestimate severity in these patients

	Condition	Antibiotic	Comments
Respiratory Tract Infections	**Health care associated pneumonia**[5]	Patients from nursing home/chronic care nursing facility/recent hospitalisation refer to algorithm page 19.	
	Hospital acquired pneumonia [6] **(including aspiration pneumonia)** Within 4 days of admission & no recent antibiotics:	**Co-amoxiclav 625mg TDS PO or 1.2g TDS IV for 8 days.** *Penicillin allergy (NOT IgE mediated reaction /anaphylaxis):* Cefuroxime 750 mg -1.5g TDS IV. (add metronidazole in aspiration pneumonia). *Severe IgE mediated reaction/anaphylaxis to penicillin:* Levofloxacin 500mg PO / IV OD. (12 hourly if severe). (add metronidazole in aspiration pneumonia).	Send sputum for culture if possible. Consider legionella risk. In at risk patients send urine for legionella antigen and add clarithromycin empirically. Send sputum for Legionella culture, if possible. For confirmed legionellosis see page 16.
	More than 4 days since admission :	**Piperacillin-tazobactam 4.5g TDS IV** If risk factors for MDR pathogens see page 19. *Penicillin allergy:* if NOT IgE mediated/anaphylaxis and if pneumonia is not severe consider cefuroxime 1.5g TDS IV. (add metronidazole in aspiration pneumonia). *Severe IgE mediated reaction/anaphylaxis to penicillin:* Levofloxacin 500mg PO/IV OD (12 hourly if severe). (add metronidazole in aspiration pneumonia).	**If patient is considered to be high risk for MRSA, consider adding Vancomycin.** **De-escalate based on culture results where possible.**

Algorithm for healthcare-associated pneumonia (HCAP) therapy*



Patients with HCAP should be **identified** and **then divided on the basis of severity of illness** to guide initial therapy. Patients in each group are **then further divided based on whether they have risk factors for drug-resistant (MDR) pathogens** that include: recent antibiotic therapy in the past 6 months, recent hospitalization in the past 3 months, the presence of immune suppression, and poor functional status as defined by activities of daily living. **CAP**, community-acquired pneumonia; **HAP**, hospital-acquired pneumonia.

*Adapted from Brito V, *et al.* Current Opinion in Infectious Diseases 2009, 22:316-325

	Condition	Antibiotic	Comments
Respiratory Tract Infections	**Acute exacerbation of COPD** (no consolidation on CXR)	**Antibiotics may not be required** See "Comments" **Co-amoxiclav oral or IV depending on severity for 5-7 days. Review need for IV therapy on a daily basis.** *Penicillin allergy :* Clarithromycin 500mg BD daily PO for 5-7 days	Consider antibiotic therapy if 2 or more present: Increased breathlessness Increased sputum volume Sputum purulence If consolidation on CXR treat as CAP.
Endocarditis		**Seek advice from Microbiology.**	Send 3 sets of blood cultures.
Intra-abdominal infections	**Examples: Peritonitis, Diverticulitis, Biliary tract infections**	**Co-amoxiclav 1.2g TDS IV** Consider addition of gentamicin if unstable **In severe sepsis:** Tazocin +/- Gentamicin Consider 7-10 day course	*Penicillin allergy (NOT IgE mediated reaction /anaphylaxis):* Cefuroxime 750mg- 1.5g TDS and metronidazole 500mg TDS IV+/- gentamicin. *Severe hypersensitivity reaction/anaphylaxis to penicillins:* metronidazole + gentamicin +/- teicoplanin
	Pancreatitis	First line: **Co-amoxiclav 1.2g TDS IV** Second line: Piperacillin-tazobactam 4.5g TDS IV. Consider addition of gentamicin	
	Severe acute necrotising Pancreatitis	First line: **Piperacillin-tazobactam** 4.5g TDS IV. Consider addition of gentamicin Second line: Meropenem 1g TDS IV	Discuss with Microbiology team as soon as possible

	Condition	Antibiotic	Comments
Gastro-intestinal Infections	**Acute gastroenteritis**	Antibiotic Treatment most often not necessary. **Consider antibiotics ONLY if immunosuppressed or signs of systemic sepsis.** **Discuss with microbiology team.**	Ensure appropriate isolation with standard and contact precautions are instituted. Send stool specimen to laboratory. **Note all patients with unexplained diarrhoea should be isolated.**
	Clostridium difficile **Associated Disease (CDAD)**	**Refer to Appendix 5 at back of booklet.**	**Discontinue other antibiotics if possible.** Discuss with microbiology team if not responding to therapy. Refer to HSE SE *Clostridium difficile* guidelines in the Infection Control Manual available on all wards.[8] Refer to C. difficile algorithm on page 32.

	Condition	Antibiotic	Comments
Genital Tract Infection	Pelvic Inflammatory Disease (PID), Salpingitis, Tubo-ovarian abscess	**Outpatient Rx:** Ceftriaxone 500mg IM or IV as single dose, then doxycycline PO 100 mg BD + metronidazole PO 400mg TDS **Inpatient Rx:** Ceftriaxone 1g once daily IV + doxycycline 100mg BD PO + metronidazole PO 400mg TDS **Severe 1gE mediated reaction/ anaphylaxis to penicillin:** Clindamycin 900 mg IV TDS + gentamicin (refer pg 26 - 27) + doxycycline PO 100 mg BD	**Total duration of therapy:** 14 days **Switch to oral/outpatient regime when satisfactory response for ≥ 24 hours.** Note: **Fluoroquinolones** (eg ciprofloxacin or ofloxacin) **not recommended** due to increasing resistance. Ref: MMWR 59 (RR-12)2010 & www.cdc.gov/std/treatment In pregnancy, a macrolide (azithromycin or erythromycin) may be used instead of doxycycline. (Doxycycline is contraindicated in pregnancy) Consider treating partner.

	Condition	Antibiotic	Comments
Bone and Joint Infections *Prophylaxis of open fracture - see local orthopaedic protocols available in surgical prophylaxis guidelines and ED Dept. *Diabetic foot infections / OM consult local/national guidelines.	**Osteomyelitis / Septic arthritis**	**Flucloxacillin 2g QDS IV plus sodium fusidate 500mg tabs TDS PO (or fusidic acid susp. 750mg TDS PO)** *Penicillin allergy (NOT IgE mediated reaction/anaphylaxis):* Cefuroxime 1.5g TDS IV plus sodium fusidate as above. *Severe IgE mediated reaction/anaphylaxis to penicillin:* Vancomycin plus sodium fusidate as above.	Adjust treatment when cultures available. Treat for 4 to 6 weeks. **Monitor CRP.** **MRSA known or high risk: vancomycin.** Discuss possible oral switch options with the clinical microbiology team.
Skin and soft tissue Infections	**Cellulitis, erysipelas**	**Benzylpenicillin (penicillin G) 1.2g-2.4g QDS IV plus flucloxacillin 1-2g QDS IV** *Penicillin allergy (NOT IgE mediated reaction/anaphylaxis):* Cefuroxime 750mg-1.5g TDS *Severe IgE mediated reaction/anaphylaxis to penicillin:* Clindamycin 1.2g QDS IV. (+ Vancomycin if severe cellulitis)	Switch to flucloxacillin 500mg-1g QDS PO when clinical improvement achieved. Treat for 10 days minimum. **NOTE: severe cellulitis should not be treated with clarithromycin).** If MRSA suspected use vancomycin.
	Suspected Severe/Invasive Group A Strep Infection	Treat as **Necrotising fascitis, see below**	If Group A Strep Infection confirmed, consider de-escalation to IV benzylpenicillin plus clindamycin, following discussion with Microbiologist. Modify treatment according to Microbiology results and clinical response.
	Necrotising soft tissue infections/Necrotising fascitis	**Refer to surgical team urgently. Piperacillin-tazobactam 4.5g IV 6 to 8 hourly plus clindamycin 1.2g QDS +/- gentamicin.**	
	Human and animal bites	**Co-amoxiclav 625mg TDS (or 1.2g TDS IV if severe) for 5 days**	*Penicillin allergy:* Doxycycline 100mg BD PO plus metronidaziole 400mg TDS PO[23] If severe discuss with microbiology team.

