A GUIDE TO ANTIBIOTIC PRESCRIBING FOR ADULTS IN SOUTH AFRICA, 2026

Contents

GLOSSARY

Term	Definition
Antibiogram	A list of antibiotics to which a cultured bacterium is susceptible, intermediate, or resistant
AWaRe	**A**ccess, **W**atch, and **Re**serve (AWaRe) antibiotic groups **Access** – 1st line antibiotics for infection syndromes, which are recognised to have narrowest spectrum of activity and the least risk of driving antibiotic resistance **Watch** – 2nd line antibiotics that require greater stewardship and oversight in use. This group of antibiotics generally have broader spectrum and are more likely to drive antibiotic resistance and *Clostridioides difficile* infection. **Reserve** – these are last-line antibiotics, which are used to treat multi-drug-resistant bacterial infections where no other options exist. Reserve antibiotics require the highest level of stewardship and are rarely available outside of tertiary hospitals in South Africa's public health system. Throughout these guidelines, antibiotics will be denoted by the colour representing the AWaRe grouping that they belong to i.e., **Access**, **Watch**, and **Reserve**
BC	Blood culture
BD	Twice daily
CA	Community-acquired
CAP	Community acquired pneumonia
Cleaning solution	Antiseptic for hand hygiene, including 0.5% chlorhexidine in 70% alcohol and iodine-based solutions
Community-acquired (CA) infection	Illness that starts in the community or symptoms that develop within 48 hours of admission to hospital.
CRB-65 score	A bedside clinical prediction rule for mortality in community-acquired pneumonia based on the CURB-65 score. The score is an acronym for individual risk factors as follows: **C**onfusion of new onset **R**espiratory rate ≥ 30 breaths per minute **B**lood pressure < 90 mmHg systolic or < 60 diastolic **65** years or older A single point is assigned to each risk factor.
CRAB	Carbapenem-resistant *Acinetobacter baumannii*
CRE	Carbapenem resistant Enterobacterales
CRPA	Carbapenem-resistant *Pseudomonas aeruginosa*
CXR	Chest X-ray
eGFR	Estimated glomerular filtration rate
ESBL	Extended-spectrum beta-lactamase
Hospital-acquired infection (HAI)	A new infection starting ≥48 hours after admission that was not apparent at the time of admission, or any infection related to an intravascular or urinary tract catheter inserted during the current admission, surgical wound, or ventilator-associated pneumonia . The following factors increase risk: • Admission to an acute care hospital within 90 days of the current presentation • Resident of a nursing home or long-term care facility • Recent intravenous antibiotic therapy, chemotherapy or wound care within the past 30 days of the current presentation

	• Patients attending a haemodialysis clinic
HAP	Healthcare-associated pneumonia
IPC	Infection prevention and control
IV	Intravenous
LMIC	Low- and middle-income country
MRSA	Methicillin-resistant *Staphylococcus aureus*
MSSA	Methicillin-sensitive *Staphylococcus aureus*
PO	Per Os (oral)
Rx	Treatment/therapy
q (dosing frequency)	*quaque* (Every) e.g, q^{12} = every 12 hours
TOE	Trans-oesophageal echocardiogram
TTE	Trans-thoracic echocardiogram
VRE	Vancomycin-resistant Enterococci

Disclaimer

This document is provided as an information resource for all health care workers to assist in the appropriate prescribing of antibiotics. It attempts to summarise relevant information for clinicians from South African Essential Medicines List, South African Structured Treatment Guidelines, the World Health Organization AWaRe Antibiotic book, and current literature.

Recommendations change rapidly and opinion can be controversial. The authors do not warrant that the information contained in this booklet is complete and shall not be liable for any damages incurred because of its use.

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SAASP would also like to acknowledge reviewers of the 2nd Edition: Prof Adrian Brink, Prof Renier Coetzee, Prof Sipho Dlamini, Dr Nectarios Papavarnavas, Dr Lauren Richards, Prof Natalie Schellack,

Forward to the First Edition

The international community sits on the brink of a post-antibiotic era, where common bacterial infections are no longer treatable with the antibiotic armamentarium that exists. In South Africa, the identification of the first case of pan-resistant *Klebsiella pneumoniae* marked a watershed and highlights the tip of the antibiotic resistance 'iceberg' in this country. Multi-drug resistant (MDR)-bacterial infections, predominantly in Gram-negative bacteria such as *Klebsiella pneumoniae*, *Escherichia coli*, *Pseudomonas aeruginosa* and *Acinetobacter baumannii* are now commonplace in South African hospitals. Whilst several expensive new antibiotics for Gram-positive bacterial infections have been manufactured recently (some of which are licenced for use in South Africa), no new antibiotics active against Gram-negative infections are expected in the next 10-15 years. Hence what we have now, needs conserving.

The development of antibiotic resistance is a natural phenomenon. Bacteria have or acquire antibiotic resistance mechanisms. There are over 800 different naturally occurring enzymes that are produced by different bacteria, which inactivate antibiotics. The selection of antibiotic-resistant populations of bacteria is a natural result of the use of antibiotics. Given the right circumstances, the resistant bacteria that are selected out can either colonize a patient (be present, potentially transmissible, but not cause clinical disease i.e. infection) or cause infection. It follows that the more antibiotics are used, the greater the likelihood of selecting out antibiotic resistance, and the broader the spectrum of antibiotic that is used, the greater the number of different types of resistant bacteria will be selected out. Hence it is our overuse of antibiotics that is driving resistance. The fact that it is estimated that half of all antibiotics prescribed are unnecessary e.g. for viral upper respiratory tract infections, demands our renewed efforts to rationally prescribe this endangered, vital resource.

Rather than be an exhaustive text on infectious diseases or microbiology, the aim of this guide is to give you the information to rationally prescribe antibiotics when they are truly indicated, and to prevent their use when not.

Sean Wasserman
Tom Boyles
Marc Mendelson
Cape Town, 2014

Forward to the Second Edition

Much progress has been made in the global response to bacterial antimicrobial resistance (AMR) in the decade since the publication of the first edition of the Pocket Guide to Antimicrobial Prescribing in South Africa: Low- and middle-income countries have been supported in building surveillance; antibiotic stewardship programs in public and private hospitals have advanced; a greater focus on the One Health nature of AMR has been evident; and a greater appreciation of the need for equitable access to antibiotics, diagnostics, and vaccines has developed in the aftermath of the COVID-19 pandemic. Inappropriate use of antibiotics, however, continues in South Africa and globally. Indeed, the COVID-19 pandemic clearly indicated how misuse of antibiotics can drive AMR.

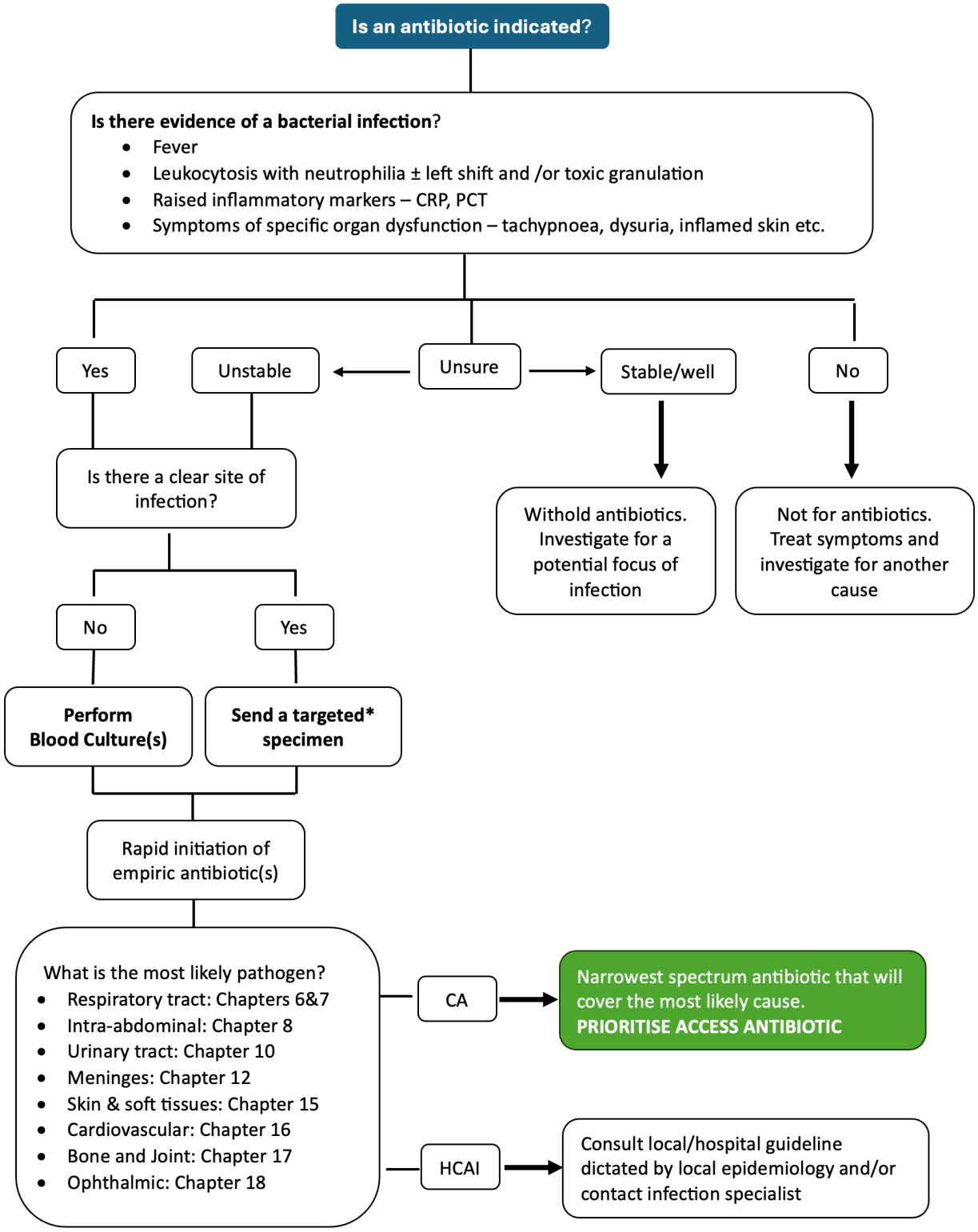
This 2nd edition of the SAASP prescribing guidelines incorporates another important development in stewardship, the re-classification of antibiotics by WHO's Essential Medicines List Working Group into the AWaRe (**Access**, **Watch**, **Reserve**) groupings. Wherever and whenever possible, **Access** antibiotics should be used as first-line antibiotics for infection.

Antibiotic stewardship remains an important intervention in reducing mortality and morbidity from bacterial infection. These guidelines provide clinical algorithms to guide clinicians in making the decision of whether an antibiotic is needed, and if so, how to ensure optimisation of use and limitation of unwanted effects.

Marc Mendelson
2026

Chapter 1
Principles for appropriate antibiotic prescribing

1. Decide if an antibiotic is indicated: Does the patient have a bacterial infection?



*Targeted refers to specimens from the site of infection e.g. urine for cystitis

2. **Perform cultures <u>BEFORE</u> administering antibiotics**

   This is a cornerstone of antibiotic stewardship, and increases the opportunity to de-escalate from broad-spectrum to a narrow-spectrum **Access** antibiotic, once the antibiogram is available

   South African national guidelines for the optimal use of blood cultures in the management of infection are available here

3. **Choose an appropriate empiric antibiotic:**
   a. Target the most likely bacterial pathogen(s) for the site of infection

      This can be predicted by understanding the broad groups of bacteria that most commonly cause infections at various sites:

      - Skin and soft tissue: Gram-positive cocci
      - Urinary tract: Gram-negative bacilli
      - Intra-abdominal: Gram-negative, Gram-positive and anaerobic bacteria i.e., often polymicrobial
      - See chapters on specific infections for more details

      An appropriate empiric antibiotic, preferably an Access antibiotic can then be selected by matching the narrowest spectrum with the likely pathogens. Spectrums of activity of commonly used antibiotics are shown below:

Gram-positive bacteria:

Spectrum of antibiotic activity against named antibiotics	Gram-positive Cocci					
	Clusters		Pairs/Chains			
	MSSA	MRSA	*S.pneumoniae* Most other streptococci	*E. faecalis*	*E. faecium*	VRE
Amoxicillin/Ampicillin	-	-	++	++	+/-	-
Amoxicillin-Clavulanate	+ (HD)	-	+	+	-	-
Cefazolin	++	-	+	!	-	-
Clindamycin	+	+/-	+	!	-	-
Cloxacillin	++	-	+/-	!	-	-
Cotrimoxazole	+	+/-	+/-	!	-	-
Ceftriaxone	+	-	+	!	-	-
Ciprofloxacin	!	-	+/-	!	-	-
Ertapenem	!	-	!	!	-	-
Imipenem	!	-	!	!	-	-
Meropenem	!	-	!	-	-	-
Vancomycin	!	++	!	!	++	-
Linezolid	!	!	!	!	+	++

++	usually susceptible and first-line choice
+	usually susceptible: can start while awaiting antibiogram
+/-	variable susceptibility: only use with antibiogram result
!	not first choice: do not use unless no alternative
-	frequent resistance or poor clinical efficacy: do not use
HD	High dose

Gram-negative bacilli – non-ESBL or -CR

Spectrum of antibiotic activity against named antibiotics	**Gram-negative bacteria (Non-ESBL or CR)**				
	Bacilli				Cocci
	E.coli Klebsiella spp.	Enterobacter spp.	Salmonella spp.	Pseudomonas spp.	*N. meningitidis*
Aminoglycosides	++	++	-	+	-
Amoxicillin and Ampicillin	-	-	!	-	+/-
Amoxicillin-Clavulanate	+/-	-	!	-	!
Cotrimoxazole	+/-	+/-	+/-	-	-
Nitrofurantoin	+	+/-	-	-	-
Cefepime	!	+	+	+	!
Ceftazidime	!	-	+	++	!
Ceftriaxone	+	-	++	-	++
Ciprofloxacin	+	+	+/-	+ (HD)	!
Ertapenem	!	!	!	-	!
Imipenem	!	!	!	+	!
Meropenem	!	!	!	+	!
Piperacillin-tazobactam	/	+/-	!	+	!

++	usually susceptible and first-line choice
+	usually susceptible: can start while awaiting antibiogram
+/-	variable susceptibility: only use with antibiogram result
!	not first choice: do not use unless no alternative
-	frequent resistance or poor clinical efficacy: do not use
CR	carbapenem resistant
ESBL	extended-spectrum beta-lactamase producing
HD	high dose

ESBL- and Carbapenem-resistant Gram-negative bacteria

Spectrum of antibiotic activity against named antibiotics	Resistant Gram-negative bacilli			
	ESBL	CRE	CRPA	CRAB
Amikacin	+/-	+/-	+/-	+/-
Cotrimoxazole	+/-	+/-	-	+/-
Cefepime	-	-	+/-	+/-
Ceftazidime	-	-	+/-	+/-
Ciprofloxacin	+/-	+/-	+/-	+/-
Ertapenem	++	+/-	-	-
Meropenem	+/-	+/-	+/-	+/-
Imipenem	+/-	+/-	+/-	+/-
Piperacillin-tazobactam	++	+/-	+/-	+/-
Aztreonam	!	-	+	_
Cefepime-Enmetazobactam	+	-	-	-
Cefiderocol	!	!	!	-
Colistin	+	+	+	+
Ceftazidime-avibactam	!	!	+/-	+/-
Ceftolozane-tazobactam	!	-	+	+/-
Tigecycline	!	+/-	-	+

++	usually susceptible and first-line empirical choice
+	usually susceptible: can start while awaiting antibiogram
+/-	variable susceptibility: only use with antibiogram result
!	not first choice: do not use unless no alternative
-	frequent resistance or poor clinical efficacy: do not use
CRE	carbapenem resistant Enterobacterales
CRAB	carbapenem resistant *Acinetobacter baumannii*
CRPA	carbapenem resistant *Pseudomonas aeruginosa*
ESBL	extended-spectrum beta-lactamase producing
HD	high dose

Although **Cefepime-Enmetazobactam** has variable susceptibility for CRE, it's major benefit is restricted to use in ESBL-GNB infections

Activity of Reserve antibiotics against different carbapenemases

Reserve antibiotic	Activity against carbapenemases
Aztreonam	NDM-producers
Cefiderocol	NDM-, Oxa-48-like-, & KPC-producers
Colistin	Active against variable CR-GNB via non-carbapenemase mechanism of action
Ceftazidime-avibactam	Oxa-48-like- & KPC-producers
Ceftolozane-tazobactam	Reserved mainly for XDR-Pseudomonas infections
Tigecycline	Active against variable CR-GNB via non-carbapenemase mechanism of action

NDM	New Delhi Metallo-beta-lactamase
KPC	Klebsiella pneumoniae carbapenemase
CR-GNB	Carbapenem-resistant Gram-negative Bacteria

b. Assess likelihood of antibiotic resistance

Risk factors include known colonisation with a resistant pathogen, HCAI, recent antibiotic exposure, and proton pump inhibitors. Local resistance patterns inform prescribing.

c. Review potential contraindications: toxicity or allergy

A clear history of previous anaphylaxis (angioedema, anaphylactic shock or bronchospasm) or cutaneous reactions with mucous membrane or systemic involvement is required to establish intolerance. Gastrointestinal upset, other non-specific symptoms or subsequent uneventful use of the implicated antibiotic suggest that it may be safe to use. In such patients, the bedside PEN-FAST score [1] can be used to help guide clinical and antibiotic management:

PEN	*Pe*nicillin allergy reported by patient	☐ *If yes, proceed with assessment*
F	*F*ive years or less since reaction[a]	☐ **2 points**
A	Anaphylaxis or angioedema	
	OR	☐ **2 points**
S	Severe cutaneous adverse reaction[b]	
T	*T*reatment required for reaction[a]	☐ **1 point**
		☐ **Total points**

Interpretation

Points	
0	**Very low risk** of positive penicillin allergy test <1% (<1 in 100 patients reporting penicillin allergy)
1-2	**Low risk** of positive penicillin allergy test 5% (1 in 20 patients)
3	**Moderate risk** of positive penicillin allergy test 20% (1 in 5 patients)
4-5	**High risk** of positive penicillin allergy test 50% (1 in 2 patients)

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NB: Advice on choice of antibiotic for beta-lactam allergic patients throughout the guidelines refers to those patients with a PEN-FAST score of 3-4 (see chapter 2)

d. Choose an antibiotic with adequate target tissue penetration

[1] Trubiano J., et al. JAMA Intern Med. 2020 May 1;180(5):745-752. doi: 10.1001/jamainternmed.2020.0403

Antibiotic class	Blood/serum	CSF	Lung (ELF)	Bone & Joint	Skin/Soft tissue	Urine
Aminopenicillins	+++	Inflamed ++ Otherwise –	++/+	+	++	+++
Penicllins	+++	Inflamed ++ Otherwise –	+	+	++	+++
Cephalosporins	+++	$3^{rd}/4^{th}/5^{th}$ gen Inflamed + 1^{st} / 2^{nd} gen –	++	++	++	+++ (ceftriaxone biliary)
Monobactams	+++	Inflamed ++	++	+	++	+++
Carbapenems	+++	Meropenem + Imipenem avoid Ertapenem -	++	++	++	+++
Aminoglycosides	+++	–	–	+	+	+++
Fluoroquinolones	+++	Moxi/Levo ++ / +	+++	+++	+++	+++
Glycopeptides	+++	Inflamed high dose + Otherwise -	+ (variable)	+		+++ (Teicoplanin lower)
Lincosamides	+++	–	++	+++		-
Tetracyclines	+++	Minocycline ++ Doxycycline +	++	++	+++	+
TMP-SMX	+++	++ (inflamed)	+++	++	+++	+++
Colistin	+	–	- (Inhaled preferred)*	-	+ to -	++ (variable)
Tigecycline	+/-	–	+	++	+++	_

Novel BL/BLIs (ceftazidime-avibactam, ceftolozane-tazobactam)	+++	Inflamed + (ceftazidime-avibactam data strongest);	++ (ceftolozane-tazobactam ELF ~50% plasma; ceftazidime-avibactam well-established in nosocomial pneumonia RCTs)	+ (limited data; off-label)	+	+++

+++ Excellent ++ Good + Moderate +/- Very low - Poor

* Note that ELF penetration after IV colistin is poor (~20% of plasma concentrations), supporting the existing recommendation for inhaled colistin in lower respiratory tract infections.

e. Aim for a single antibiotic with the desired spectrum of activity
Monotherapy is preferred unless combination therapy is required for synergy (e.g. endocarditis) or extended spectrum beyond what can be obtained with a single antibiotic (e.g. atypical pathogens in severe CAP may require addition of azithromycin to a beta-lactam).

4. Ensure correct dose and route of administration

The oral/enteral route is preferred whenever possible for patients with mild to moderate infections. Intravenous antibiotics should be reserved for severe infection when absorption from the gastrointestinal tract may be impaired or for certain sites such as the central nervous system to overcome the blood-brain barrier.

Antibiotic	Oral absorption (%)
Aminoglycosides	None
Amoxicillin	Good
Amoxicillin-clavulanate	Good
Ceftriaxone	None
Ciprofloxacin	Good - do not give via NGT or with antacids
Clindamycin	Good
Co-trimoxazole	Good
Daptomycin	None
Ertapenem	None
Flucloxacillin	Good (take on empty stomach)
Linezolid	Good
Ertapenem	None
Imipenem	None
Meropenem	None
Vancomycin	None – but used in *C.difficile* for that reason

Certain sites of infection that were previously thought to be only amenable to intravenous antibiotic management such as bloodstream infections, endocarditis, and bone and joint infections have recently been re-appraised based on randomised controlled trial evidence[2]. Consult an infection specialist.

Patients on intermittent dialysis should have dosing after dialysis whenever possible.

5. Start the appropriate antibiotic rapidly

[2] Wikiguidelines. https://www.bradspellberg.com/copy-of-scientific-publications

Mortality increases by 7.8% for every hour antibiotic administration is delayed in septic shock[3]

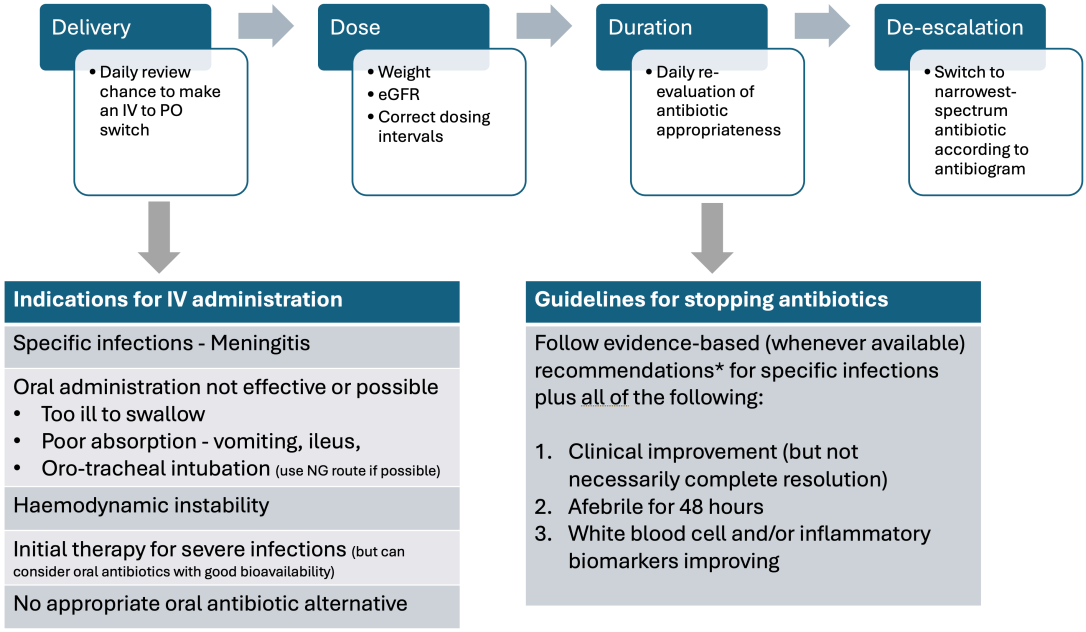
6. Therapeutic Drug Monitoring (TDM)

Common examples of antibiotics require TDM to optimise dosing and ensure optimal patient outcomes include vancomycin and aminoglycosides. Where resources allow and TDM is available, consider other potential candidates such as Linezolid and beta-lactams in serious infection. Resource constraints and health system factors such as distance from testing lab, may limit opportunity.

7. Practice early and effective source control

Search for and remove any persistent foci of infection. Source control is a fundamental pre-requisite for antibiotic effectiveness and inadequate source control is independently associated with higher mortality than even inappropriate antibiotic use.

8. Evaluate antibiotic appropriateness every day



*There is increasing evidence from randomised controlled trials (RCTs), systematic reviews and meta-analyses that shorter durations of antibiotic treatment for certain infections are non-inferior (and in some cases superior) to longer courses. For example, as of May 2026, there have been 14 RCTs in community-acquired pneumonia (CAP) that show that duration of 3-5 days is non-inferior to 5-14 days of antibiotics. Similarly, there are over 20 RCTs that show non-inferiority of <5 days antibiotics for acute exacerbation of chronic bronchitis versus ≥7 days.

[3] Kumar et al. Crit Care Med. 2006 Jun;34(6):1589-96.

We highly recommend the use of the 'Shorter is better' website accessed here, which provides evidence-based guidance for antibiotic durations for many common infections.

Antibiotic Stewardship Checklist

1. Does the patient have a bacterial infection that requires an antibiotic?
2. If so, have appropriate cultures been sent prior to starting antibiotics?
3. Is the choice of antibiotic appropriate?
    a. Directed prescribing based on an antibiogram
        i. Access antibiotic whenever possible i.e., least collateral damage
    b. Empirical prescribing
        i. For the site of Infection
        ii. For the most likely pathogen(s)
        iii. For the likely resistance profile – community- vs hospital-acquired
4. Is the dose correct, accounting for:
    a. Weight, renal function, & liver function
    b. Critical illness often requires increased doses
    c. Specific pathogens – e.g., *Pseudomonas* use higher doses
5. Is dosing interval correct?
6. Is route of administration appropriate? Oral whenever possible
7. Is therapeutic drug monitoring necessary and if so, is it being undertaken and the results being acted upon
8. Is the duration of antibiotic treatment appropriate
9. Can de-escalation be performed – both in terms of spectrum of activity and route of administration.

Chapter 2
Interpreting test results

Non-culture-based tests

Non-culture-based tests such as urinary dipstick, peripheral white cell count (WCC), and C-reactive protein (CRP) confirm the presence of inflammation when positive but do not differentiate bacterial from non-bacterial causes. Nor do they necessarily prove that infection is present.

The absence of white cells and nitrites on urine dipstick testing has good negative predictive value (NPV) unless the patient is profoundly neutropenic and helps rule out UTI. Conversely, a positive urine dipstick, high neutrophil count with left-shift and CRP >100 mg/ml all suggest inflammation and make bacterial infection highly.

Procalcitonin (PCT) is more specific for bacterial infection than CRP or WCC. There is high quality evidence for its use in a limited number of infections, and its use should be limited to these indications. Specifically, low PCT safely excludes bacterial infection such that antibiotics can be withheld in meningitis, bronchitis and acute exacerbations of chronic obstructive pulmonary disease (see later sections for details). PCT has no value in differentiating bacterial infection from tuberculosis and has very limited value in sepsis. Its price generally excludes its use in serial measurement to determine when to stop, although some evidence in ICU settings alone, exists.

Cultures

Does this positive culture represent infection, colonisation or contamination?

	Definition	Patient
Infection	The presence of one or more microorganisms with an inflammatory response	Commonly symptomatic
Colonisation	The presence of microorganisms without significant inflammation	Asymptomatic
Contamination	A culture that contains a microorganism(s) that did not originate from the intended anatomical site	

Sterile sites

Normally sterile sites are CSF, lungs (below the glottis), urinary tract, biliary tract, and blood. Bacteria cultured from these sites are likely to be causing infection but still sometimes represent colonisation or contamination.

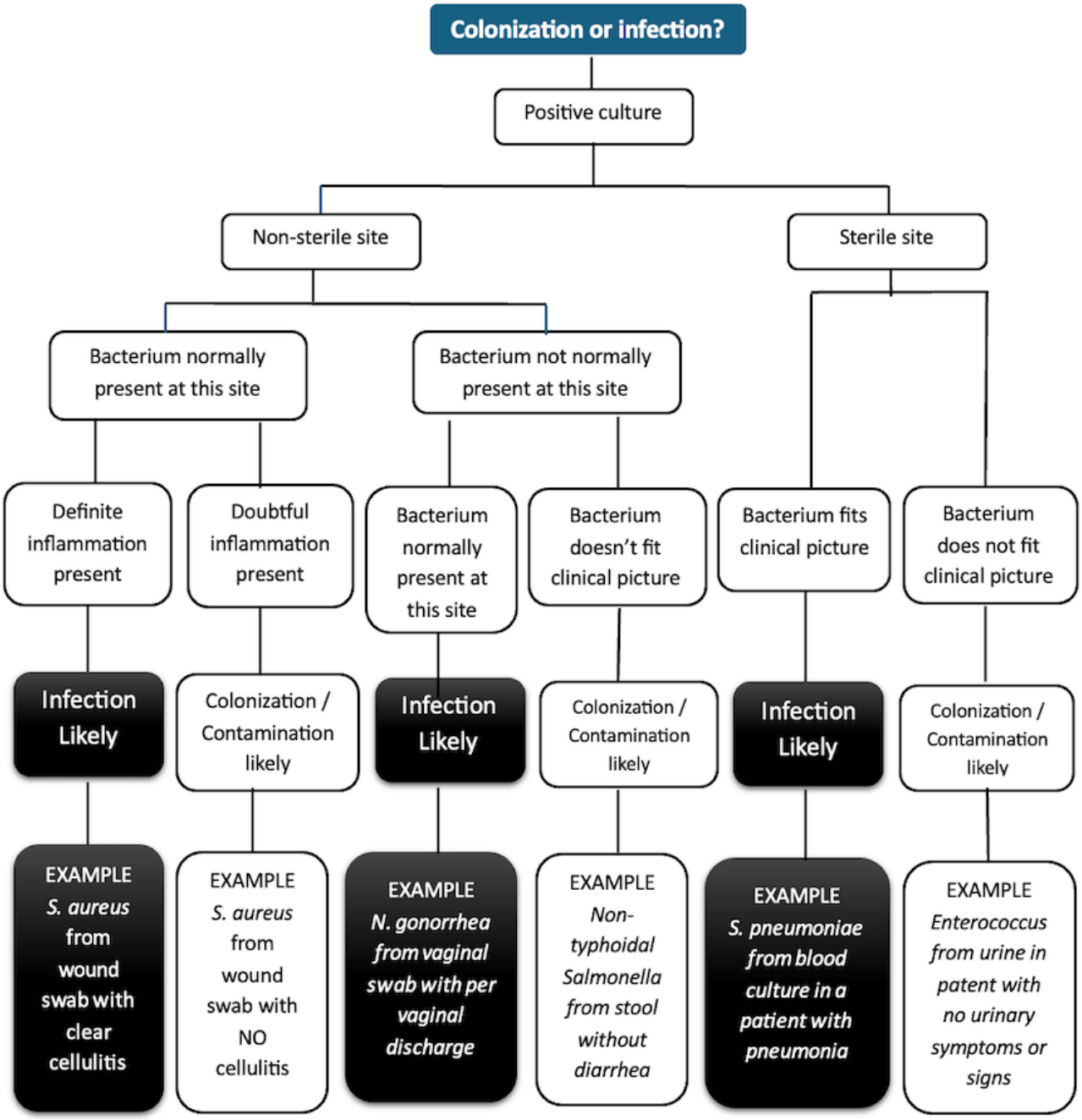
Finding bacteria in a sterile site is abnormal but may represent infection, or contamination. Bacteria colonizing skin such as coagulase-negative staphylococci may cause contamination of sterile sites. Colonisation of urinary tract can occur

without causing infection. If the bacterium corresponds with the clinical scenario then this should be considered to be causing infection

Non-sterile sites

Non-sterile specimens include sputum (as it must pass through the mouth), pus swabs from skin, GI tract and vagina. Specimens from these sites are **expected to culture bacteria** (unless growth is inhibited by laboratory techniques). Interpretation therefore depends on the organism(s) being compatible with the clinical scenario.

Cultures from non-sterile sites are often much harder to interpret and usually of less value.



Chapter 3
Correct techniques of microbiological sampling

Optimal sampling is very important to increase yields and decrease contamination rates (see boxes below). Surgical specimens from abnormal structures such as abscesses should usually be collected at the time of operation. Once surgical drains are placed they quickly become colonised with skin and environmental bacteria and culture results are not interpretable.

We do **NOT** advise sending pus swabs collected outside of theatre after debridement and cleaning of wounds. The best sample to take is a deep biopsy after this has taken place. Pus swabs from wards or outpatient departments are discouraged as it is extremely rare for them to yield information that will change patient management and skin flora including antibiotic-resistant colonising bacteria are commonly cultured.

Blood Culture

The optimal number of blood cultures taken for most suspected infections except for endocarditis, which requires 3 cultures, is 2. However, due to cost issues in a low-resource environment such as South Africa, 1 culture is commonly taken.[4] The most important factor in increasing the chance of a positive culture that can be interpreted properly is if **the blood culture is taken before antibiotics are administered.** If undertaken under proper aseptic technique (see box), then the second most important factor increasing yield is the volume of blood inserted into the bottle. This should be 10ml for adults. Less or more will reduce the sensitivity of the test.

A step-by-step teaching on how to take a blood culture can be found on the Groote Schuur Hospital Infectious Diseases YouTube Channel by clicking here.