	Condition	Antibiotic	Comments
Central Nervous System	**Meningitis**	**Ceftriaxone 2g BD IV** If *Listeria* risk add amoxicillin 2g 4 hrly IV. If Strep pneumoniae (pneumococcus) or severe infection suspected add vancomycin until sensitivities confirmed. Treat for 14 days if pneumococcus. Treat for 7 days if meningococcus. *Severe IgE mediated reaction/ anaphylaxis to penicillin:* chloramphenicol 1g IV QDS. If immunocompromised add vancomycin and co-trimoxazole.	**Seek Microbiology advice. Consider Dexamethasone phosphate for bacterial meningitis.**(10mg IV 6 hourly for 2 to 4 days. Must commence before or at same time as antibiotic). **Send Blood cultures, throat swab, EDTA blood for PCR +/- CSF. Isolate patient. Notify Public Health.**
	Encephalitis	Acyclovir 10 mg / kg IV every 8 hours (use ideal body weight in obese patients)	Adjust dose in renal impairment. (See page 42) Request HSV PCR on CSF.
ENT Infections	**Acute epiglottitis**	**Ceftriaxone 2g BD IV for 7-10 days**	*Penicillin allergy:* Consider clindamycin + ciprofloxacin for 7-10 days.
	Tonsillitis/pharyngitis	**Phenoxymethylpenicillin (penicillin V) 666mg QDS PO for 10 days** Severe: Benzylpenicillin (penicillin G) 1.2g QDS IV	*Penicillin allergy:* Clarithromycin 500mg BD PO for 10 days Send throat swab
	Sinusitis, otitis media	**Co-amoxiclav 1.2 g IV / 625mg TDS PO for 5-7 days**	*Penicillin allergy:* Clarithromycin 500mg BD PO for 5-7 days

Appendix 1: Start Smart, Then Focus Care Bundle.

Start Smart, Then Focus

An Antibiotic Care Bundle for Hospitals

ROYAL COLLEGE OF PHYSICIANS OF IRELAND

RCSI

Day 1: Start Smart...

1. Start antibiotics only if there is clinical evidence of bacterial infection
   - If there is evidence of bacterial infection, prescribe in accordance with your local antibiotic guidelines and appropriately for the individual patient (see notes below)

2. Obtain appropriate cultures before starting antibiotics

3. Document in both the drug chart and medical notes:
   - Treatment indication
   - Drug name, dose, frequency and route
   - Treatment duration (or review date)

4. Ensure antibiotics are given within four hours of prescription
   - Within 1 hour for severe sepsis or neutropenic sepsis

When deciding on the most appropriate antibiotic(s) to prescribe, consider the following factors:
- History of drug allergy (document allergy type: minor (rash only) or major (anaphylaxis, angioedema))
- Recent culture results (e.g. is patient colonised with a multiple-resistant bacteria?)
- Recent antibiotic treatment
- Potential drug interactions
- Potential adverse effects (e.g. *C. difficile* infection is more likely with broad spectrum antibiotics)
- Some antibiotics are considered unsafe in pregnancy or young children
- Dose adjustment may be required for renal or hepatic failure

Consider removal of any foreign body/indwelling device, drainage of pus, or other surgical intervention

For advice on appropriate investigation and management of infections, consult your local infection specialist(s) (microbiologist, infectious disease physician and/or antimicrobial pharmacist)

...then Focus (Day 2 onwards)

At 24-48 hours after starting antibiotics, make an **Antimicrobial Prescribing Decision**
- Review the clinical diagnosis
- Review laboratory/radiology results
- Choose one of the five options below
- Document this decision

Options

1. Stop antibiotic(s)
   - no evidence of bacterial infection, or infection resolved
2. Switch from intravenous to oral antibiotic(s)
   - if patient meets criteria for oral switch
3. Change antibiotic(s)
   - narrower spectrum, if possible; broader spectrum, if indicated
4. Continue current antibiotic(s)
   - review again after further 24 hours
5. Outpatient parenteral antibiotic therapy
   - consult with local OPAT team

Developed by the RCPI Hospital Antimicrobial Stewardship Working Group (2012)
Adapted, with permission, from the UK Department of Health "Start Smart, Then Focus" hospital antimicrobial stewardship programme

Appendix 2: Once daily Aminoglycoside protocol: Gentamicin 5mg/kg IV daily

Infuse in 100ml of glucose 5% or sodium chloride 0.9% over 30-60 minutes.

Dose Adjustment	Levels	Comments
Suitable for normal renal function, creatinine clearance >80ml/min. Dose reduction if <80ml/min, seek advice. **NB: Gentamicin doses in excess of 400mg IV / day are rarely required.** **Dose should never exceed 500mg IV/Day.** See page 27 for dosing algorithm.	**Pre-dose levels are required to monitor for toxicity** Clotted sample 16-18h after the first dose of gentamicin should be **< 1µg/ml.** If >1µg/ml: **Check timing of level, review dosing schedule, check renal function, consider alternative therapy and seek advice if necessary.** See page 27 for dosing algorithm. If continuing gentamicin and renal function is stable, repeat level twice weekly. Daily levels may be required if renal function is unstable. ***Clearly state dose, time of dose and time of blood sample collection on the request form. ***	**Endocarditis:** 3mg/kg once daily Note exclusions, please discuss with Microbiology Team. and see algorithm p27 **Note:** Divided doses prefered to once daily dosing in the following cases: • Endocarditis cased by HACEK organisms • Prosthetic Valve Endocarditis • Enterococcal Endocarditis (List may not be exhaustive - discuss case with microbiology team). **Pregnancy:** 3-5mg/kg once daily Please discuss with microbiology team if needed and see algorithm p27.

Adult Gentamicin Once Daily Dosing Guideline

1. Select patient appropriately

- Cautions : Endocarditis, pregnancy, renal replacement therapies, in Cystic Fibrosis & patients with severe burns.
- Consider patient factors associated with potential toxicity prior to prescribing Gentamicin e.g. underlying renal function, hearing difficulty, and concurrent nephrotoxic drugs.
- Contraindicated in myasthenia gravis.
- Review need to continue Gentamicin beyond 7 days. Increased risk of nephrotoxicity beyond 7 days treatment. If to continue rationale should be documented.

2. Prescribe dose

- If weight> 120% IBW use obese dosing weight (ODW) to calculate gentamicin dose
- Maximum dose 500mg daily
- If anuric (<500mls/day), treat as CrCl <10ml/min.

CrCl (ml/min)	Dose
>80	5mg/kg
50-80	4mg/kg
30-50	3mg/kg
10-30	2mg/kg
<10	1-2mg/kg redose when level <1µg/ml

Calculating the dose

Weight used should be actual body weight (ABW), or for obese patients (Weight ≥ 120% IBW) an obese dosing weight (ODW) must be calculated.