Correct technique for performing blood culture

1. Verify the patient's identity and obtain verbal consent.
2. Assemble the correct materials required for blood culture:
    - blood culture bottle(s)
    - syringe (≥10 ml)
    - needle (≥22 gauge)
    - sterile gloves
    - tourniquet
    - adhesive strip
    - Cleaning solution*
    - sterile pack containing cotton/gauze swabs, sterile paper x2 and waste bag
    - patient labels
    - sharps waste disposal bin
3. Apply tourniquet and select a suitable vein
4. Wash hands and apply sterile gloves

[4] Papavarnavas NS et al. https://scielo.org.za/scielo.php?script=sci_arttext&pid=S0256-95742022000600005

5. Clean the puncture site with cleaning solution using aseptic technique and allow 30 seconds for the disinfectant to dry
6. Place green sterile cover with opening over site for blood culture
7. Collect **10ml of blood per bottle** for adults¶
8. Release tourniquet and remove needle
9. If not using the vacutainer system, disinfect the top of the blood culture bottle before inoculating blood
10. Do not change needles between blood sample collection and inoculation of blood culture bottle
11. Always fill blood culture bottle before filling vials for other tests
12. Label the blood culture bottle making sure not to cover the bar code label or the bottom of the bottle
13. Complete a laboratory request form in full
    If there is a delay in getting the sample to the laboratory, do not refrigerate the
    bottle; rather leave it at room temperature.
14. Document in the notes, the date and time that the blood culture was taken

Urine Collection

Instructions for collection of midstream urine (MSU) specimens	
Females	1. Wash your hands 2. Clean the vulva front to back with sterile water on sterile gauze 3. Spread labia with fingers 4. Void and discard first portion of urine 5. Collect second portion of urine
Males	1. Wash your hands 2. Retract foreskin 3. Clean the glans penis with sterile water on sterile gauze 4. Void and discard first portion of urine 5. Collect second portion of urine

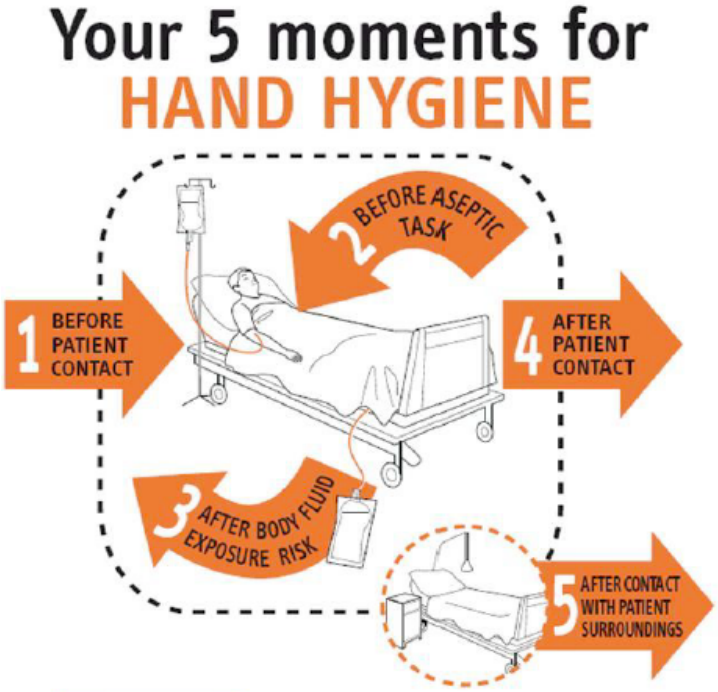
Correct technique for collecting urine catheter specimens of urine (CSU)
1. Use aseptic technique with sterile gloves and apron 2. Clamp tubing just distal to sampling port 3. Wait for urine to collect above clamp 4. Wipe sampling port with cleaning solution 5. Remove urine with a small gauge sterile needle and syringe 6. Transfer urine to sterile container 7. Clean port again 8. Unclamp tubing

Chapter 4
Infection prevention

The most important tools to prevent the spread of infection are hand hygiene and contact precautions. Correct management of IV lines and urinary catheters is essential for reducing hospital-acquired infections.

Hand hygiene

WHEN:



HOW:

Use alcohol-based solutions for routine hand decontamination, except when:

Indication for soap and water	Indication for gloves
Hands visibly dirty or contaminated with body fluids	Patient interactions that involve exposure to blood, mucous membranes or non-intact skin
Exposure to *Clostridioides difficile**	Suspected/proven *C. difficile*
After using the restroom or eating	NB: Always perform hand hygiene after removing gloves

*C. difficile spores are resistant to alcohol

Contact precautions

These should be implemented for any patient infected by or colonised with a drug-resistant bacterial pathogen other than tuberculosis (which requires airborne precautions to prevent small droplet spread) such as MRSA, ESBL- and CR-Gram-negative bacteria. Contact precautions involve the following:

1. Clear signage indicating that contact precautions are in place
2. Patient preferably placed in isolation
3. Hand disinfection prior to patient contact
4. Mandatory use of apron and gloves when entering the patient's room, before any contact with the patient or their surroundings and during examination
5. Remove apron first, followed by gloves
6. Hand disinfection after disposal of apron and gloves
7. Contact precautions remain in place even after treatment with antibiotics and for every hospital or nursing care re-admission for a period of 3 months. For patients with *C. difficile* associated diarrhoea contact precautions can be withdrawn after completion of treatment and resolution of diarrhoea.

Droplet Precautions

The following pathogens require droplet precautions:

- *Corynebacterium diphtheriae*
- *Neisseria meningitidis*
- *Bordetella pertussis* (whooping cough)
- *Yersinia Pestis*
- Influenza
- Rubella
- Mpox

NB – the same precautions are part of reverse barrier care for neutropaenic patients to reduce transmission of mainly viral pathogens to the patient

The following needs to be adhered to:

- Clear signage indicating that droplet precautions are in place
- Patient preferably placed in isolation
- Hand disinfection prior to patient contact
- Mandatory use of apron and gloves when entering the patient's room, before any contact with the patient or their surroundings and during examination
- Use of eye protection such as goggles or visor
- Remove apron first, followed by gloves
- Hand disinfection after disposal of apron and gloves

Airborne Precautions

The following pathogens need to have airborne precautions

- *Mycobacterium Tuberculosis*
- Viruses - SARS-CoV-2; Measles; Varicella zoster virus infections (+ apron)

The following needs to be adhered to:

- Clear signage indicating that airborne precautions are in place
- Patient preferably placed in isolation
- Mandatory use of an N95 or equivalent
- Hand disinfection prior to patient contact and after exiting the room

Management of peripheral IV lines

A link to a video on how to insert a peripheral vascular catheter can be found here.

Correct indication

- Does the patient require IV antibiotics or other IV medicines?
- Does the patient require IV fluids or nutrition?
- If the sole purpose is for an investigation – remove immediately after

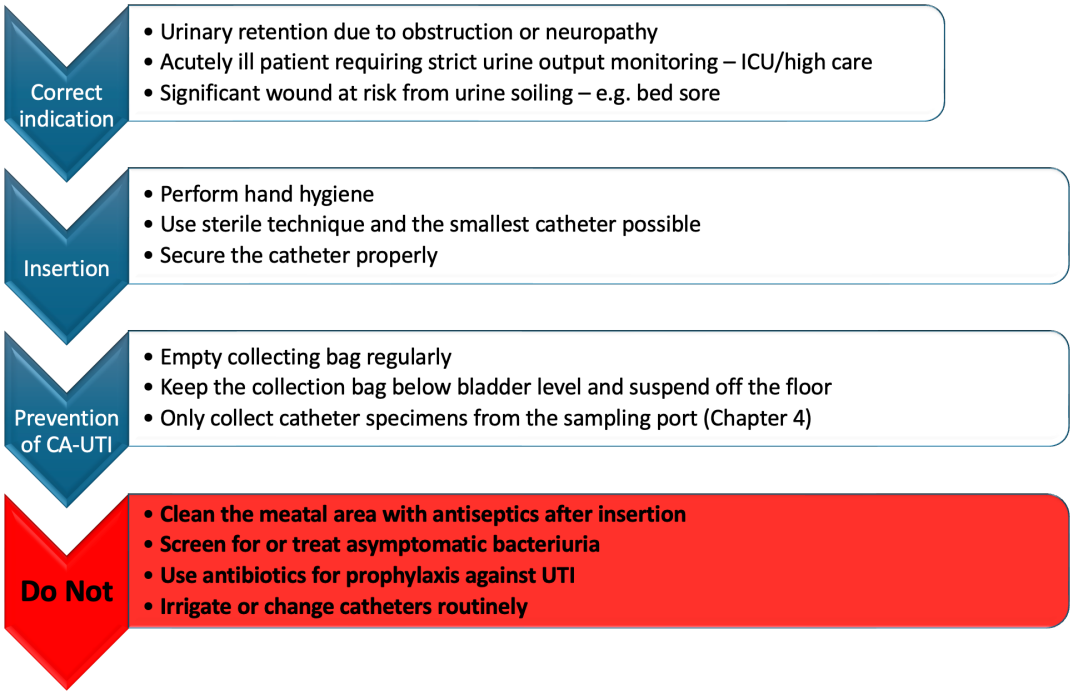
Insertion

- Perform hand hygiene
- Use sterile technique: Clean the skin with antiseptic
- Secure the catheter properly

Prevention of drip site infection

- Remove IV lines at the first opportunity when IV route no longer needed
- **Examine daily** for signs of inflammation/infection and remove if present
- Discard and replace the giving set and medicine if replacing a drip

Management of urinary catheters



Three simple questions you should be asking yourself when you see your patient daily

Can I stop or de-escalate antibiotics?

Can I remove this IV line?

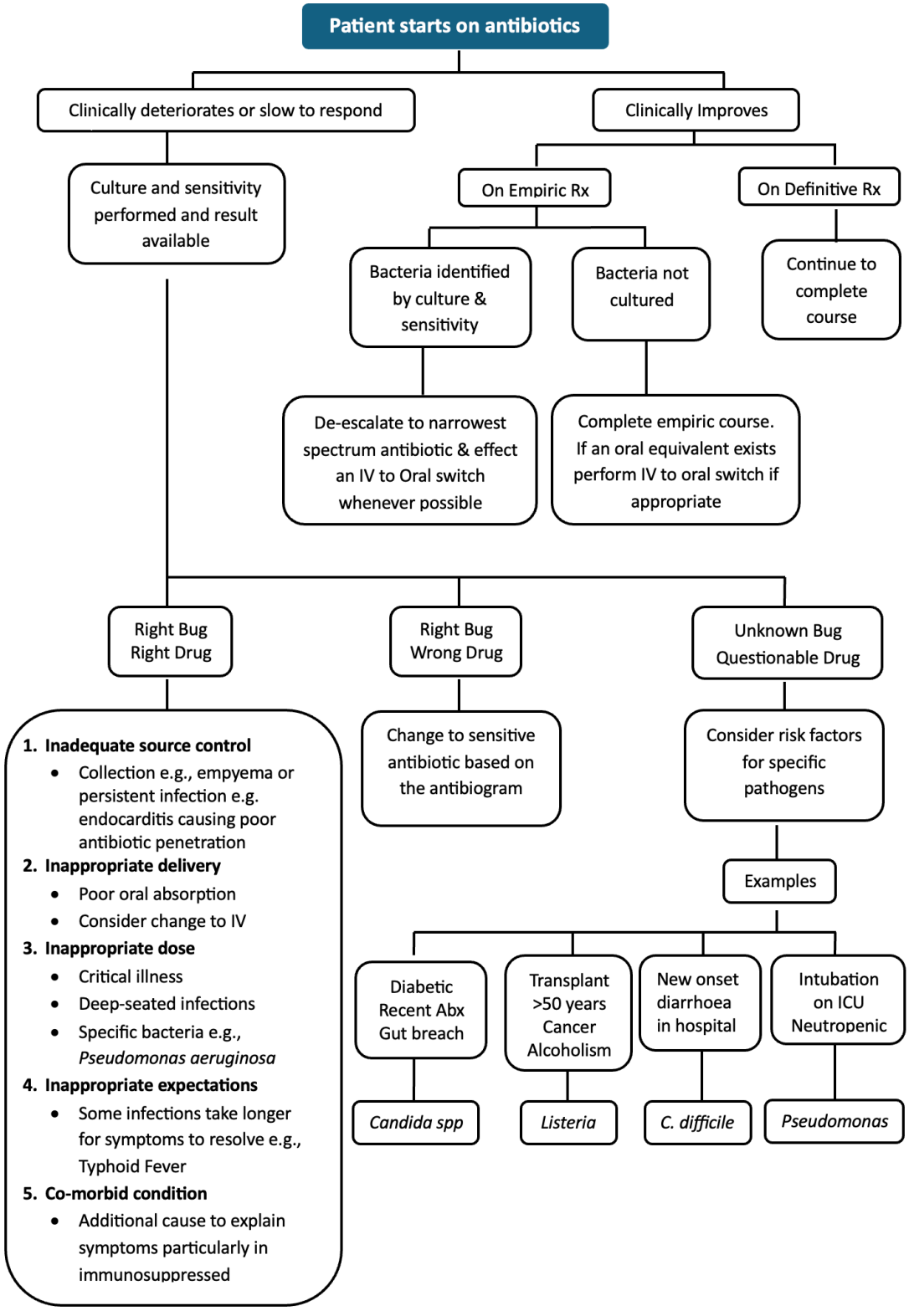
Can I remove this urinary catheter?

Additional useful IPC videos on the GSH Infectious Diseases YouTube site https://www.youtube.com/channel/UCz8Pp9sqaOY3nYUhA1xtpPg

1. How to prevent needlestick injury when taking blood - here
2. How to prevent needlestick injury during peripheral line insertion - here
3. Donning and doffing personal protective equipment - here

Chapter 5
Changing Antibiotics

Once antibiotics have been initiated the decision to change or stop therapy depends on the patient's clinical response and culture results (see algorithm):



Antimicrobial Stewardship: 48–72 Hour Antibiotic Review
Every antibiotic prescription should be reviewed within **48–72 hours** to ensure that ongoing therapy remains appropriate.

At 48–72 hours, ask:

- Does the patient still have evidence of a bacterial infection?
- Are microbiology or culture results available to allow antibiotic(s) to be stopped or de-escalated?
- Is IV to PO switch possible?
- Is the planned duration of treatment still appropriate?

Every antibiotic review should result in one of four actions: **Stop, Continue, De-escalate, Escalate, or Switch IV to oral therapy.**

Good documentation supports appropriate antimicrobial stewardship, improves continuity of care, and facilitates timely review, de-escalation, or discontinuation of antibiotic therapy.

Document every antibiotic prescription in the patient's notes

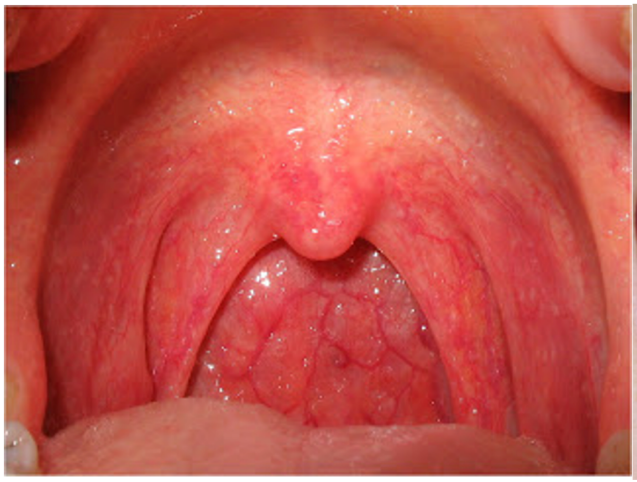
- Indication: Why is the antibiotic being prescribed?
- Antibiotic: Name of the antimicrobial agent.
- Dose and route: Record the prescribed dose and route of administration.
- Planned duration: Specify the intended duration of treatment.
- Review date: Document when therapy should be reassessed (ideally within 48–72 hours).

Chapter 6
Acute Upper Respiratory Tract Infection

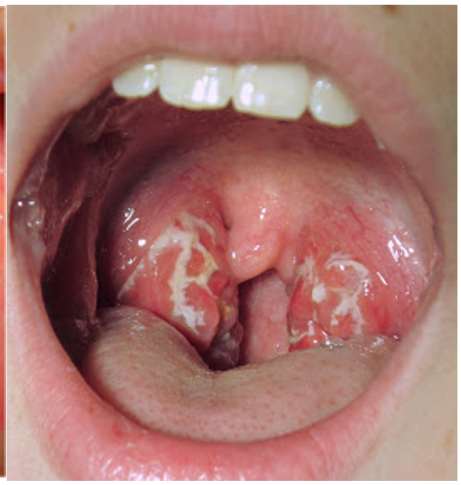
Over-prescribing of antibiotics for upper respiratory tract infection (URTI) is a major driver of bacterial resistance in the community. URTI comprises three clinical syndromes depending on the site of infection: pharyngotonsillitis (sore throat), acute otitis media, and acute bacterial sinusitis.