For formula (see appendix 13 page 43)

Dose should never exceed 500mg daily

3. Check a trough level 16-18 hours after FIRST dose

- Monitor U&Es ensure patient is well hydrated and monitor creatinine as gentamicin is nephrotoxic.
- Ensure sample is labelled with the date & time of the last dose and the date & time level was taken. E.g. 4pm dosing=8 -10am level, 6pm dosing=10am12noon level

4. Trough level	Action
<1µg/ml In range	Continue current regimen.
>1µg/ml Level is High	Check the time dose was given and sample taken. Was level taken at 16-18 hours after dose? If trough level >1µg/ml and <2µg/ml and treatment still indicated then consider holding the dose until the level is <1µg/ml and reducing the dose by 1mg/kg. Discuss with Pharmacy if required. If trough >2µg/ml and treatment still indicated seek advice from Pharmacy.

5. Repeat trough level when clinically indicated

Creatinine normal	Twice weekly gentamicin trough level
Creatinine abnormal or deteriorating	Daily or alternate day gentamicin level

Appendix 3: Aminoglycosides – Amikacin dosing guidelines

Once daily dosing

Dosing Schedule	Monitoring and Levels	Comments
Refer to Algorithm page 29	• Monitor U&Es ensure patient is well hydrated and monitor creatinine as amikacin is nephrotoxic. • TROUGH (i.e. Pre-Dose) levels required. No need for Peak levels. • First TROUGH (Pre-dose) level to be taken just prior to the second.[18] • Target TROUGH (Pre-dose) level ≤5mg/L[15] • Ensure sample is labelled with the date & time of the last dose and the date & time level was taken.	• Amikacin is a restricted antimicrobial and should only be prescribed for the treatment of infections due to gentamicin resistant Gram negative bacilli or if recommended by a consultant microbiologist • Standard Once daily regimen is not suitable in endocarditis[15], cystic fibrosis[19], ascities[19], major burns[19], febrile neutropenia[15], meningitis[15], tuberculosis, or pregnancy[15]. Use multiple daily dosing see page 29. • Consider renal function, hydration status and concomitant nephrotoxic medicines • Therapeutic Drug Monitoring is necessary to prevent toxicity notably nephrotoxicity & ototoxicity. • Risk of ototoxicity increases with higher cumulative doses and longer treatment courses. • Contra-indicated in myasthenia gravis.[15]

Multiple daily dosing

Dosing Schedule	Monitoring and Levels	Comments
Refer to Algorithm pg 29	• Monitor U&Es ensure patient is well hydrated and monitor creatinine as amikacin is nephrotoxic. • TROUGH (i.e. Pre-Dose) levels required. Take TROUGH level immediately pre-dose.[18] Target Trough Level ≤10mg/L • PEAK levels required. Take PEAK level one hour post dose. Target Peak Level ≤30mg/L[18] • Initially take PEAK & TROUGH levels around the third/fourth dose. Then take TROUGH (Pre-dose) levels every 48 hrs or more if renal function is unstable/impaired. Monitor Peak levels Once weekly. • Ensure sample is labelled with the date & time of the last dose and the date & time level was taken.	• Amikacin is a restricted antimicrobial and should only be prescribed for the treatment of infections due to gentamicin resistant Gram negative bacilli or if recommended by a consultant microbiologist • Multiple Daily Dosing daily regimen is to be used for indications of endocarditis, cystic fibrosis, ascities, major burns, febrile neutropenia, meningitis or pregnancy. • Therapeutic Drug Monitoring is necessary to prevent toxicity notably nephrotoxicity & ototoxicity. • Risk of ototoxicity increases with higher cumulative doses and longer treatment courses. • Contra-indicated in myasthenia gravis.[15]

Adult Amikacin Dosing Guideline

1. Select patient appropriately

Consider once daily dosing (except for indications for multiple daily dosing on page 28).

2. Prescribe dose based on Patient's – Weight, Height, BMI & Renal Function

CHECK & DOCUMENT: Weight, Height, Renal Function (CrCl) before prescribing dose
Maximum dose 1.5g daily (Maximum cumulative dose 15g[15])
If weight > Ideal Body Weight (IBW), Dose is based on IBW.
If weight is < IBW use actual body weight
Obese patients (weight >120% IBW), use ODW.

For formula for weight calculation see appendix 11, page 43-44

See indications p28.

ONCE DAILY DOSING [16]

Renal Function CrCl ml/min	Dose
≥ 80ml/min	15mg/kg daily
60-80 ml/min	12mg/kg daily
40-60 ml/min	7.5mg/kg daily
30-40 ml/min	4mg/kg daily
20-30ml/min	7.5mg/kg every 48 hours
< 20 ml/min	Multiple Daily Dosing Recommended

MULTIPLE DAILY DOSING [17]

Renal Function CrCl ml/min	Dose
> 50ml/min	7.5mg/kg every 12 hours
20-50 ml/min	5-6mg/kg every 12 hours
10-20ml/min	3-4mg/kg every 24 hours
<10ml/min	2mg/kg every 24-48 hours

3. Monitor Renal function and Carryout Therapeutic Drug Monitoring

ONCE DAILY DOSING

MULTIPLE DAILY DOSING

4. Take Trough level then give the next dose (provided patient is not at risk of nephrotoxicity). Check the trough level result before giving the SECOND dose.
(See page 28 for guidance on monitoring and levels)

Trough level	Action
≤ 5mg/L[15] In range	● Continue current regimen. Provided renal function is stable. Monitor level every 3-5 days.
> 5mg/L[15] Level is High	●Check when level was taken – level taken <18hrs post dose are not true trough levels. ● If it is a true trough level then omit next dose, re-assay in 24 hrs. & check U&Es ● Re-dose if clinically indicated when levels fall ≤5mg/L but extend dosing interval accordingly for subsequent doses depending on the creatinine clearance - discuss appropriate reduced dose with pharmacist.

4. Interpretation of Therapeutic Drug Monitoring Troughs & Peaks
(See page 28 for guidance on monitoring and levels)

Trough level	Action
≤ 10mg/L[15] **In range**	Continue current dose regimen. Provided renal function is stable and continued administration is required, monitor levels twice weekly.
> 10mg/L[15] **Level is High**	Ensure the level was taken at the correct time. If a true pre-dose level omit any further doses. Re-check renal function and review need for further amikacin treatment. If further advice is needed contact pharmacy.
Peak level	**Action**
≤ 30mg/L[15] **In range**	Continue current regimen. Provided dose & renal function is stable and continued administration is required, monitor peak levels once weekly.
> 30mg/L[15] **Level is High**	Check level taken at correct time. Contact pharmacy for advice on further management.

Appendix 4: Glycopeptides: Vancomycin & Teicoplanin

Vancomycin Dosage Schedule	Levels	Comments
Refer to dosing algorithm page 31.	Collect predose level before 4th dose of vancomycin. Give the dose. Any adjustments necessary can be made to the 5th dose onwards. **Predose level should be between 10-15µg/ml. (In severe/complicated infection 15-20 µg/ml).** If continuing vancomycin and renal function is stable, repeat level twice weekly. Daily levels may be required if renal function is unstable. **Note that 1- hour post dose levels are not necessary.** Clearly state dose, time of dose and time of blood sample collection on the request form.	Must be administered slowly IV at a maximum rate of 10mg/min to avoid reaction such as red man syndrome. **A loading dose of 25mg/kg will facilitate rapid attainment of target trough serum vancomycin concentration. Especially important in complicaed infections such as:** 1. Bacteraemia 2. Endocarditis 3. Osteomyelitis 4. Meningitis 5. Hospital Acquired Infections caused by Staph aureus
Teicoplanin dosage schedule	**Levels**	**Comments**
6 mg/kg 12 hourly for 3 doses and thereafter once daily. Higher doses, **10- 12mg/kg,** in similar dosing schedule is indicated in **serious infections** e.g. MRSA infections and endocarditis. Such patients should be discussed with the clinical microbiology team.	May be required in certain circumstances eg. endocarditis. Discuss with Microbiology team.	Renal impairment: If teicoplanin is to be used, the full dose is given for the first 4 days. Thereafter extended dosing intervals are required. (see also appendix 10 page 42).