Acute pharyngotonsillitis (sore throat)

Typical appearance viral pharyngitis



Typical appearance bacterial pharyngotonsillitis



Definition

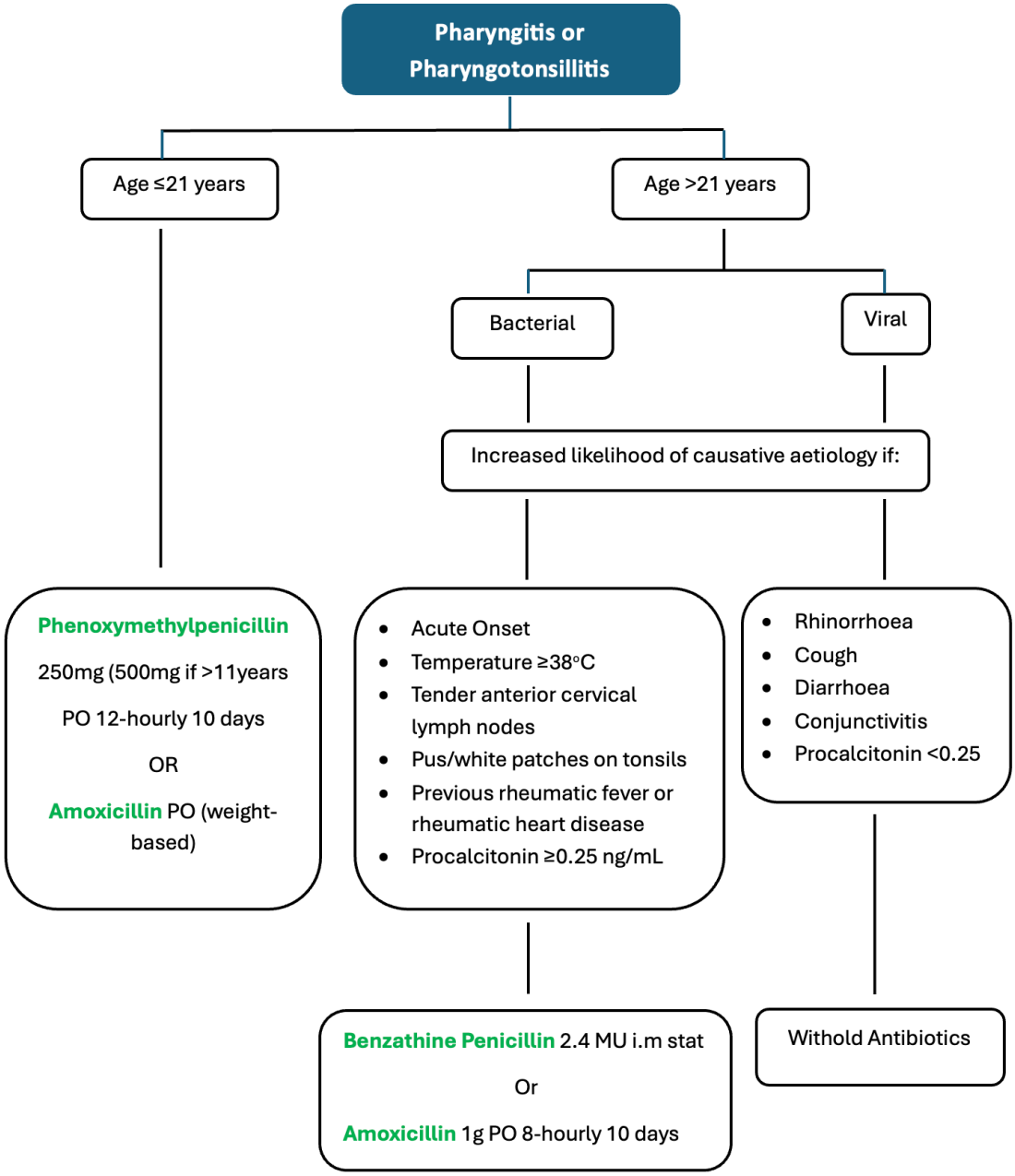
- Acute inflammation of the pharyngeal wall and tonsils.

Likely pathogens

- Commonly due to respiratory viruses and Epstein-Barr Virus, especially in adults
- Prevalence of group A β-haemolytic streptococci (*S. pyogenes)* in South Africa is decreasing but remains a significant risk for Rheumatic Heart Disease in children between 3-15 years
- Viral and bacterial acute pharyngitis are self-limiting, hence, the primary reason for considering antibiotic therapy is to prevent Acute Rheumatic Fever in children between 3-15 years

Clinical features

- Although only a microbiological confirmation of the causative agent provides absolute proof, clinical and biomarker (if available) assessment can help direct use of antibiotics
- Features listed in the following algorithm should be used.

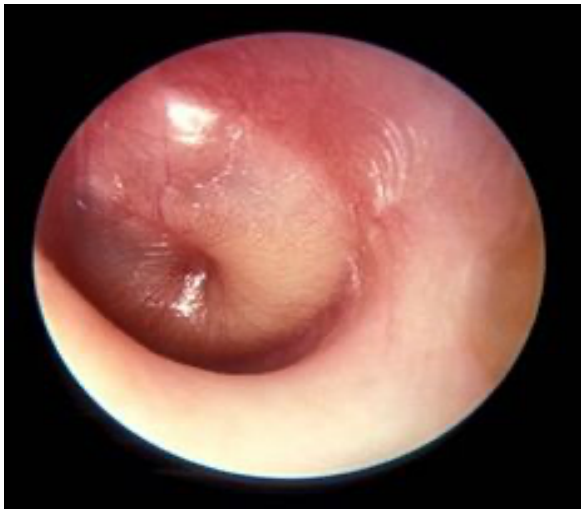


Beta-lactam allergy
Azithromycin 500mg PO daily adults (10 mg/kg for children <3 years) for 3 days

NB: As the prevalence of rheumatic fever in South Africa is still significant, patients <21 years of age (as per STGs) should be treated to prevent development of rheumatic heart disease

Acute otitis media

Definition- Acute inflammation of the middle ear due to infection that is rare in adults



Typical appearance of acute otitis media

Likely pathogens

- Upper respiratory tract viruses – Rhinovirus, RSV, SARS-Cov2, Influenza
- *Haemophilus influenzae, Streptococcus pneumoniae, Moraxella catarrhalis*

Clinical features

- Acute onset ear pain (otalgia) ± decreased hearing
- Ear discharge
- Reddened and bulging tympanic membrane

Tests

- None required – do not use pus MCS from perforated eardrum to guide treatment

Treatments

- Initially analgesics and decongestants only
- Consider antibiotic treatment If symptoms worsen within 48-hrs or systemically very unwell with T ≥39^{o}C or ear pain despite analgesia - **Amoxicillin** 1g 12-hourly PO 5-10-days
- Severe penicillin allergy - **Azithromycin** 500mg PO q^{24} for 3-days

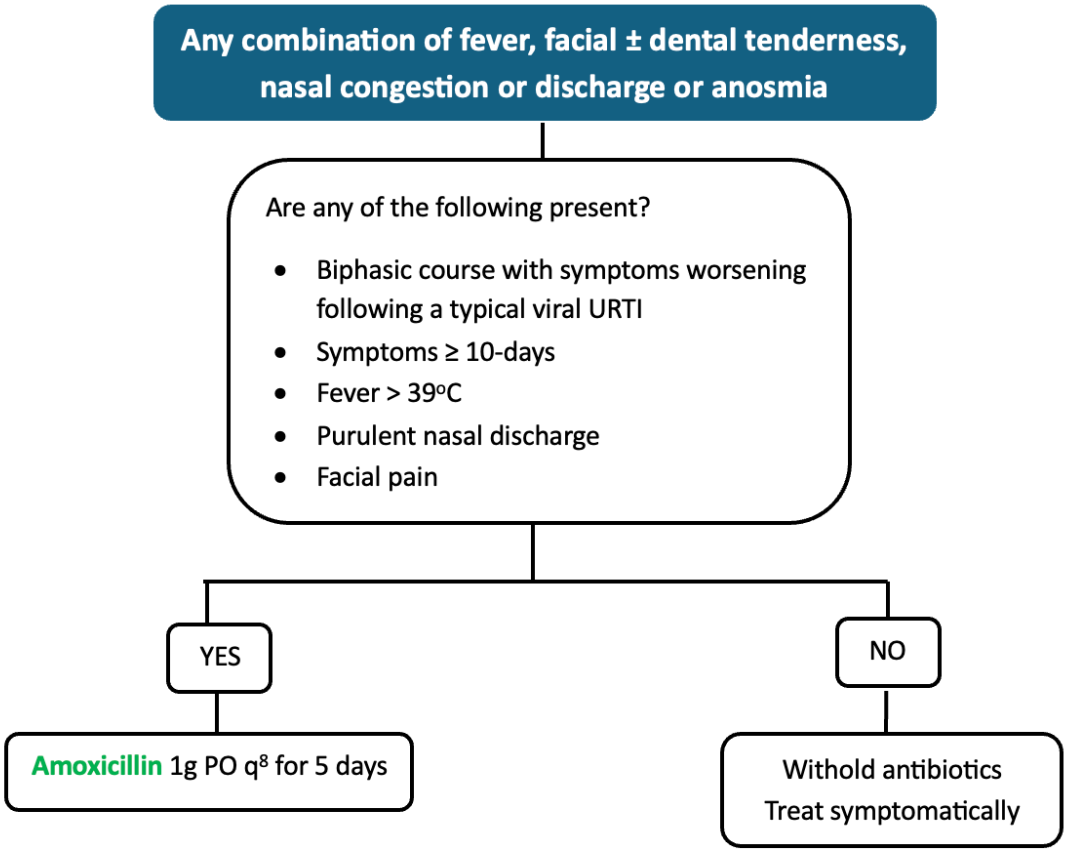
Acute bacterial sinusitis

Definition- Acute bacterial infection with symptomatic inflammation of the paranasal sinuses

Likely pathogens- *Haemophilus influenzae, Streptococcus pneumoniae, Moraxella catarrhalis*

Tests

- If failure of initial therapy a CT scan, fibre-optic endoscopy with aspiration and culture of pus may be necessary – discuss with ENT specialist



Severe penicillin allergy – **Azithromycin** 500mg PO daily for 3 days

Chapter 7
Acute Lower Respiratory Tract Infection

The patient presenting with acute onset of cough and fever is one of the commonest presentations to hospital, and the commonest reason for inappropriate antibiotic use in community settings. A thorough history and examination are the key to appropriate management of such a presentation (see following algorithm). Cough may be caused by infectious or non-infectious causes.

In South Africa, tuberculosis should always be considered. Most commonly, tuberculosis presents with sub-acute or chronic cough of >2 weeks with ≥1 of night sweats, anorexia, or weight loss, but HIV-positive patients in particular, can present acutely. In one study 30% presented with symptoms <2 weeks' duration.[5]

Other than tuberculosis, the commonest causes of fever and cough are viral influenza-like illness and acute bronchitis, acute exacerbation of chronic obstructive pulmonary disease (AECOPD), community-acquired pneumonia, aspiration pneumonitis/pneumonia, and in the South African context, post-TB infective bronchiectasis and lung abscess. Less common are infections complicating other forms of structural lung disease such as cystic fibrosis, interstitial lung disease, and conditions affecting the lungs such as systemic lupus erythematosus.

Acute bronchitis

Definition

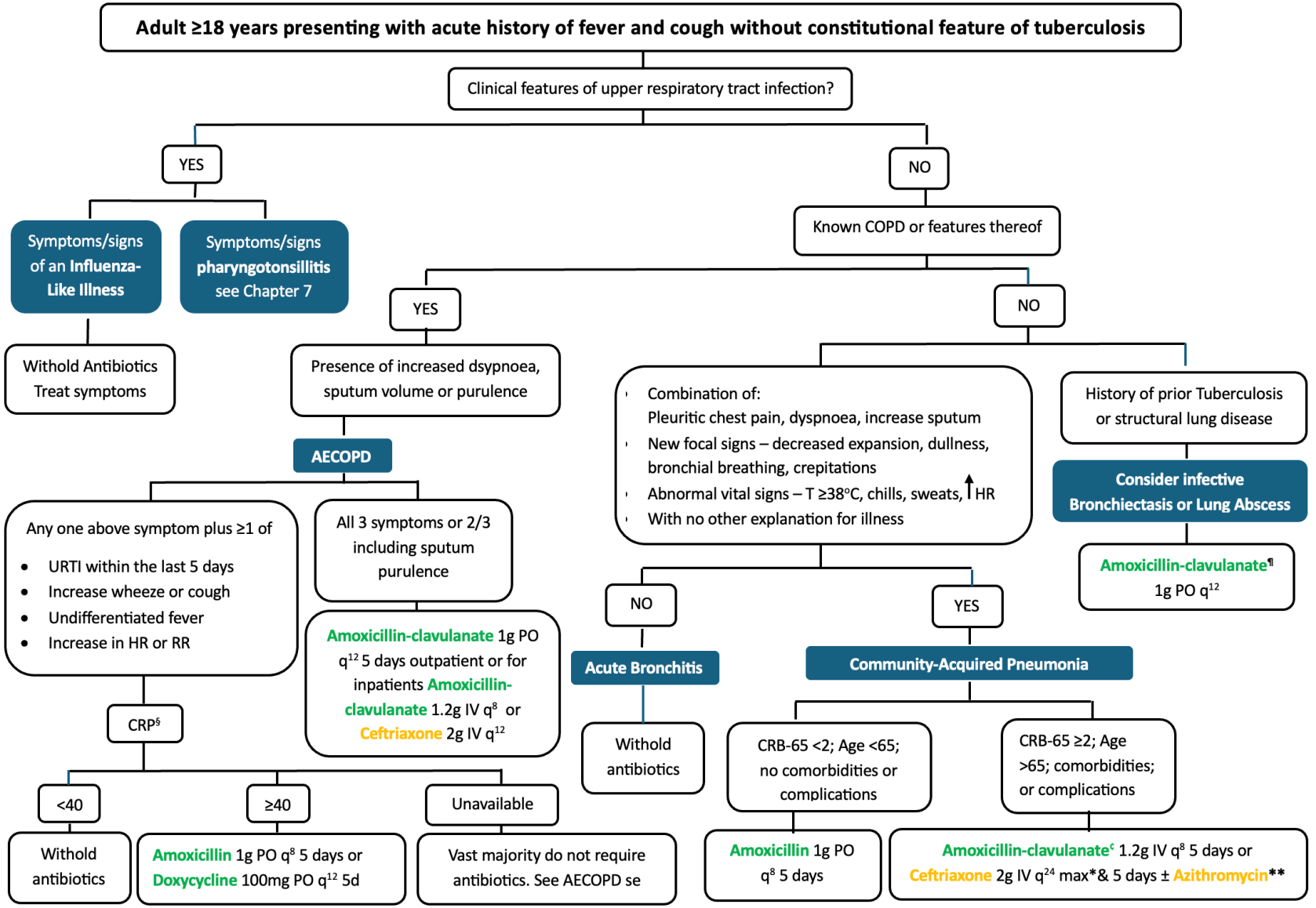
Self-limited inflammatory process involving large and mid-sized airways, presenting with persistent cough generally lasting < 3 weeks with or without fever but no clinical features of pneumonia on chest examination (decreased chest expansion, dullness on percussion, crackles or bronchial breathing on auscultation). Commonly associated with viral URTI-like symptoms

Common aetiologies

- Respiratory viruses (90-95%)
  - Influenza, Parainfluenza, RSV, human metapneumovirus, Rhinovirus
- Bacterial (<10%)
  - Suspect if prolonged cough, longer incubation period (if clear exposure history given), local outbreaks
    - *M. pneumoniae; C. pneumoniae*, *B. pertussis*
  - No association with *S. pneumoniae* or *H. influenzae* in patients without evidence of underlying lung disease

Tests – None. CXR is not indicated in the management of acute bronchitis
Management – symptomatic– analgesia, mucolytics, bronchodilators if wheeze

[5] Griesel et al. Clin Infect Dis. 2018 Apr 17;66(9):1419-1426.



¶Duration of treatment depends on pathology. Infective bronchiectasis generally 7-14 days depending on severity, whereas lung abscess would be 6 weeks
*IV to PO switch at earliest opportunity. **CRB-65>2 and/or if atypical CAP is considered – send urine for legionella urinary antigen
§CRP cut offs differ by country guidelines. This threshold as per Llor et al. Am J Respir Crit Care Med. 2012 Oct 15;186(8):716-23
[c]In non-severe presentations, oral amoxicillin-clavulanate 1g q12 can be used in this population

Acute Exacerbation Chronic Obstructive Pulmonary Disease (AECOPD)

Definition
Acute increase in baseline dyspnoea, cough and/or sputum above the normal day-to-day variations, requiring a change in medication. Up to 80% of AECOPD have an infectious aetiology.