Adult VANCOMYCIN Dosing Guideline

1. Select patient appropriately

- Renal & ototoxicity has been associated with use of vancomycin.
- Monitoring of serum levels is a necessity.
- Administer at a rate not greater than 10mg/min.

2. Prescribe dose

Initial Dose: Prescribe initial loading dose of 25mg/kg
Maximum single dose 2g

Maintenance Dose: see table below

CrCl	Dose (Round to nearest 50mg)
≥ 60ml/min	15mg/kg BD
30 – 60 ml/min	15mg/kg OD
15 – 30 ml/min	15mg/kg every 48hrs
< 15 ml/min or dialysis	15mg/kg day 1. Only re-dose at 15mg/kg when trough level in target range. Hold dose until level available

- **Maximum Single Dose 2g**
- If anuric, output<500mls/day, treat as CrCl < 15ml/min

Actual body weight is used to calculate all doses unless weight >120% IBW
use obese dosing weight- see calculations as per Appendix 13 page 43-44.

3. Take FIRST trough level BEFORE 4th dose. Trough must be measured PRE-DOSE (or within one hour prior to administering dose)

Doses are NOT to be held whilst awaiting levels unless renal function deteriorating or specifically advised

4. Ascertain target level. Standard target level is 10-15mg/L but if patient has a serious infection such as endocarditis, osteomyelitis, bloodstream infection, meningitis or hospital-acquired pneumonia caused by S.aureus, target level is 15-20mg/L.

5. Check trough level result and adjust dose accordingly

Target level 10-15mg/L

Level (mg/L)	Dose alteration	Recheck pre-dose level
<5#	Increase **each** dose by 500mg	After adjusted dose given and before following morning dose*
5-10	Increase **each** dose by 250mg	After adjusted dose given and before following morning dose*
10-15	Maintain dosing regimen	Twice weekly, providing renal function is stable*
15-20	Reduce **each** dose by 250mg	After adjusted dose given and before following morning dose*
>20	Omit next dose and decrease **each** dose by 500mg	After adjusted dose given and before following morning dose*

Target Level 15-20mg/L

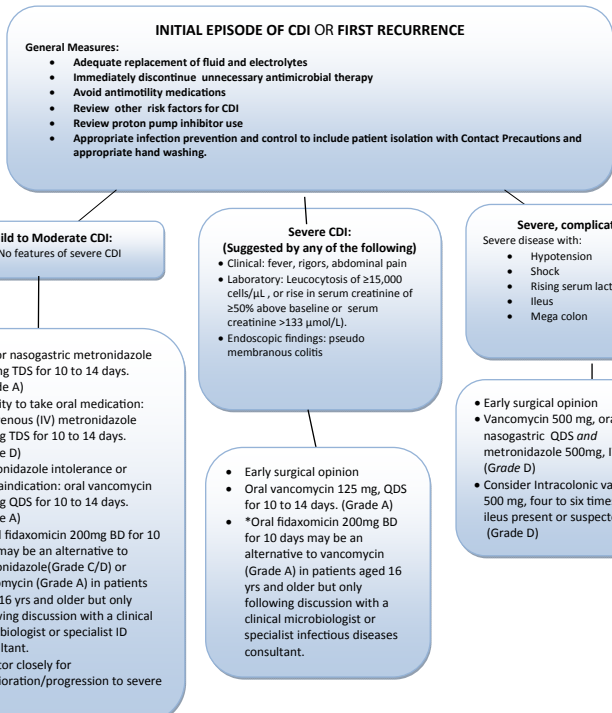
Level (mg/L)	Dose alteration	Recheck pre-dose level
<10#	Increase **each** dose by 500mg	After adjusted dose given and before following morning dose*
10-15	Increase **each** dose by 250mg	After adjusted dose given and before following morning dose*
15-20	Maintain dosing regimen	Twice weekly providing renal function is stable*
20-25	Reduce **each** dose by 250mg	After adjusted dose given and before following morning dose*
>25	Omit next dose and decrease **each** dose by 500mg	After adjusted dose given and before following morning dose*

*** Doses are NOT to be held whilst awaiting levels unless renal function is deteriorating or specifically advised**
 # If persistently sub-therapeutic levels, contact pharmacy for advice

6. Check serum creatinine regularly

- Ensure patient well hydrated.
- If renal function stable (& level in target range), twice weekly levels are sufficient
- If renal function unstable, check trough level more frequently (e.g. daily or alternate days)

Appendix 5: Treatment of *Clostridium difficile* Infection

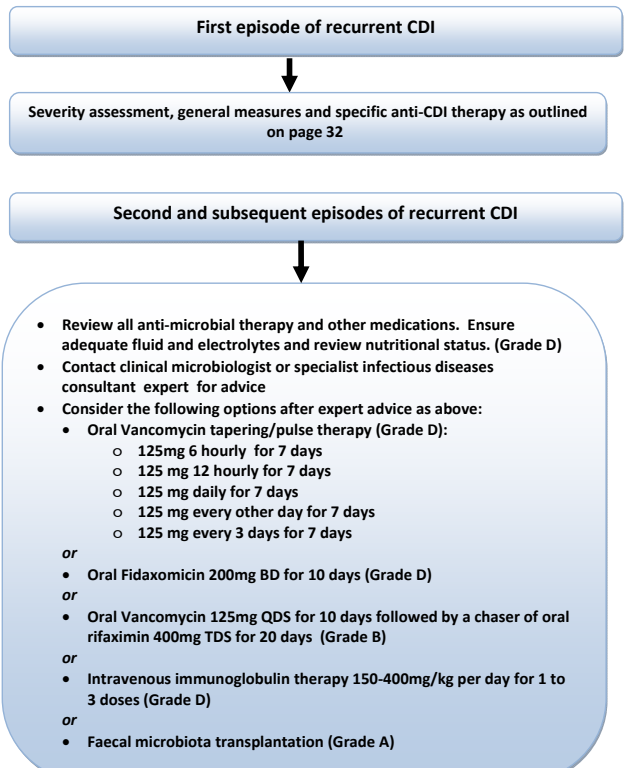


Please refer to BNF for children or local paediatric formulary for doses of metronidazole and vancomycin for paediatric patients.

**Fidaxomicin has not been tested in pregnant or breastfeeding women or in patients with a history of inflammatory bowel disease.*

Adapted From Surveillance, Diagnosis and Management of *Clostridium difficile* Infection in Ireland Update of 2008 Guidance HPSC 2013 [13]

Figure R3: Management of Multiple Recurrences of CDI



Adapted From Surveillance, Diagnosis and Management of *Clostridium difficile* Infection in Ireland Update of 2008 Guidance HPSC 2013

Appendix 6: IV to PO Switch

ANTIMICROBIALS WITH GOOD ORAL BIOAVAILABILITY

*Sanford Guide 2014
** Martindale 33rd edition
***Sanford Guide 2014 and Martindale 33rd edition

Oral switch – consider when patient is afebrile and infection parameters are settling for 48 hours and normal oral absorption. Generally **NOT** appropriate in **meningitis, endocarditis, febrile neutropenia** or **acute osteomyelitis/septic arthritis.**

Antimicrobial	Oral Bioavailability
Ciprofloxacin	70-80%***
Clindamycin	90%*
Sodium Fusidate	91%(tablets)*
Fluconazole	90%*
Levofloxacin	99%*
Linezolid	100%*
Metronidazole	99%**

Examples of choices of switch from IV to oral route

"Note: Oral Antimicrobials are significantly less costly than intravenous"

IV	ORAL
Benzylpenicillin 1.2 -2.4g 4-6 hr Amoxicillin 1g 6 hr	Amoxicillin 500mg 8 hr
Co-amoxiclav 1.2g 8 hr	Co-amoxiclav 625mg 8 hr
Clindamycin 600mg 6 hr Clindamycin 1.2g 6 hr	Clindamycin 300mg 6 hr Clindamycin 450mg 6 hr
Flucloxacillin 1 - 2 g 6 hr	Flucloxacillin 500mg -1g 6 hr 30 minutes before food
Clarithromycin 500mg 12 hr	Clarithromycin 500mg 12 hr
Metronidazole 500mg 8 hr	Metronidazole 400mg 8 hr
Ciprofloxacin 400mg 12 hr	Ciprofloxacin 500 - 750 mg 12 hr
Levofloxacin 500mg - 24hr/12hr	Levofloxacin 500mg - 24hr/12hr
Cefuroxime 750mg - 1.5 g TDS 8 hr	Co-amoxiclav 625mg 8 hr In Penicillin Allergy discuss with Microbiologist

Appendix 7: Relative Costs of Antimicrobials*

Relative Costs of Antimicrobials

COST OF ONE WEEK'S SUPPLY OF ANTIMICROBIALS BASED ON NORMAL ADULT DOSE (antifungals in bold italics)	
€0-€10	Flucloxacillin PO, Metronidazole PO, Ciprofloxacin PO, Amoxicillin PO, Co-amoxiclav PO, Clarithromycin PO, Doxycycline PO, Levofloxacin PO
€10-€40	Clindamycin PO, Fusidic acid PO, Oseltamivir PO, Amoxicillin IV, Metronidazole IV, Co-amoxiclav IV, Cefuroxime IV,Ciprofloxacin IV, ***Fluconazole PO,*** Levofloxacin ***IV, Fluconazole IV***
€40-€60	Gentamicin IV, Benzypenicillin IV, Piperacillin-Tazobactam IV, Vancomycin IV
€100-€300	Colistin IV, Meropenem IV, Clarithromycin IV, Rifampicin IV, Amikacin IV, Ceftriaxone IV, Aciclovir IV, Aztreonam IV, Cefazolin IV (Unlicensed), Fosfomycin PO
€300-€500	Clindamycin IV, Ertapenem IV, Linezolid PO & IV
€500-€1000	Ceftazidime IV, , Ceftaroline IV, Fosfomycin IV, Tigecycline IV
€1000-€3000	Daptomycin IV, Teicoplanin IV, Fidaxomicin PO, **Anidulafungin IV**, **Voriconazole PO**
>€3000	***Voriconazole IV, Amphotercin IV, Caspofungin IV***

Appendix 8: Tips on Clinical Assessment of Patients Following Notification of Positive Blood Culture and Gram Stain.

Gram Positive Cocci (GPC)

Perhaps the most common gram stain result phoned during the working day or after hours.

Potential GPC organisms (most common):

Staphylococci (*Staphylococcus aureus* (MSSA **or** MRSA) **or** Coagulase Negative Staphylococci)
Staphylococci often have an appearance of cells in groups or clusters on gram.

Streptococci (Including Group A streptococci or other haemolytic streptococci e,g Group B/C/G, Enterococci (including Ent Faecalis / Ent faecium / VRE if either resistant to vancomycin) *Streptococcus pneumoniae*, (pneumococcus), Streptococcus viridans.
Streptococci often have an appearance of cells in pairs or chains on gram

Risk assessment

The key is to review the patient carefully for signs and symptoms of sepsis / bacteraemia. Carry out a NEWS score and follow the Sepsis Six protocol if clinically indicated. Bear in mind that the gram stain result may reflect a causative organism of life threatening sepsis (e,g MSSA, MRSA, Group A Strep, *Streptococcus pneumoniae*, Enterococcus spp) or a skin contaminant (e.g Coag Neg Staph / Strep viridans) , ***therefore careful clinical risk assessment is paramount***. Note it is important not to dismiss potential skin contaminants such as Coagulase Neg Staph / Strep viridans if endocarditis / intravascular catheter or prosthetic device infection suspected.

Empiric Antibiotic Cover

This should be guided by the gram stain appearance and likely significance / pathogen based on the clinical risk assessment. Consult the current empiric antimicrobial guideline document for advice on empiric cover in the relevant section. Check previous microbiology results and for a history of MRSA colonisation / infection. If the potential pathogen appears likely from the likely source of sepsis ensure patient is on appropriate antimicrobial therapy for that source and pathogen (e.g Group A Strep in severe soft tissue infection / Strep pneumoniae in CAP).
If systemic sepsis suspected, and source and potential pathogen unclear - glycopeptides cover most gram positive organisms and a stat dose of vancomycin is a reasonable option to cover the patient pending the culture result of ID and sensitivity. It is critically important however that this step is taken only if clinical indication of sepsis or significant infection and that the antimicrobial treatment is later reviewed with the culture ID and sensitivity and assessed re need to continue / stop / change therapy.
If the patient is clinically well following a thorough clinical review and contamination is suspected – a watch-and-observe approach is reasonable pending ID and sensitivity on culture. Ensure there is a trigger for a repeat review and initiation of empiric antimicrobial therapy if the patient develops new signs/symptoms.

Gram Negative Bacilli (GNB)

Gram negative bacilli on gram of blood culture represents presumptive gram negative septicaemia and the need for urgent review and prompt antibiotic treatment pending confirmation of ID.

Potential GNB organisms (most common):

Enterobacteriaciae including *E-coli*, Klebsiella,Enterobacter spp, Pseudomonas, Acinetobacter spp, gram negative anaerobes including bacteroides (less common)
Note that MDRO (Multi-Drug Resistant Organism) including ESBL E-coli/Klebisella, CRE E coli/Klebsiella, MDR Pseudomonas / Acinetobacter are included in this category

Risk assessment

The key is to review the patient carefully for signs and symptoms of sepsis / bacteraemia. Carry out a NEWS score and follow the Sepsis Six protocol if clinically indicated. Bear in mind that the gram stain result of GNB may reflect a causative organism of life threatening sepsis and may harbour antibiotic resistance mechanisms. Ensure Sepsis Protocols are followed as clinically appropriate.
In a very small number of cases GNB on blood culture may turn out to be contaminants (e.g *some* Acinetobacter / environmental GNBs) but the vast majority are clinically significant and often pathogens of life-threatening sepsis, warranting immediate appropriate antibiotic therapy and source control.

Empiric Antibiotic Cover

Gram negative sepsis requires urgent review and appropriate empiric antibiotic therapy.
Consult this document for advice on empiric cover in the relevant section. If the potential pathogen appears likely from the likely source of sepsis ensure patient is on appropriate antimicrobial therapy for that source and pathogen. If source unclear – see section on Septicaemia / Systemic Sepsis – Unknown source on P.6 of this guideline.

Gram Negative Cocci (GNC)

Gram negative cocci on gram of blood culture represents presumptive Meningococcal Septicaemia and is a medical emergency warranting urgent senior clinical review, supportive therapy and rapid administration of appropriate empiric antimicrobials pending confirmation of ID. Notify Public Health.

The key is to review the patient urgently for signs and symptoms of meningococcal sepsis. The patient may already be on appropriate empiric therapy following the initial clinical assessment if meningococcal sepsis was suspected. Carry out a NEWS score and follow the Sepsis Six protocol if clinically indicated. Ensure Meningococcal Sepsis Protocols are followed and that the patient is on the appropriate antimicrobials and doses. See relevant section in this guideline.