Another common cause of inappropriate cause of antibiotic prescribing

Common microbial aetiologies

- Viral (up to 50%) – more common in winter months
  Rhinoviruses, Parainfluenza, Influenza, RSV, SARS_CoV2
- Bacterial
  - *S. pneumoniae, M. catarrhalis. H. influenzae*
  - Enterobacterales (consider if recurrent hospitalisation and antibiotic use)
  - Atypical bacteria are not implicated in AECOPD

Classification of severity
Classifications are often used based on symptoms such as Global Initiative for Chronic Obstructive Lung Disease (GOLD), which focuses on treatment requirements:

- Mild – Slight increase dyspnoea, cough or sputum, requiring short-acting bronchodilators (SABs) only – No antibiotics
- Moderate – SABs + systemic steroids and/or antibiotics
- Severe – Hospitalisation with or without need for O_2 or ventilatory support

Tests
Sputum culture is only useful if patient has had frequent admissions and/or repeated antibiotics increasing risk of resistant bacterial infection

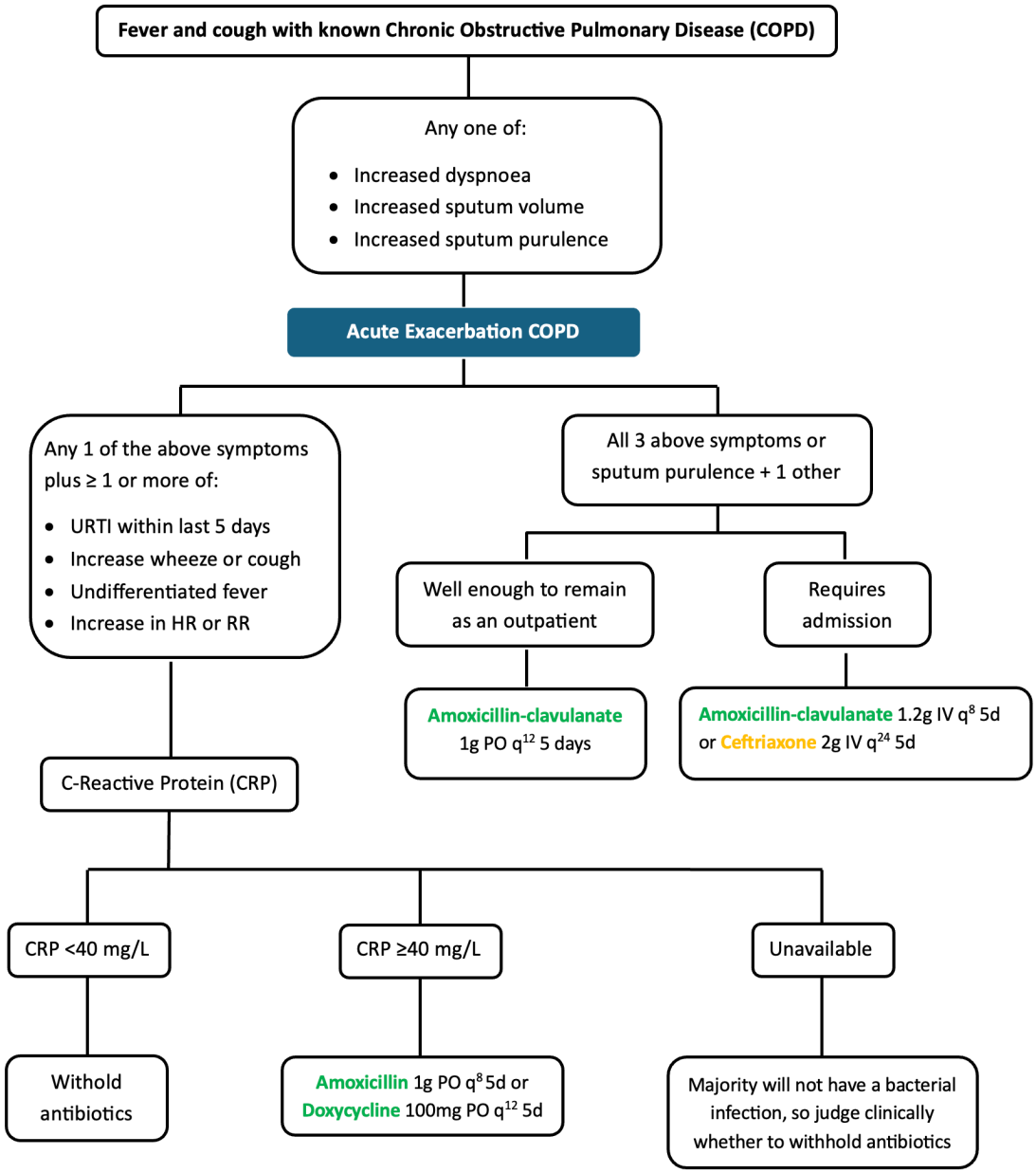
C-Reactive Protein (CRP) has been used to safely withhold antibiotic treatment in cases of mild or moderate AECOPD. Cut-off thresholds differ between guidelines e.g., NICE (UK):

CRP mg/L	Action
<20	Bacterial infection unlikely. Withhold antibiotics
20-100	Bacterial infection possible. Delayed prescription or treat if high-risk individual
>100	Bacterial infection more likely. Antibiotics recommended

For these guidelines **we have used a 40mg/L cut-off** to direct antibiotic use based on CRP threshold for successful antibiotic treatment in a Spanish RCT.[6]

[6] Llor et al. Am J Respir Crit Care Med. 2012 Oct 15;186(8):716-23

Diagnosis and management



Prevention

- Annual influenza vaccine recommended for all patients with COPD
- Pneumococcal conjugate vaccine is recommended for all individuals >50 years
- Antiviral chemoprophylaxis is not recommended
- Antibiotic prophylaxis with azithromycin 250mg x3/week is recommended for selected patients after discussion with a pulmonologist
  - Patients who do not smoke and have optimised non-pharmacological management including vaccinations
  - Continue to have ≥1 or more of: frequent AECOPD (typically >4/y); prolonged exacerbations with sputum; requiring hospitalisation

Community Acquired Pneumonia (CAP)

Definition
Pneumonia is acute infection of lung parenchyma distal to the terminal bronchiole and causes consolidation.

Common aetiologies

Pathogen	Comments
S. pneumoniae	Most common cause
H. influenzae	More common in COPD
M. tuberculosis	More common in HIV
Atypical bacteria – *L. pneumophilia* – *M. pneumoniae* – *C. pneumoniae*	Fastidious - difficult to culture No specific clinical features. CXR may show bilateral infiltrates Suspect if risk factors or non-response to beta-lactams
Oral anaerobes	Risk factors: alcoholism, aspiration, lung abscess
Respiratory viruses	Seasonal influenza; SARS-Cov-2, RSV Risk factors: pregnancy, elderly, co-morbidities
P. jirovecii	HIV or other cause of severe immunosuppression, bilateral infiltrates, desaturation on minimal exertion, poor response to beta-lactams

Tests
Sputum MCS rarely changes management unless if the patient has failed antibiotic therapy at which stage, also send Xpert Ultra MTB/RIF

For severe CAP (CRB-65 ≥3) or comorbidities such as chronic cardiopulmonary disease, alcoholism, immune suppression (excluding HIV), CKD, cirrhosis

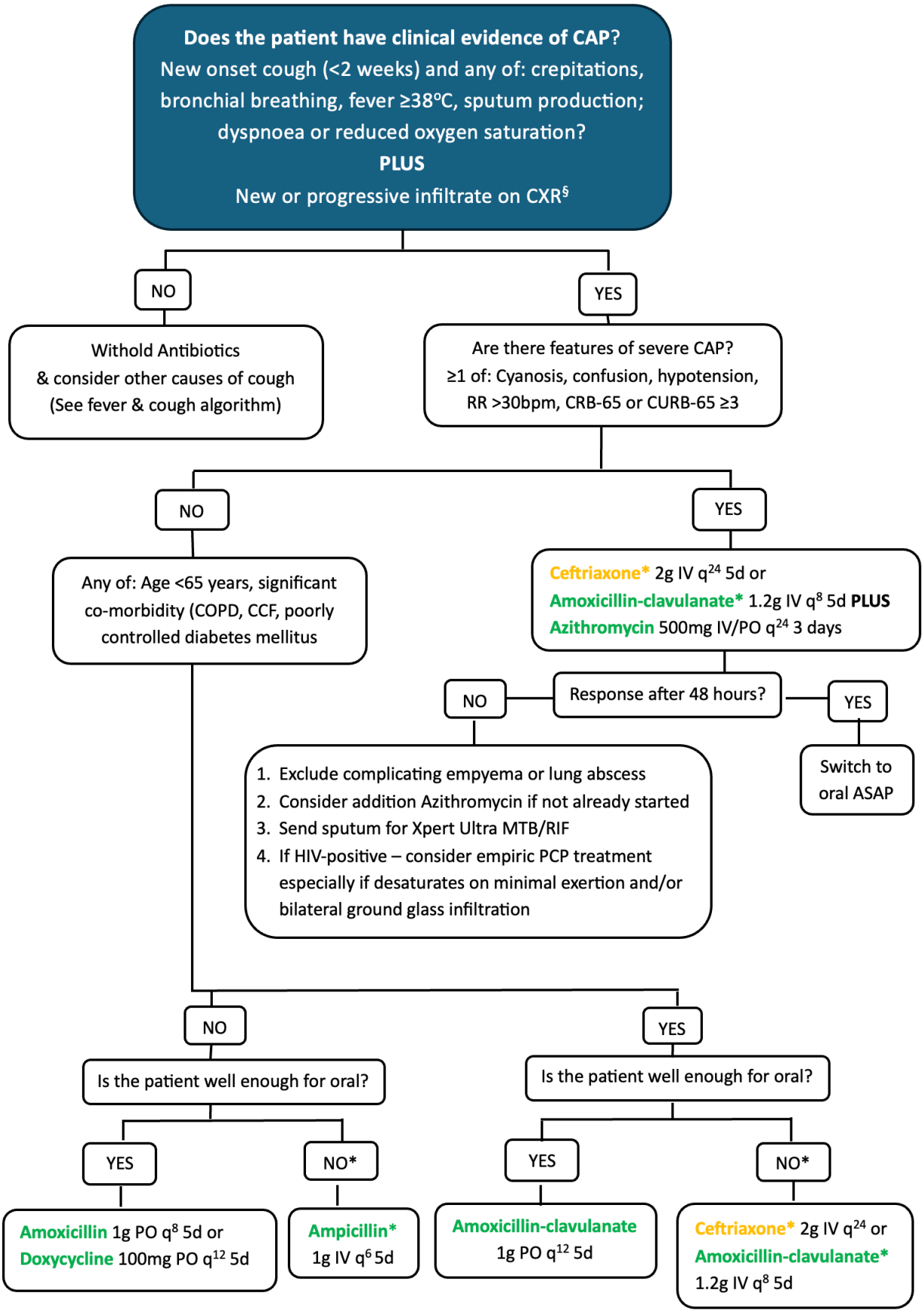
- Sputum and blood culture for MCS
- Legionella urinary antigen
- Induced sputum or BAL for *P. jirovecii* PCR if HIV-positive
- Respiratory viral panel – as resources allow and if indicated clinically

Diagnosis and management
Inappropriate use of azithromycin for CAP is a common.
Azithromycin has 2 possible indications:

1. Atypical CAP is suspected which should prompt a legionella urinary antigen test, which if positive will require 5-7 day duration & stopping the beta-lactam
2. In severe CAP i.e., CRB-65 ≥3, azithromycin acts as an immune modulator and has been demonstrated to reduce mortality and morbidity, if given for a maximum of 3 days.

NB – there is RCT evidence that single dose azithromycin 1.5mg[7] is non-inferior to 3 days of 500mg q[24].

[7] Spellberg B. https://www.bradspellberg.com/shorter-is-better



§If unavailable, go on clinical grounds alone
*Criteria for de-escalabion – HR <100bpm, RR <25bpm on room air, no delirium, able to take oral meds.

Severe penicillin allergy - **Moxifloxacin** 400mg PO or IV q^{24}

Chapter 8
Intra-abdominal infection (IAI)

Definitions and causes

Infections in the abdomen can be divided into the following main groups:

1. Hepatobiliary infections including cholecystitis, cholangitis & liver abscess
2. Bowel infections, including appendicitis, diverticulitis and *Clostridioides difficile*
3. Intra-abdominal collections or abscesses
4. Peritonitis, including bowel perforations and spontaneous bacterial peritonitis (SBP) related to liver disease

Common aetiologies

Empiric antibiotic therapy for community-acquired IAIs should cover:

- Enteric gram-negative bacilli: *E. coli, K. pneumoniae, E. Cloacae* etc
- Anaerobes
- *Enterococci*

In healthcare-associated infections or severely ill patients also consider *E. faecium*, MRSA, and Candida species

Tests

Most cases will require abdominal imaging (either ultrasound or CT), unless there is a clear indication for urgent laparotomy.

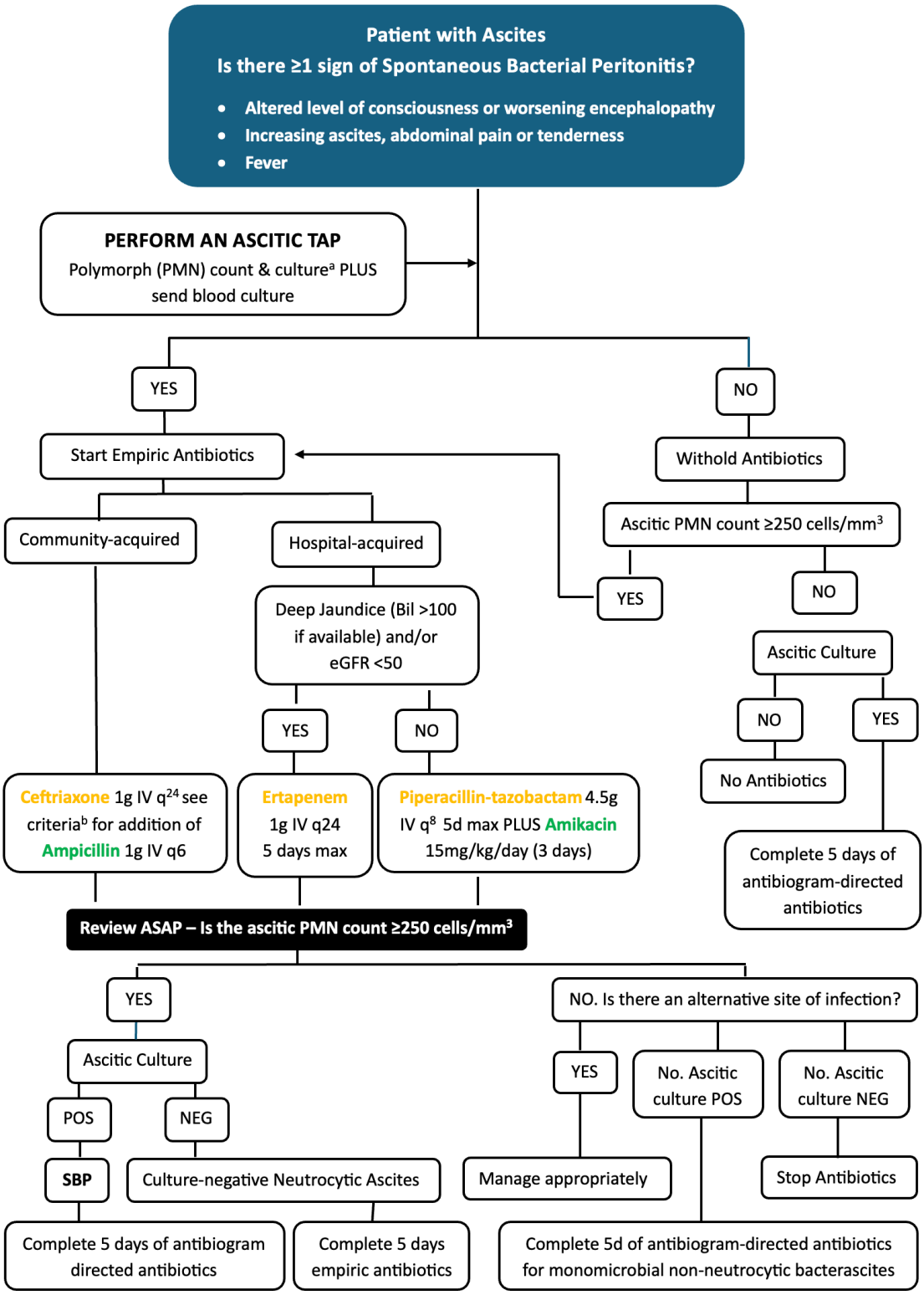
- Blood culture
- Culture of infected material is recommended in the following situations:
    - Ascitic fluid for suspected SBP
    - Liver abscess with incomplete source control
    - Aspiration of a collection either surgical or interventional radiology
    - Hospital-acquired IAIs

Spontaneous Bacterial Peritonitis

The following algorithm relates to the patient with cirrhosis and portal hypertension presenting with ascites and one or more clinical features of SBP.

The commonest antibiotic stewardship errors are:

a. Routine administration of **ampicillin** to cover *E. faecalis.* Over 95% of community-acquired SBP is due to Enterobacterales infection. Indications for ampicillin are provided in the footnote
b. De-escalation from **ceftriaxone** to oral **ciprofloxacin** should be performed if the antibiogram allows, to complete the 5 days
c. Prolonged duration of antibiotics past 5 days is rarely necessary and should be discussed with Infectious Diseases, Microbiology and hepatologist



a. Inoculate 10ml ascitic fluid directly into a blood culture bottle, 5ml into a sterile container (for Gram stain), and an EDTA tube for cell count

b. Indications for ampicillin - Any one of: fulminant hepatic failure; clinically apparent deep jaundice (Bilirubin >100 if available); significant renal dysfunction (doubling of baseline creatinine); Clinical deterioration after 48h of ceftriaxone monotherapy; Enterococcus spp cultured from ascites or blood (in this case, stop ceftriaxone); underlying biliary disease e.g. primary sclerosing cholangitis. NB – liver patients without ascites but altered LOC or worsening encephalopathy should only receive ampicillin if underlying liver disease is biliary in nature or for directed therapy based on culture and sensitivity.

c. Give loading dose of ertapenem 1g iv stat even independent of the eGFR

Acute Cholecystitis and Acute Cholangitis

Acute inflammation of the gall bladder (cholecystitis) or biliary system (cholangitis) most frequently caused by gallstone obstructing the cystic and common bile duct respectively.

Enterobacterales are the most common causative pathogens, followed by *Enterococci* and anaerobes. The decision on surgical drainage or cholecystectomy will depend on whether uncomplicated or complicated (peritoneal cavity is involved and/or abscess present)

Tests

Mild cases usually not required. In severe infection (critical illness – more common in those >60 years, immunocompromise or comorbidities) send blood cultures and if drainage occurs, biliary fluid to enable de-escalation.