Gram Positive Bacilli (GPB)

Potential GPB organisms later confirmed by culture:

"Diphtheroid" bacilli or Coryneforms
Proprionibacteria
Bacillus species
Listeria monocytogenes/spp
Anaerobic GPB including *Clostridium perfringens* and other Clostridia species

Risk assessment

The key is to review the patient carefully for signs and symptoms of sepsis / bacteraemia. Carry out a NEWS score and follow the Sepsis Six protocol if clinically indicated. Bear in mind that the gram stain result may reflect a causative organism of life threatening sepsis (e,g Listeria / Clostridia species) or more frequently, a skin contaminant (e,g Diphtheroid bacilli or Bacillus species), ***therefore careful clinical risk assessment is paramount***. It is important not to dismiss potential skin contaminants such as Diphtheroid bacilli / Bacillus species if endocarditis / intravascular catheter or prosthetic device infection suspected, *or* if the more uncommon conditions such as Diphtheria / *Bacillus anthracis* / *Bacillus cereus* infection suspected on clinical grounds.

Empiric Antibiotic Cover

This should be guided by the gram stain appearance and likely significance / pathogen based on the clinical risk assessment.
If Listeria bacteraemia / sepsis suspected – Amoxicillin +/- Gentamicin (Penicillin allergy - use Vancomycin)
If Clostridial bacteraemia / sepsis suspected (e.g in setting of faecal peritonitis / severe wound infection etc) – a broad – spectrum penicillin such as co-amoxiclav / piperacillin – tazobactam + metronidazole (in penicillin allergy discuss with microbiology team).
If systemic sepsis suspected, and source unclear - glycopeptides cover most gram positive organisms and a reasonable option to cover the patient pending ID and sensitivity and follow up with culture and review of antimicrobial therapy.
However if the patient is clinically well following a thorough clinical review and contamination is suspected, – a watch-and-observe approach is reasonable pending ID and sensitivity on culture. Bear in mind that the patient may already be on appropriate antibiotic regimen for their condition. Ensure there is a trigger for a repeat review and initiation of empiric antimicrobial therapy if the patient develops new signs/symptoms.

Yeasts on gram stain

Yeasts on gram stain should be considered as significant and suggestive of candidaemia (candida blood stream infection) pending full clinical review and subsequent species identification.
Assess the patient for signs and symptoms of candidaemia, carry out a NEWS score and review previous microbiology results for history of candida colonisation.

Review with regards to potential source(s) including intravenous catheters.

Empiric antifungal cover

Start an echinocandin such as anidulafungin 200mg stat IV followed by 100mg OD IV pending subsequent identification of the candida species and antifungal sensitivity testing. Liaise with clinical microbiology team regarding follow up and assessment for potential de-escalation to fluconazole as part of the clinical review the following day, and for advice on ongoing management such as source control and optimisation of antifungal therapy based on antifungal sensitivity testing and clinical response.

Note on Appendix 8:

Please note that this guide is not comprehensive of all potential pathogens and scenarios for positive blood cultures. It is a simply a guide to aid the attending doctor when assessing the clinical significance and need for urgent action on receipt of a new blood culture gram stain result (verbal / electronic).
All empiric therapy should be modified according to definitive ID and sensitivity testing, clinical response and senior consultation.

Each individual case should be taken on its own merits and the clinical assessment of the patient and actions, including prescribing of empiric antimicrobial therapy for newly positive blood cultures remains the responsibility of the attending clinician.

Appendix 9: Guidelines for Consultation with the Clinical Microbiology Advisory Team (C-MAT) University Hospital Waterford

The On-Duty Clinical Microbiology Advisory Team (C-MAT) can be contacted on the contact numbers on page 40 (9.30 - 5.30 Monday to Friday). A consultant out-of-hours-service is available for urgent clinical advice outside of these hours.

Prior to contacting the team please have the following 3 actions completed:

1. Review the Guidelines for Empiric Use of Antimicrobials in Adults 2014 – many queries including empiric therapy by condition, treatment algorithms and therapeutic drug monitoring can be answered here.
2. Ensure the patients' previous microbiology results have been reviewed and summarised and available for the consultation.
3. Provide the C-MAT team member with an ISBAR summary – please see below

C-MAT Consultation Modified ISBAR

Identify
1.Yourself, 2. Patient, Name, MRN, DOB, Ward

Situation
Summarise main issues related to sepsis / infection
Include other relevant key issues in presenting complaint

Backgound
LOS in hospital
Lead up to this point – course in hospital, procedures done and dates, relevant test results
Current antimicrobial therapy

Assessment
Outline relevant details of your clinical assessment– general impression, signs and symptoms, temp, BP, NEWS score etc
Laboratory findings – e.g WCC, CRP, Lactate, Renal fx , Liver fx, Other as relevant
Imaging results if available and relevant (Echo, CT, MRI, Bone Scan, Other)
Results of other relevant investigations available / pending

Recommendations
Based on this consultation, accurately document the further recommendations from the C-MAT team which ***may include for example***:

- Further tests-
  -Micro (blood cultures, swabs, fluids, tissue, stool, sputum, urine, serology, CSF, other)
  -Lab WCC ,CRP, Lactate, U/E, LFTs, antibiotic drug levels, Other)
  -New / Further Imaging (Echo, CT, MRI, Bone Scan, Other)
- Antimicrobial therapy
  -Recommendations on antimicrobial therapy, choice of agent(s), dose optimisation, proposed length of treatment.

Appendix 10: Antimicrobial Dose Adjustment in Patients with Renal impairment

Antimicrobials where no dose adjustment is necessary (in adults)

Amphotericin iv (liposomal)[15,17,20,21]
Anidulafungin iv[15,17,20,21]
Caspofungin iv[15,17,20,21]
Ceftriaxone iv[17,20,21]
Chloramphenicol iv[17]
Clindamycin iv[15,17,20,21]
Doxycycline po[15,17,20,21]
Fusidic acid po/iv[15,17]
Metronidazole po/iv[15,17,21]

**Trimethoprim may cause hyperkalaemia in patients with renal impairment

Antimicrobial	Mild Renal Impairment (GFR 20-50mls/min)	Moderate Renal Impairment (GFR 10-20mls/min)	Severe Renal Impairment (GFR <10mls/min)
Aciclovir iv	GFR 25-50mls/min 5-10mg/kg q12h[17,21]	GFR 10-25 mls/min 5-10mg/kg q24h[17,21]	2.5-5mg/kg q24h[17,21]
Amoxicillin	Dose as in normal renal function[17]	Dose as in normal renal function[17]	250mg-1g q8h (max 6g in 24h in endocarditis)[17]
Benzylpenicillin	Dose as in normal renal function[17]	600 mg – 2.4 g q6h depending on severity of infection[17]	600 mg – 2.4 g q6h depending on severity of infection[17]
Cefuroxime iv	Dose as in normal renal function	750mg-1.5g q12h[17]	750mg-1.5g q 24h[17]
Ciprofloxacin	Dose as in normal renal function[17]	10-30ml/min 50-100% of normal dose	50% of normal dose (100% dose may be given for short periods under exceptional circumstances)[17]
Clarithromycin	GFR 30-50mL/min Dose as in normal renal function[17]	GFR 10-30mL/min Oral: 250-500mg q12h IV: 250-500mg q12h[17]	Oral: 250-500mg q12h IV: 250-500mg q12h[17]
Co-amoxiclav	GFR 30-50mL/min Dose as in normal renal function[17]	GFR 10-30ml/min IV: 1.2g q12h **Oral:** Dose as in normal renal function[17]	IV:1.2g stat followed by 600mg q8h or 1.2g q12h Oral: Dose as in normal renal function[17]
Flucloxacillin	Dose as in normal renal function[17]	Dose as in normal renal function[17]	Dose as in normal renal function up to a total daily dose of 4g[17]
Fluconazole Levofloxacin	50-100% of normal dose Initial dose 250-500mg then 125-250mg 12-24 hourly	50-100% of normal dose Initial dose 250-500mg then 125mg q12-24h[17]	Reduce dose by 50%[15] Initial dose 250-500mg then 125mg 12-48 hourly.
Meropenem	(26-50ml/min) 500mg-2g q12h[17,21] or 1gTDS	(10-25ml/min) 500mg-1g q12h or 500mg q8h[17,21]	500mg-1g q24h[17,21]
Nitrofurantoin	Contraindicated[17]	Contraindicated[17]	Contraindicated[17]
Piperacillin/ Tazobactam (TAZOCIN®)	Dose as in normal renal function[17,21]	4.5g q12h,	4.5g q12h
Teicpolanin	GFR (mL/min): 40-60 Dose as in normal renal function, then reduce dose after 4th day to 200mg daily or 400mg every 48H	GFR (mL/min): <40 Dose as in normal renal function, then reduce dose after 4th day to 30% of the dose daily or 400mg every 72H	Give normal loading dose, then 200-400mg q48-72h[17]
Trimethoprim**	Dose as in normal renal function[17]	GFR <15 give 50-100% of dose.[17]	GFR <15 give 50-100% of dose.[17]

This table is for guideline purposes only and correct at time of publication (July 2016)
Consult most up-to-date SPC / renal drug database before prescribing.

Antimicrobial Dose Adjustment in Patients with Renal impairment

This table includes many of the antimicrobials recommended within these guidelines but is not exhaustive. Vancomycin, Gentamicin & Amikacin, please see relevant algorithms. For advice on an antimicrobial not listed, please contact pharmacy.

The majority of the published information available on dosing recommendations in renal impairment is based on the traditional Cockcroft and Gault estimation of creatinine clearance (CrCl). [2]. Estimated Glomerular Filration Rate (eGFR) provided by the Modification of Diet in Renal Disease trial (MDRD) is now routinely used as a guide to renal impairment and is reported by biochemistry . eGFR is an estimate of GFR only. Creatinine must be stable (eGFR may be unreliable in acutely ill patients). eGFR is not valid in pregnancy, children or at extremes of body type (high or low BMI). Multiply eGFR by 1.21 for Black race.

For advice on antimicrobial prescribing in patients on renal replacement therapy or peritoneal dialysis and transplant patients please contact pharmacy or dialysis unit/consultant nephrologist.

For usual dose consult current BNF/SPC [15,21]

FORMULA FOR RENAL FUNCTION CALCULATION

CrCl = (140 – age) x weight (kg) x K
Serum Cr(micromoles/L)

- K = 1.23 for males and 1.04 for females
- Weight = actual weight (use ODW* if obese SEE BOX with Formulae for weight calculations)
- If patient is anuric or intermittent dialysis, treat as CrCl < 10ml/min

Appendix 11: Formulae For Weight Calculation

FORMULAE FOR WEIGHT CALCULATIONS

- **If actual weight > Ideal Body Weight (IBW) Dose is based on IBW**
- **If actual weight is < IBW use actual body weight**

IBW (kg) = **R+** (2.3kg X every inch over 5ft)
R=50 for males and 45.5 for females

Obese patients (weight >120% IBW) use Obese Dosing Weight (ODW)
ODW *(kg) = IBW+0.4 (Actual weight-IBW)

BMI = weight (kg)/height (m)^2 **see page 44**

1 foot = 30.5cm 1 inch = 2.54cm

Appendix 11

Body Mass Index (BMI) Chart for Adults

Obese (>30) | Overweight (25-30) | Normal (18.5-25) | Underweight (<18.5)

HEIGHT in feet/inches and centimeters

WEIGHT		4'8"	4'9"	4'10"	4'11"	5'0"	5'1"	5'2"	5'3"	5'4"	5'5"	5'6"	5'7"	5'8"	5'9"	5'10"	5'11"	6'0"	6'1"	6'2"	6'3"	6'4"	6'5"
lbs	(kg)	142cm		147	150	152	155	157	160	163	165	168	170	173	175	178	180	183	185	188	191	193	196
260	**(117.9)**	**58**	**56**	**54**	**53**	**51**	**49**	**48**	**46**	**45**	**43**	**42**	**41**	**40**	**38**	**37**	**36**	**35**	**34**	**33**	**32**	**32**	**31**
255	(115.7)	57	55	53	51	50	48	47	45	44	42	41	40	39	38	37	36	35	34	33	32	31	30
250	**(113.4)**	**56**	**54**	**52**	**50**	**49**	**47**	**46**	**44**	**43**	**42**	**40**	**39**	**38**	**37**	**36**	**35**	**34**	**33**	**32**	**31**	**30**	**30**
245	(111.1)	55	53	51	49	48	46	45	43	42	41	40	38	37	36	35	34	33	32	31	31	30	29
240	**(108.9)**	**54**	**52**	**50**	**48**	**47**	**45**	**44**	**43**	**41**	**40**	**39**	**38**	**36**	**35**	**34**	**33**	**33**	**32**	**31**	**30**	**29**	**28**
235	(106.6)	53	51	49	47	46	44	43	42	40	39	38	37	36	35	34	33	32	31	30	29	29	28
230	**(104.3)**	**52**	**50**	**48**	**46**	**45**	**43**	**42**	**41**	**39**	**38**	**37**	**36**	**35**	**34**	**33**	**32**	**31**	**30**	**30**	**29**	**28**	**27**
225	(102.1)	50	49	47	45	44	43	41	40	39	37	36	35	34	33	32	31	31	30	29	28	27	27
220	**(99.8)**	**49**	**48**	**46**	**44**	**43**	**42**	**40**	**39**	**38**	**37**	**36**	**34**	**33**	**32**	**32**	**31**	**30**	**29**	**28**	**27**	**27**	**26**
215	(97.5)	48	47	45	43	42	41	39	38	37	36	35	34	33	32	31	30	29	28	28	27	26	25
210	**(95.3)**	**47**	**45**	**44**	**42**	**41**	**40**	**38**	**37**	**36**	**35**	**34**	**33**	**32**	**31**	**30**	**29**	**28**	**28**	**27**	**26**	**26**	**25**
205	(93.0)	46	44	43	41	40	39	37	36	35	34	33	32	31	30	29	29	28	27	26	26	25	24
200	**(90.7)**	**45**	**43**	**42**	**40**	**39**	**38**	**37**	**35**	**34**	**33**	**32**	**31**	**30**	**30**	**29**	**28**	**27**	**26**	**26**	**25**	**24**	**24**
195	(88.5)	44	42	41	39	38	37	36	35	33	32	31	31	30	29	28	27	26	26	25	24	24	23
190	**(86.2)**	**43**	**41**	**40**	**38**	**37**	**36**	**35**	**34**	**33**	**32**	**31**	**30**	**29**	**28**	**27**	**26**	**26**	**25**	**24**	**24**	**23**	**23**
185	(83.9)	41	40	39	37	36	35	34	33	32	31	30	29	28	27	27	26	25	24	24	23	23	22
180	**(81.6)**	**40**	**39**	**38**	**36**	**35**	**34**	**33**	**32**	**31**	**30**	**29**	**28**	**27**	**27**	**26**	**25**	**24**	**24**	**23**	**22**	**22**	**21**
175	(79.4)	39	38	37	35	34	33	32	31	30	29	28	27	27	26	25	24	24	23	22	22	21	21
170	**(77.1)**	**38**	**37**	**36**	**34**	**33**	**32**	**31**	**30**	**29**	**28**	**27**	**27**	**26**	**25**	**24**	**24**	**23**	**22**	**22**	**21**	**21**	**20**
165	(74.8)	37	36	34	33	32	31	30	29	28	27	27	26	25	24	24	23	22	22	21	21	20	20
160	**(72.6)**	**36**	**35**	**33**	**32**	**31**	**30**	**29**	**28**	**27**	**27**	**26**	**25**	**24**	**24**	**23**	**22**	**22**	**21**	**21**	**20**	**19**	**19**
155	(70.3)	35	34	32	31	30	29	28	27	27	26	25	24	24	23	22	22	21	20	20	19	19	18
150	**(68.0)**	**34**	**32**	**31**	**30**	**29**	**28**	**27**	**27**	**26**	**25**	**24**	**23**	**23**	**22**	**22**	**21**	**20**	**20**	**19**	**19**	**18**	**18**
145	(65.8)	33	31	30	29	28	27	27	26	25	24	23	23	22	21	21	20	20	19	19	18	18	17
140	**(63.5)**	**31**	**30**	**29**	**28**	**27**	**26**	**26**	**25**	**24**	**23**	**23**	**22**	**21**	**21**	**20**	**20**	**19**	**18**	**18**	**17**	**17**	**17**
135	(61.2)	30	29	28	27	26	26	25	24	23	22	22	21	21	20	19	19	18	18	17	17	16	16
130	**(59.0)**	**29**	**28**	**27**	**26**	**25**	**25**	**24**	**23**	**22**	**22**	**21**	**20**	**20**	**19**	**19**	**18**	**18**	**17**	**17**	**16**	**16**	**15**
125	(56.7)	28	27	26	25	24	24	23	22	21	21	20	20	19	18	18	17	17	16	16	16	15	15
120	**(54.4)**	**27**	**26**	**25**	**24**	**23**	**23**	**22**	**21**	**21**	**20**	**19**	**19**	**18**	**18**	**17**	**17**	**16**	**16**	**15**	**15**	**15**	**14**
115	(52.2)	26	25	24	23	22	22	21	20	20	19	19	18	17	17	16	16	16	15	15	14	14	14
110	**(49.9)**	**25**	**24**	**23**	**22**	**21**	**21**	**20**	**19**	**19**	**18**	**18**	**17**	**17**	**16**	**16**	**15**	**15**	**15**	**14**	**14**	**13**	**13**
105	(47.6)	24	23	22	21	21	20	19	19	18	17	17	16	16	16	15	15	14	14	13	13	13	12
100	**(45.4)**	**22**	**22**	**21**	**20**	**20**	**19**	**18**	**18**	**17**	**17**	**16**	**16**	**15**	**15**	**14**	**14**	**14**	**13**	**13**	**12**	**12**	**12**
95	(43.1)	21	21	20	19	19	18	17	17	16	16	15	15	14	14	14	13	13	13	12	12	12	11
90	**(40.8)**	**20**	**19**	**19**	**18**	**18**	**17**	**16**	**16**	**15**	**15**	**15**	**14**	**14**	**13**	**13**	**13**	**12**	**12**	**12**	**11**	**11**	**11**
85	(38.6)	19	18	18	17	17	16	16	15	15	14	14	13	13	13	12	12	12	11	11	11	10	10
80	**(36.3)**	**18**	**17**	**17**	**16**	**16**	**15**	**15**	**14**	**14**	**13**	**13**	**13**	**12**	**12**	**11**	**11**	**11**	**11**	**10**	**10**	**10**	**9**