Management

Acute Cholecystitis:

- Asymptomatic/mild cases without risk factors for severe disease (>60y, immunocompromise or comorbidities) may not require antibiotic therapy.
- **Amoxicillin-clavulanate** 1g PO q^{12} or 1.2g IV q^{8} if unable to tolerate oral meds
    - Uncomplicated cases can stop antibiotics once gall bladder removed
    - Complicated cases with good source control – complete further 4 days

Acute Cholangitis:

- **Amoxicillin-clavulanate** 1g PO q^{12} or 1.2g IV q^{8} if unable to tolerate oral meds
    - Until biliary drainage occurs & 5 days after successful source control

Alternative antibiotic regimens

Ampicillin 1g IV q^{8} + **Gentamicin** 5mg/kg q^{24} + **Metronidazole** 500mg IV q^{8}

Ceftriaxone 1g IV q^{24} + **Metronidazole** 500mg IV q^{8}

Liver Abscess

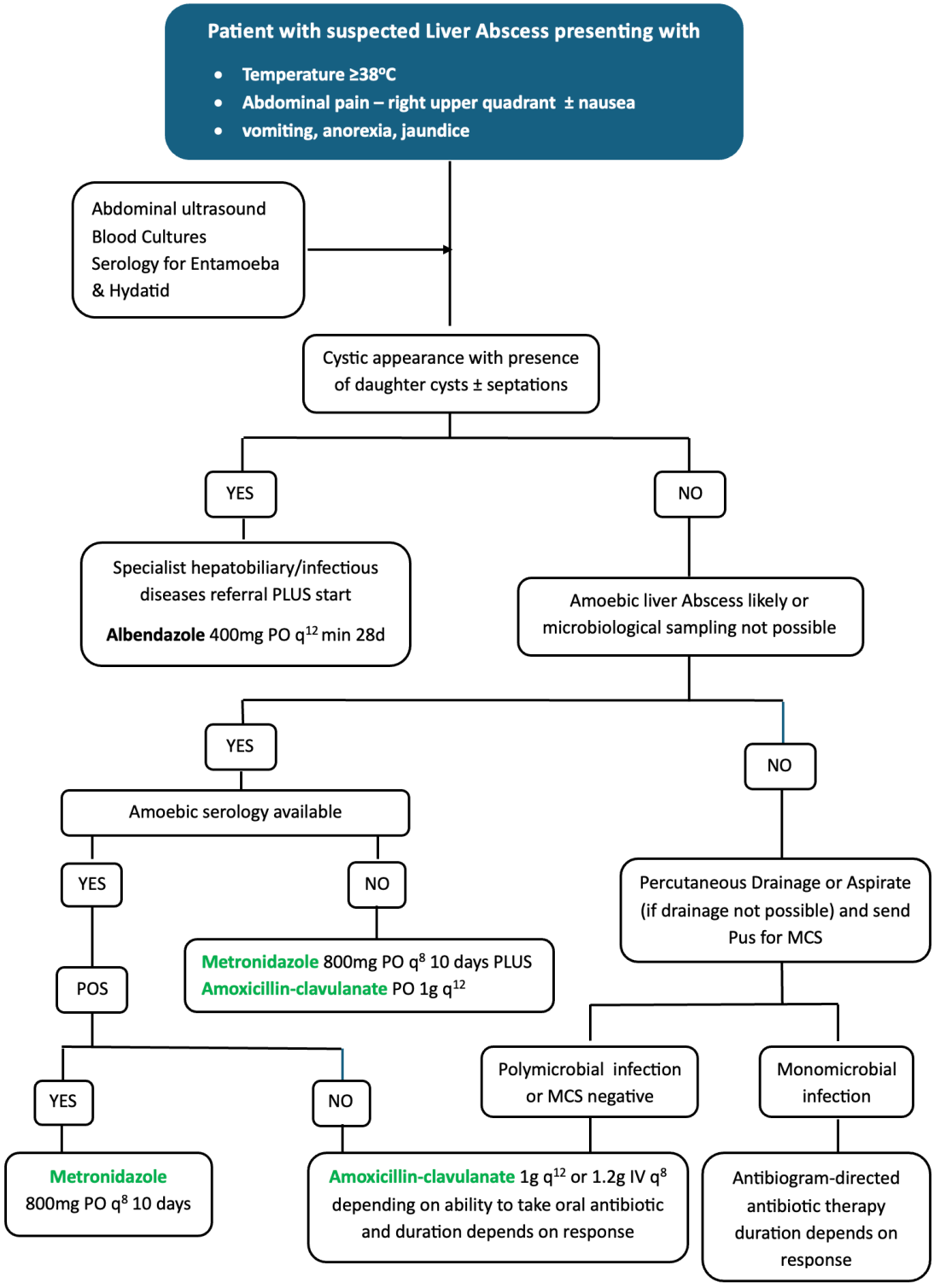
Acute bacterial liver abscesses are commonly due to haematogenous spread and typically present with fever and RUQ pain.

Commonest causes include Enterobacterales, *S. aureus*, anaerobes and *Enterococcus spp.* Other important causes include

- *Entamoeba histolytica* (amoebic liver abscess)
- Hydatid Disease caused by *Echinococcus granulosus*

Tests

Ultrasound of the liver, blood culture, and serology for Entamoeba and Hydatid



The use of metronidazole with amoxicillin-clavulanate for liver abscess of unknown cause if amoebic serology is unknown, is one of the only times in management of infectious diseases when these two antibiotics should be used together as the latter has excellent anaerobic cover for most infections.

Chapter 9
Acute diarrhoea

Definition- New (<2 weeks) onset of diarrhoea

Antibiotic Stewardship points

- **MOST** cases of acute diarrhoea do not require antibiotic treatment and are self-limiting
- Stool tests for *C. difficile* should be reserved for hospital-acquired acute watery diarrhoea or in community-acquired patients with known risk factors
    - Previous *C. difficile* infection
    - Recent antibiotics preceding the onset of diarrhoea
    - Known inflammatory bowel disease
    - Morbid obesity
    - Proton pump inhibitors (PPIs)

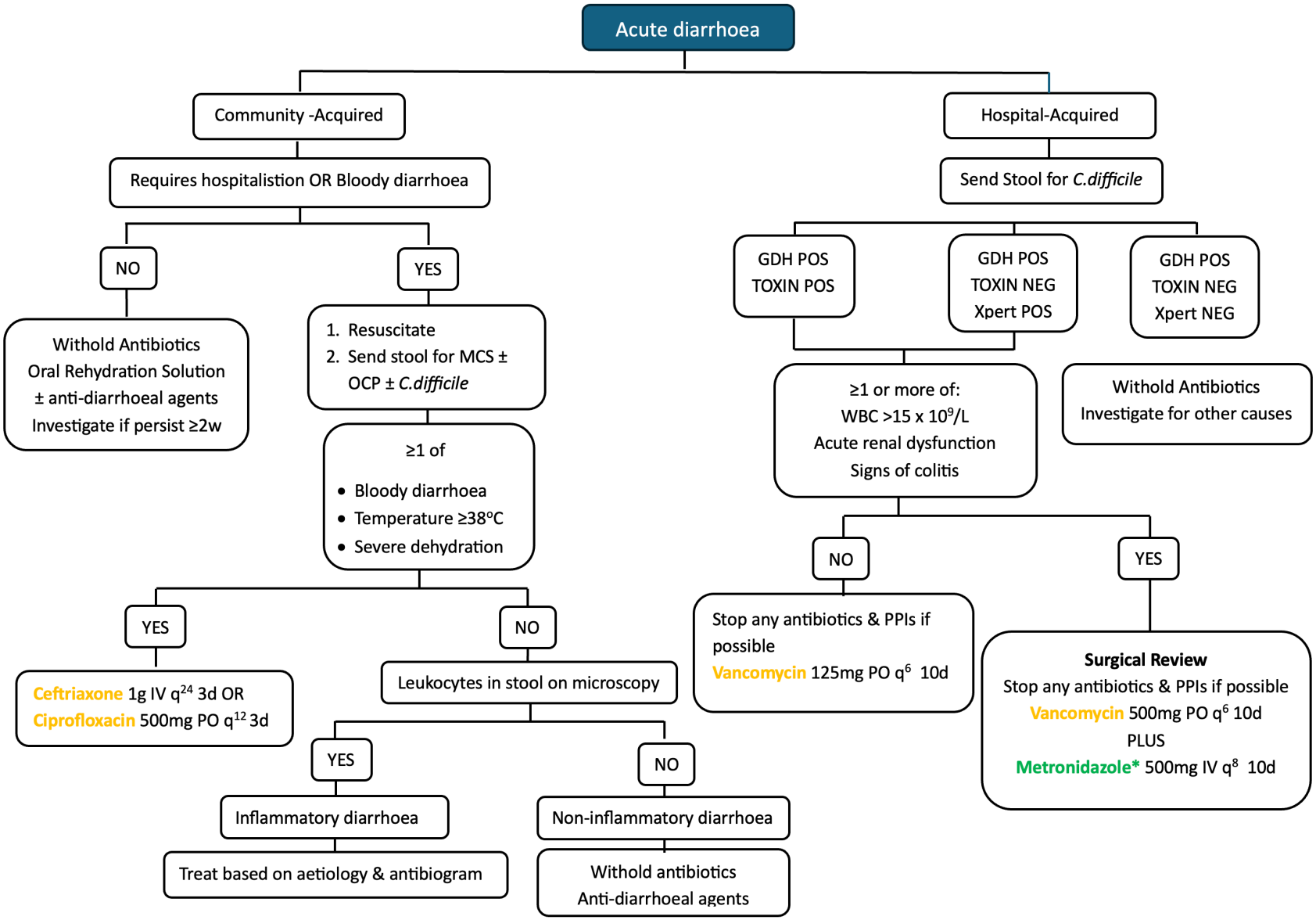
Likely pathogens

- Watery diarrhoea
    - Viruses – predominantly norovirus & rotavirus
    - Cholera – only in endemic settings or context of an outbreak
    - Shigella – although an important cause of bloody diarrhoea, shigellosis may present with watery non-bloody diarrhoea, especially in the early phase of the illness. Can also cause of significant colitis.
- Bloody diarrhoea (dysentery)
    - Shigella, Campylobacter, Non-typhoidal Salmonella, Enterotoxigenic *E. coli*
    - *Schistosoma mansoni* – rare but important cause in endemic areas
- Persistent diarrhoea (usually >2 weeks) – *Giardia lamblia* (watery) and *Entamoeba histolytica* (dysentery)

Clinical features

- ± Fever; nausea; vomiting; bloating; flatulence; flatus; cramps
  Check for history of food exposure, illness among close contacts, recent travel, HIV status, and history of recent antibiotics

Tests - Moderate to severe cases require investigation +/- hospitalisation (see algorithm). If dysentery, send 'hot' stool for wet prep microscopy to look for E. histolytica trophozoites



*Switch to oral metronidazole once diarrhoea resolving and patient improving. PPI = Proton Pump Inhibitor

Recurrent *C. difficile* diarrhoea

- Occurs in up to 25% of patients

In cases of first recurrence and any offending antibiotics have been stopped,

- Repeat 10-day course of **vancomycin**

For 2nd or subsequent recurrence

- Tapering regimen of **vancomycin** 125 mg q^{6} 10 days -> q^{12} 7 days -> q^{24} 7 days -> every 2nd day for 8 weeks

***Entamoeba histolytica* dysentery**

- **Metronidazole** 800mg q^{8} 7-10 days followed by a cysticide whenever available
- Diloxanide 500mg q^{8} 10 days or Paromomycin 25mg/kg/day in 3 divided doses for 7 days or Nitazoxanide 500mg q^{12} 10 days

Management of Enteric Fever

Definition – a severe systemic illness characterised by fever and abdominal pain ± diarrhoea caused by infection with Salmonella enterica serotypes Typhi or Paratyphi A, B or C

- Mild – not critically ill & no signs of intestinal perforation, peritonitis or sepsis
- Moderate – Critically ill with signs of intestinal perforation, peritonitis or sepsis

Presentation

- Undifferentiated fever that can be protracted
- ± headache, anorexia, diarrhoea or constipation
- ± signs of severe disease – peritonitic pain, encephalopathy, hypotension etc

Tests

- Do NOT perform Widal Test – low sensitivity and unreliable
- Blood culture and stool culture
- Liver function tests – typhoid hepatitis
- Imaging rarely necessary

Management

- Increasing resistance to ciprofloxacin in South Africa therefore use of **ciprofloxacin** 500mg PO q^{12} should be reserved for culture-positive infections when the antibiogram confirms sensitivity
- **Ceftriaxone** 2g IV q^{24} (mild) or q12 (severe)
- De-escalate ASAP if antibiogram allows
- Total duration 10 days
- NB – fever is often slow to reduce – commonly between day 3-5. Hence continued fever in the presence of clinical stability without signs of complications does not immediately require antibiotic change
- Stool culture 2-weekly to ensure carrier state has not developed
    - Treatment of carriers – **Ciprofloxacin** 500mg PO q^{12} 6 weeks or as directed by an ID sub-specialist if *S. Typhi* is resistant to quinolones

Chapter 10
Urinary Tract Infection (UTI)

Definition[8] - Infection of the urinary tract

- Uncomplicated - confined to the bladder manifesting ≥1 of dysuria, frequency, urgency, or haematuria ± suprapubic pain
- Complicated - infection beyond the bladder if in addition there is ≥1 of pyelonephritis, fever or bacteraemia, or a permanent catheter in situ is present

These guidelines agree with the updated IDSA guidelines for UTI which dispense with the old definition of complicated UTI including males by default, the evidence for which is laid out in the guidelines[8].

Common aetiologies

Enterobacterales – *E. coli, K. pneumoniae, E. cloacae, P. mirabilis*
Other – *Enterococci, Group B Streptococci, S. saprophyticus*

Common contaminants - C*andida spp, Enterococci, G. vaginalis, M. hominis*

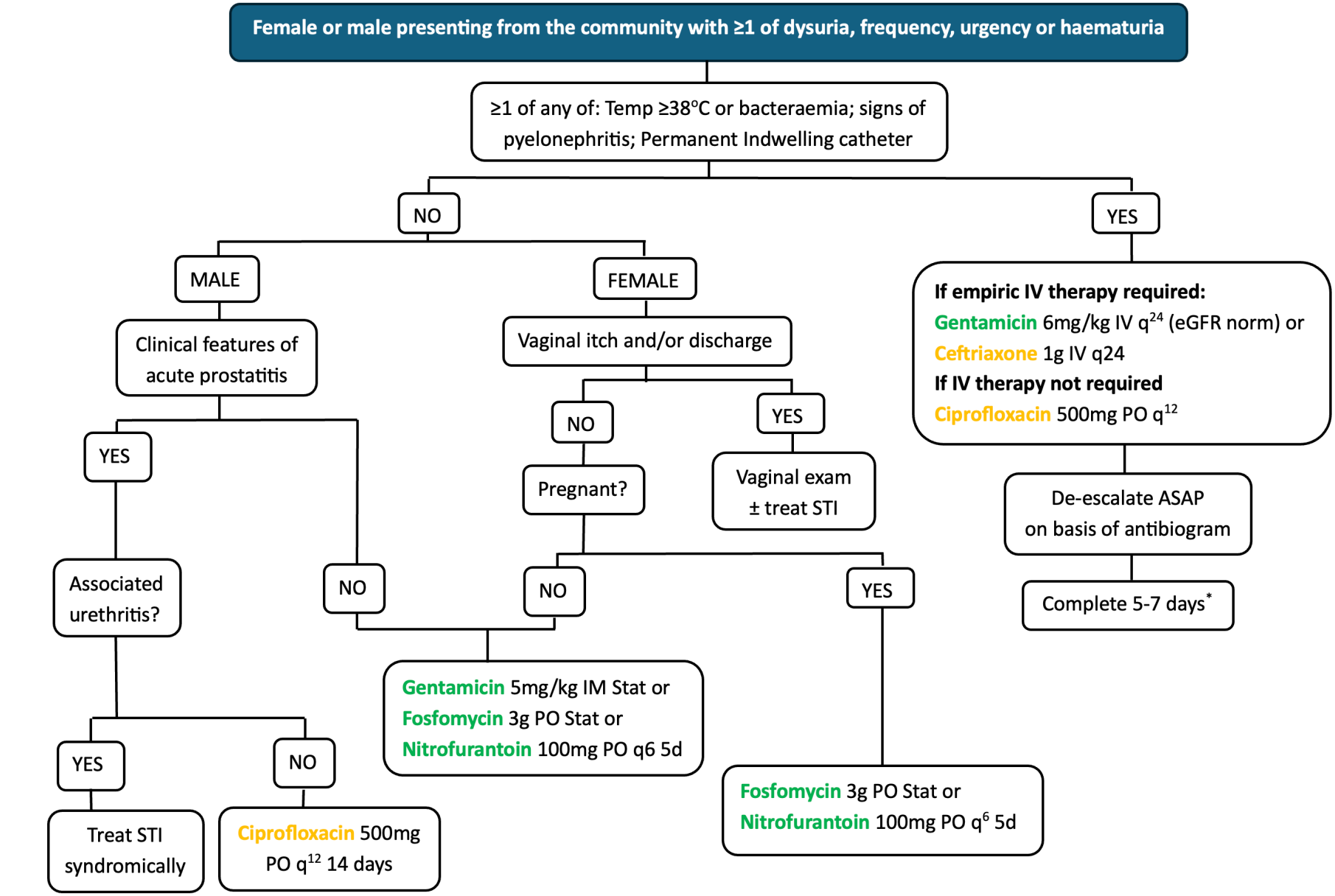
Tests

Uncomplicated UTI – urine MCS only necessary in re-infection, persistent or recurrent infection, or pregnancy. Follow-up cultures are unnecessary if symptoms resolved
Complicated UTI – urine and blood culture. Imaging may be required if a paranephric abscess is considered

Antibiotic stewardship

- The commonest reason for inappropriate prescribing is for asymptomatic bacteriuria i.e., when the patient is asymptomatic and a urine MCS returns positive when sent as part of routine investigations. Elderly patients being investigated for delirium is another very common cause of inappropriate prescribing
- Asymptomatic bacteriuria is only treated when it is either
    - during pregnancy (to reduce risk of developing pyelonephritis), hence all pregnant women should have a screening MCS. Bacteria cultured at ≥ 10^3 cfu/ml of a single organism (or any *E. coli*) is significant
    - if lower genitourinary biopsy is being planned such as prostate biopsy to prevent infection
- As a general rule – "no WBCs in the urine, no UTI". The exceptions are in profoundly neutropenic patients or those with a high urinary tract obstruction
- Nitrite positivity on urine dipstick indicates a Gram-negative bacterium is present. It does not in differentiate between infection & colonisation
- Patients presenting with a catheter-associated UTI should have the catheter replaced or if possible, removed.