Appendix 12: Other guideline documents to consult in association with these guidelines.

1. Guidelines for Restricted and Reserve Antimicrobials

2. Guidelines for Surgical Prophylaxis

3. South East Regional Orthopaedic Service antibiotic prophylaxis guidelines for open fractures

4. Local/National guidelines for treatment of diabetic foot infections including diabetic foot osteomyelitis

5. Post Splenectomy guidelines in adults

   Individuals with an absent or dysfunctional spleen are at increased risk of severe infection, particularly with invasive pneumococcal disease. Patients must be informed of the risk, educated on how to recognise symptoms of infection and advised to seek urgent medical attention if unwell.

   All patients should receive pneumococcal, Haemophilus influenzae type b and meningococcal vaccination. Vaccines should ideally be administered 2 weeks before splenectomy. If this is not possible they should be given 2 weeks after splenectomy.

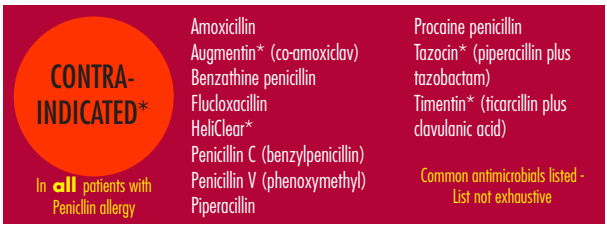
   All patients should receive antibiotic prophylaxis for at least 1 to 2 years. High risk patients should be offered life long antibiotic prophylaxis. Non high risk patients may choose to continue or discontinue antibiotic prophylaxis after the initial 1 to 2 year period based on a discussion of the risks and benefits of prophylaxis.

   Please refer to relevant section in guideline document: Guidelines for surgical prophylaxis for full details of vaccination schedule, risk stratification of patients and antibiotic prophylaxis.

6. BNF and SPCs (Summary of Product Characteristics) and renal drug database for guidance on dosing, renal and hepatic impairment, adverse drug reactions and interactions.

Note: These guidelines are for adults only. For paediatric antimicrobial guidelines refer to local/national paediatric guidelines.

Appendix 13: Penicillin Allergy



* It is important to document exactly what symptoms occurred before deciding if a patient is truly penicillin allergic. Check with Patient / Relatives / GP / Community Pharmacist to clarify the nature of allergic reaction.

- Many patients are misdiagnosed as being Penicillin allergic
- An incorrect diagnosis of penicillin allergy leads to unnecessary avoidance of this relatively non-toxic class of drugs, exposes the patient to potentially more toxic drugs, increases health care costs and contributes to the development of antibiotic resistance.
- Patients are often labelled as having a hypersensitivity reaction when in fact a patient may be experiencing a side effect of penicillin, such as gastrointestinal upset (e.g. nausea, diarrhoea) or headache.
- Other concomitant medicines can also be responsible for triggering a hypersensitivity reaction. Therefore, it is important to consider the timeframe over which the hypersensivity reaction has developed relative to the initiation of different medications.

* Patients who have previously presented with a less severe penicillin allergy (e.g. rash) may be prescribed cephalosporins/carbapenems if the benefits outweigh the risks of cross reactivity. The potential for an allergic reaction should be monitored and resuscitation equipment available if required.

* Patients who are documented as having experienced a severe reaction (anaphylaxis) from a penicillin should not be prescribed cephalosporins, carbapenems and other betalactam containing antibiotics where acceptable alternatives available. A risk-benefit assessment may be needed in certain circumstances. Discuss individual case with senior clinician and clinical microbiology team if needed.

Contact Numbers

Microbiology Department UHW:	
University Hospital Waterford switch	051-848000
Microbiology SpRs	Ext. 8053

Dr. M. Hickey	Ext.	2621/2097
Dr. M. Doyle	Ext.	
Dr. B. Carey	Ext.	
Dr. C. Fielding	Ext.	

Pharmacy Departments:

UHW Antimicrobial Pharmacist	Ext. 2530/2453
WGH Antimicrobial Pharmacist	Ext. 3261
SLKK/Kilcreene Antimicrobial Pharmacist	Ext. 5372/5328
STGH Antimicrobial Pharmacist	Ext. 7119

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Guidelines for the empiric use of antimicrobials in adults 2016 - 2017

Feidhmeannacht na Seirbhíse Sláinte
Health Service Executive