[8] Infectious Diseases Society of America 2025 Guideline Update on Complicated Urinary Tract infections.



*https://www.bradspellberg.com/shorter-is-better

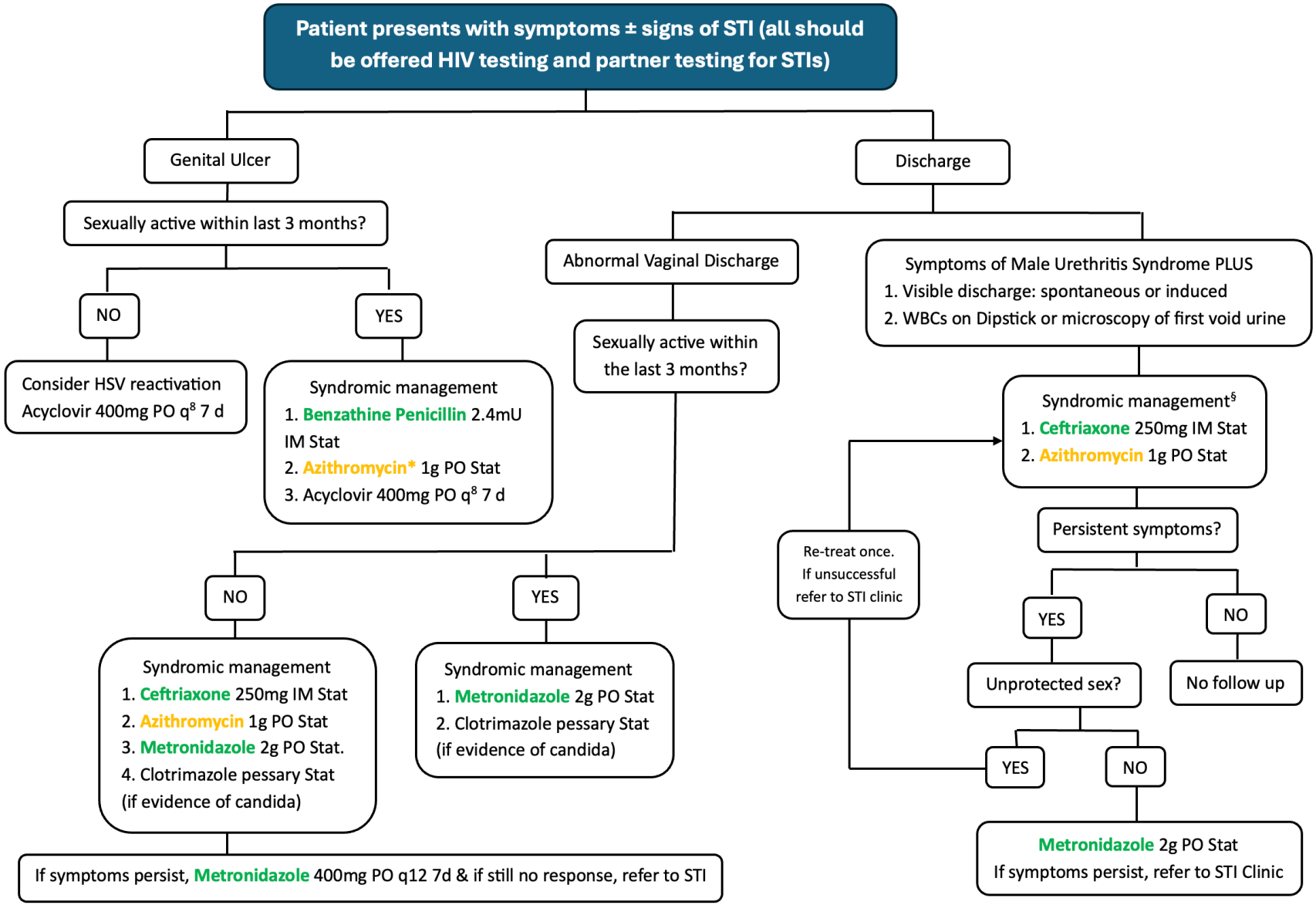
Chapter 11
Sexually transmitted infections

STI	Common Causes
Vaginal discharge Vaginal and occasionally cervical infection characterised by discharge, itching or odour	• Vaginitis - Bacterial vaginosis (replacement of normal flora by polymicrobial overgrowth); *T. vaginalis*; *C. albicans* • Cervicitis: *C. trachomatis* and *N. gonorrhoeae*
Male Urethritis Syndrome (MUS) Urethral inflammation from infectious and non-infectious causes	*N. gonorrhoeae* and *C. trachomatis*
Genital Ulcer Syndrome (GUS) New genital, anal or perianal lesion after recent sexual activity	Painful – HSV, *H. ducreyi* (Chancroid) Painless – Syphilis, *C. trachomatis (Lymphgranuloma venereum)* Non-sexually transmitted Folliculitis, tuberculosis, candida infection Non-infectious: trauma, malignancy, eczema, psoriasis, contact dermatitis (latex allergy), aphthous ulcers

It is not possible to distinguish the causes on clinical grounds alone. Do not diagnose a venereal cause of GUS if no sexual activity in the past 3 months (except for reactivated HSV).

Tests
Usually requires no investigations. For recurrent genital ulcers perform a swab for HSV PCR if painful and syphilis serology if painless.

Management
- Offer HIV testing to all
- Advise to abstain from sex until after therapy and symptom resolution
- Refer sex partner for empiric treatment of primary syphilis if index case has positive serology and chancroid if sexual contact within 10 days preceding symptoms



§If partner has vaginal discharge, ad metronidazole. *Alternative is doxycycline 100mg PO q12 14 days

Chapter 12
Acute meningitis

- Acute inflammation of the meninges of <7 days duration.

Likely pathogens

- *Streptococcus pneumoniae, Neisseria meningitidis, Haemophilus influenzae* and *Listeria monocytogenes*
- Enteroviruses, Herpesviruses (less common); Fungal or protozoal - rare

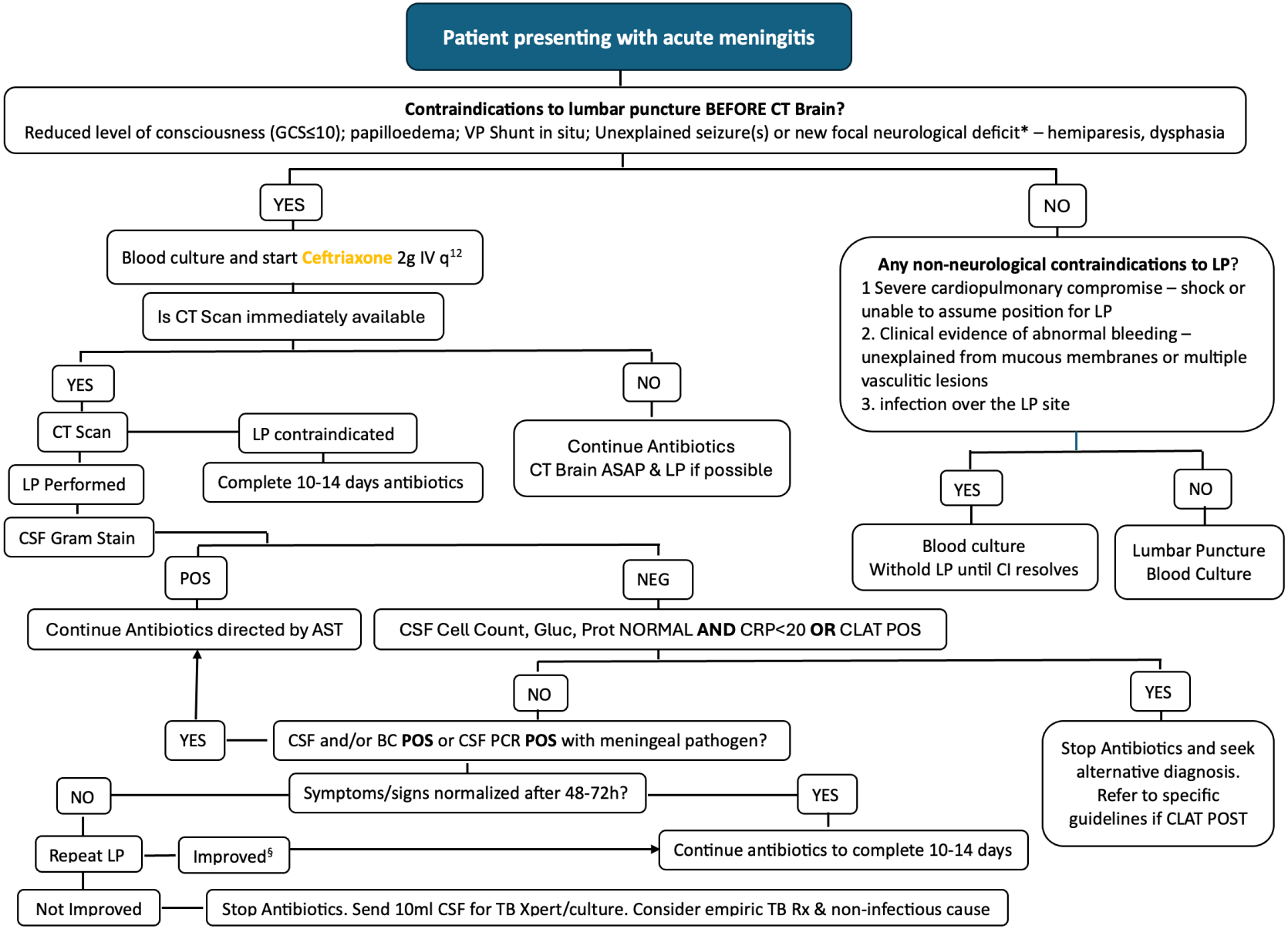
Clinical features

- Any 2 of the 4 cardinal features; headache, fever > 37.5°C, neck stiffness and altered mental status
- Supporting features are photophobia, blanching or purpuric rash and vomiting

Tests – see algorithm

Antibiotic Stewardship – see algorithm

- Lumbar puncture should be performed before administration of antibiotics ONLY if this does not cause significant delay
- Empirical treatment for community-acquired meningitis is **ceftriaxone** 2g IV q^{12} until AST enables deescalation or change.
- **Penicillin** allergy is not a contraindication to use of **ceftriaxone** in these circumstances
- Listeria monocytogenes should be considered in immunocompromised patients from transplant, alcoholism, cancer and at ages >50 years or neonates. Treatment is with **ampicillin** 3g IV q^6 for 21 days
- In HIV-positive patients with low CD4 counts and clinical features of an acute meningitis, normal CSF findings – cell counts, protein, glucose – can occur even in confirmed bacterial or tuberculous meningitis. Discuss with an Infectious Diseases specialist if the CSF results do not correlate with clinical picture.
- Interpretation of syphilis CSF serology & cell counts
- 4-fold decline in RPR at 6 months is predictive of treatment success
    - FTA negative – No treatment
    - FTA positive + VDRL positive –neurosyphilis – **Penicillin G** 5MU IV q^6 10d
    - FTA positive + VDRL negative
        - Acellular CSF and protein normal – no treatment
        - HIV-positive - WBC in CSF >20 cells - **Penicillin G** 5MU IV q^6 10d
        - HIV-negative – WBC in CSF >5 cells - **Penicillin G** 5MU IV q^6 10d

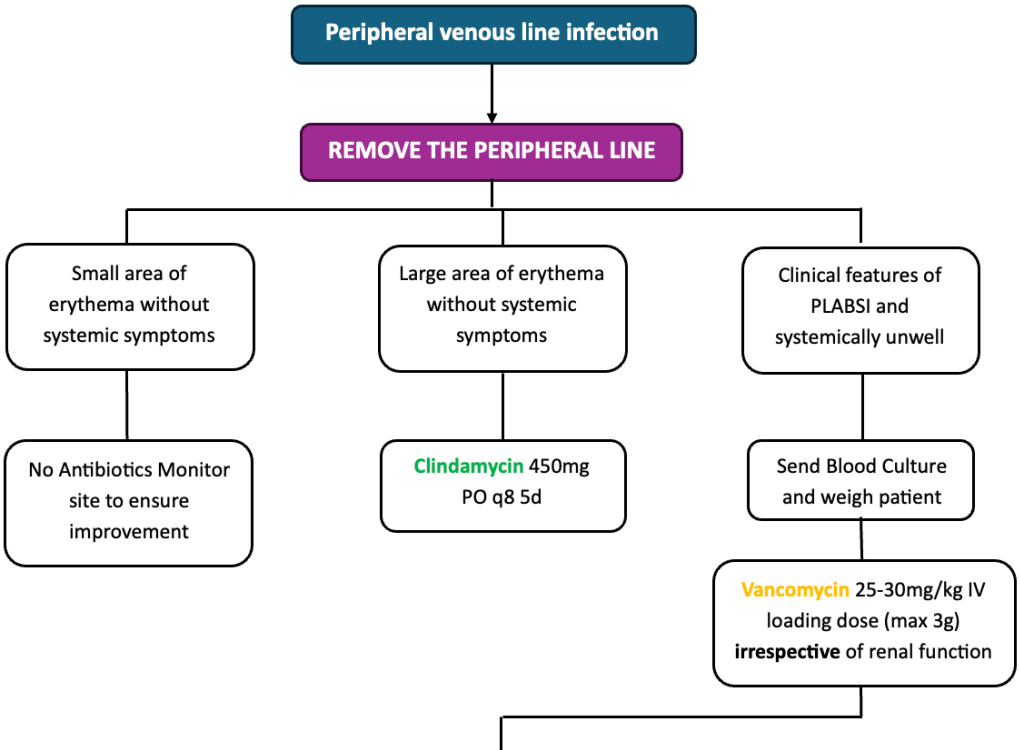


*New cranial palsies not included. §Opening pressure, protein, total WBC, %PMNs decreased. % Lymphs & CSF glucose increase

Chapter 13
Peripheral Line-Associated Infection (PLABSI)

PREVENTION BY EARLY REMOVAL OF LINES IS THE KEY INTERVENTION.

Common causes: As an HAI, pathogen resistance risk is increased.
S. aureus (MSSA/MRSA), Coagulase-negative staphylococci, Streptococcus spp.



Therapeutic Drug Monitoring (TDM) of intravenous vancomycin

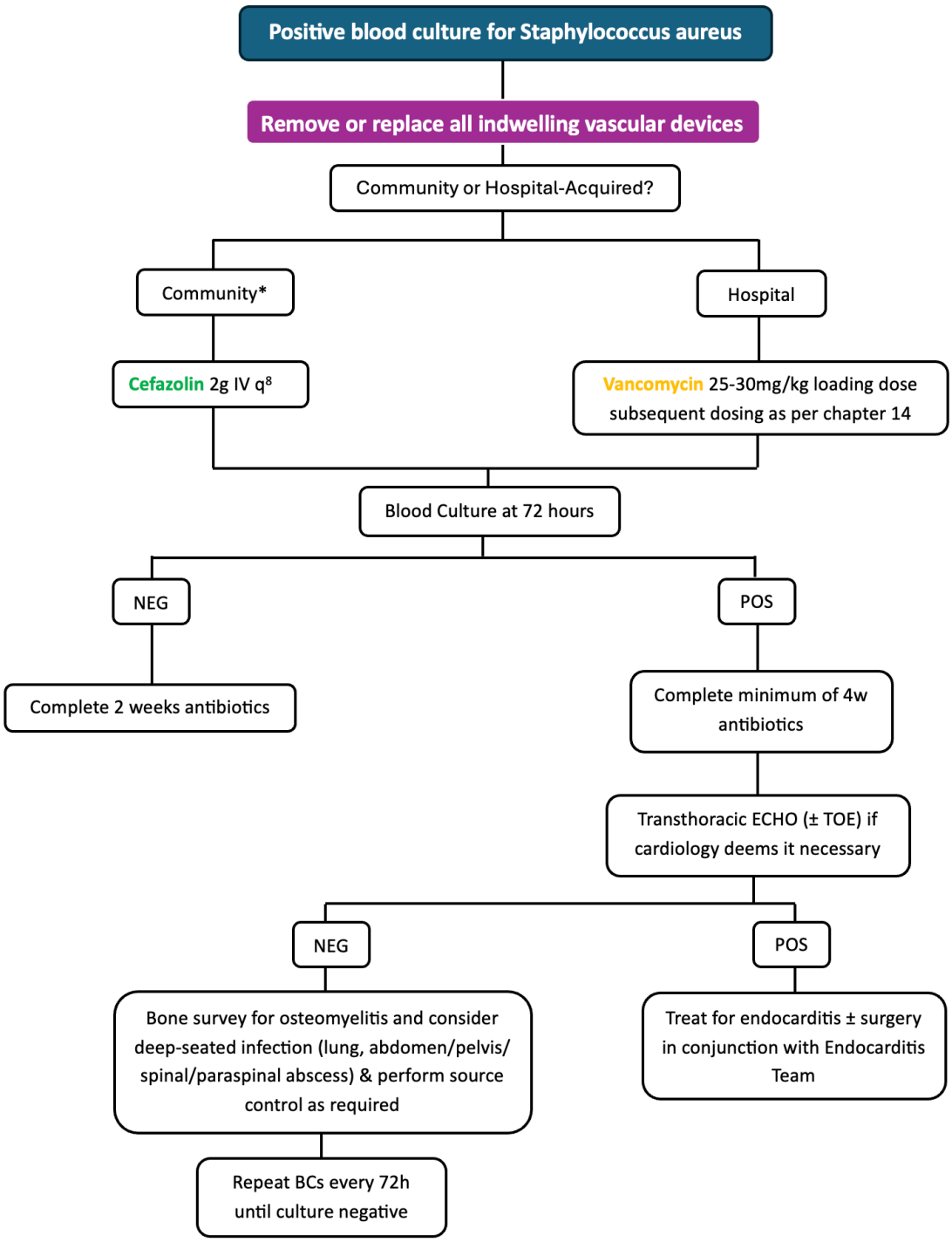
All patients must be weighed and have a baseline creatinine measured with estimated eGFR.
Dosing is based on actual body weight.
All patients should receive a loading dose regardless of renal function.
All subsequent doses should be 15-20mg/kg IV, with an infusion rate not exceeding 1g/hour. Dosing interval and measurement of trough concentrations is based on renal function:

eGFR (mg/min)	Suggested dosing interval (hours)	Measurement of trough concentration
50 – 100+	12	Before 3rd dose
20 – 49	24	Before 3rd dose*
<20 or dialysis	Dose when [trough] <15	Daily

Further dose adjustments should be guided by trough concentration or Area Under the Curve (AUC).
*In those with more severe renal impairment (eGFR <30ml/min) or changing renal function, earlier and more frequent (daily) TDM may be required

Chapter 14
Staphylococcus aureus bacteraemia (SAB)

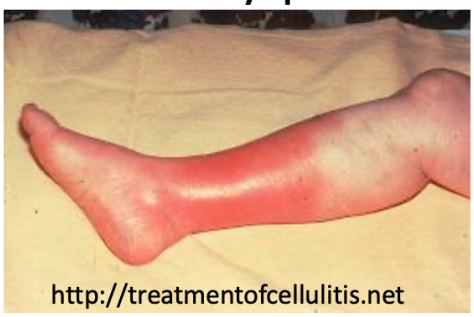
High mortality rate and should not be considered a contaminant.
SAB can disseminate to any organ including heart, bone & lung.



*All patients with community-acquired S. aureus BSI require an Echocardiogram

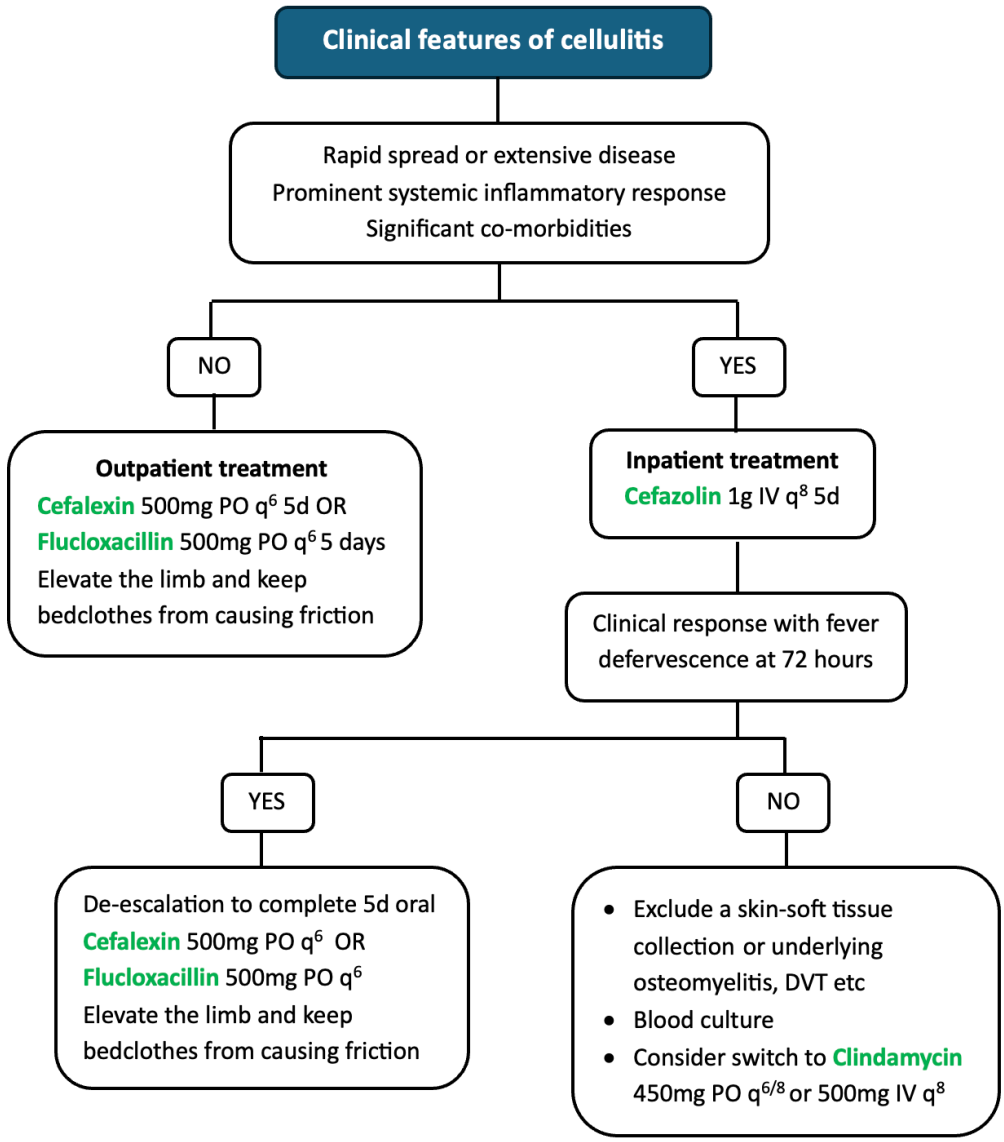
Chapter 15
Skin and soft tissue infections

Cellulitis and Erysipelas



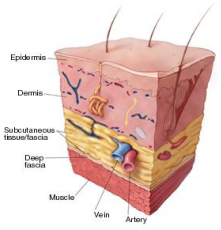
Acute infection involving skin and subcutaneous tissue usually caused by *Staphylococci* or *Streptococci* (*S. pyogenes*). Erysipelas has a raised demarcated border, which is indistinct in cellulitis. Regional lymphadenopathy may be present.
Risk factors – minor trauma, tinea pedis, consider DVT if bedbound.

Presence of necrosis, haemorrhage, or pain out of proportion to physical signs – consider necrotizing fasciitis. **Tests** - none recommended. Superficial pus swabs are NOT helpful

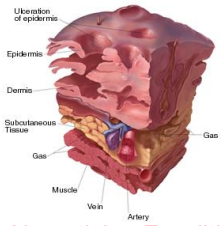


Necrotising Fasciitis

(image: http://medicatoz.com/news/view?id=57)



Normal Skin



Necrotising Fasciitis

Acute life-threatening, necrotizing infection of deep subcutaneous soft tissues specifically muscular fascial layers. Usually precipitated by trauma, surgery, peri-rectal abscess, bedsores or bowel perforation. Suspect if Temp ≥38°C, redness/skin discolouration, marked tenderness and pain of the affected area localized swelling.

Aetiologies

Type 1 – Polymicrobial - Streptococci, Enterobacterales, Anaerobes
Type 2 – Monomicrobial – Group A Streptococcus (*S. pyogenes*), *S. agalactiae* (GBS), *S. dysgalactiae*, Staphylococci (less frequent) *Clostridia spp*. Specific risk factors include seawater (*V. vulnificus*) and freshwater (*A. hydrophilia*)

Tests

Blood cultures and deep surgical tissue specimens for MCS after debridement and cleaning.

Diagnosis and management

Necrotising fasciitis requires **early surgical removal of necrotic tissue** through drainage and debridement. Delays increase morbidity/mortality. Repeat debridement may be required depending on the course of infection

Antibiotic management is complementary to the required surgery
Options:
Amoxicillin-Clavulanate 1.2g IV q^8 + **Clindamycin** 900mg IV q^8 (to reduce toxin production
Or
Piperacillin-tazobactam 4.5g IV q^8 + **Clindamycin** 900mg IV q^8
De-escalation can be undertaken in relation to the antibiogram and depending on the course of the infection. Treatment duration is also dependent on the latter.

Severe penicillin allergy: **Clindamycin** 900mg IV q^8 + **Ciprofloxacin** 400 mg IV q^8

Cutaneous abscess

Deep inflammatory nodule extending into subcutaneous tissue that develops from preceding folliculitis commonly due to *S. aureus*

Investigations are unnecessary and all cases require surgical drainage.
Antibiotics are only indicated for complicated cases – surrounding cellulitis, systemic symptoms, or facial abscess.
Flucloxacillin 500mg PO q^6 or **Cefalexin** 500mg PO q^8 3-5 days
Severe penicillin allergy – **Clindamycin** 450mg PO q^8

Diabetic Foot Infection

Infection of a foot wound located below the malleoli[9]

IWGDF/IDSA group[9]	Clinical classification of infection
Grade 1: Uninfected	No systemic or local symptoms or signs of infection
Grade 2: Mild	≥2 of: local swelling or induration; erythema >0.5 but <2cm around the wound; local tenderness or pain; local increased warmth; purulent discharge Plus No other cause for clinical features – gout, trauma etc
Grade 3: Moderate	Infection with no systemic manifestations and involving: ▪ Erythema extending ≥2 cm from the wound margin **and/or** ▪ Tissue deeper than skin and subcutaneous tissues (e.g., tendon, muscle, joint, and bone) Infection involving bone (osteomyelitis) = 3(O)
Grade 4 Severe	Any foot infection with associated systemic manifestations of SIRS response i.e., ≥2 of: • Temperature >38°C or <36°C • HR >90 beats per min • RR >20 breaths per min or $PaCO_2$ <4.3kpa • WBC >12 x 10^9/L or >10% immature band forms Infection involving bone (osteomyelitis) = 4(O)

This classification has been clinically validated and predicts hospitalisation and need for amputation

Common aetiologies

- Mild infections or previously untreated - *S. aureus* and *Streptococci*
- Chronic lesions or previously treated – add Enterobacterales
- Chronic, refractory or prolonged broad-spectrum antibiotics – add *Pseudomonas, Anaerobes*, and *Enterococci*

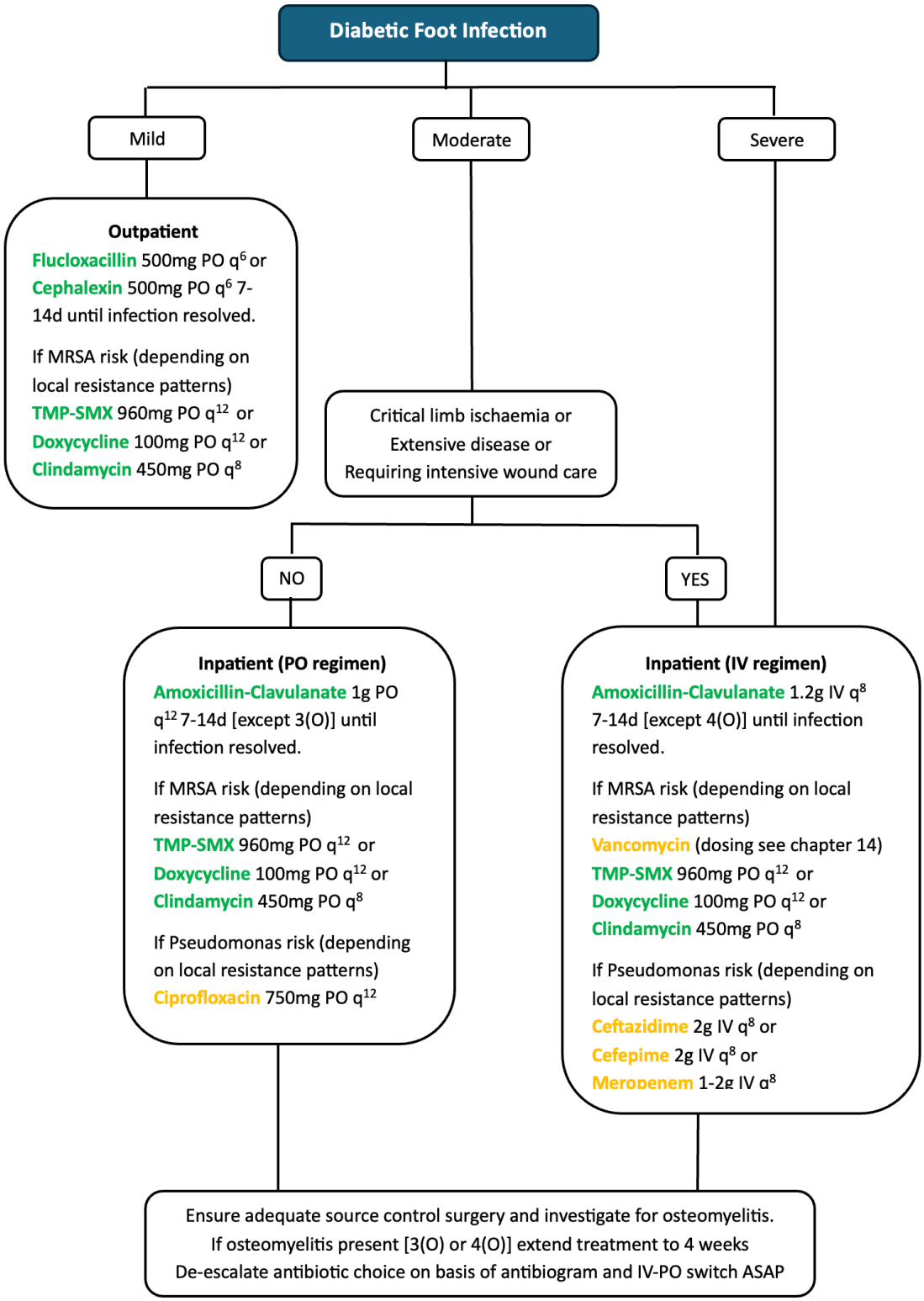
Tests

- None required in mild or previously untreated infections.
- Superficial wound swabs should NOT be taken. Colonisation is ubiquitous
- Tissue cultures are recommended in moderate or severe infection **BUT** it is essential to clean and debride the lesion **before** obtaining deep specimens for culture. Abscess aspirates are also allowed
- Blood cultures should be performed in severe infections.

Management

- Assessment for surgical debridement should always be made, especially for moderate and severe infections.

[9] Senneville et al. IWGDF/IDSA guideline. Diabetes Metab Res Rev 2024'40:e3687



Severe penicillin allergy:

- *Mild/moderate infections*: **Clindamycin** 450 mg PO q^8
- *Severe infections*: **Clindamycin** 600-900mg IV q^8 + **Ciprofloxacin** 400mg IV q^8

Chapter 16
Infective Endocarditis[10]

Historically, bacterial infective endocarditis (IE) has been managed solely with intravenous antibiotics, the basis for which was expert opinion dating from the early antibiotic era and the use of sulfanilamide, erythromycin and tetracycline - antibiotics that are inappropriate for treating bloodstream infection, either because of poor bactericidal activity or large volumes of distribution. Modern-day antibiotics have excellent bioavailability in blood, and a number are active in biofilms, important in treatment of prosthetic valve IE.

There have been multiple observational studies, 3 randomized controlled trials and one quasi-experimental study[11] demonstrating non-inferiority of oral compared to intravenous (IV) antibiotics for the treatment of IE. These studies have included patients with both left- and right-sided IE, different timings of oral antibiotic initiation (including from the start of treatment i.e., empiric choice), and many different antibiotic regimens. In contrast, not a single study has shown superiority of iv antibiotics over an IV/oral or exclusively oral regimen.

Microbiology investigation of IE

All patients with suspected infective endocarditis should have **three (3)** aerobic blood cultures taken from different sites ideally 30-60 mins apart, **BEFORE** starting any antibiotics.

The commonest reason for culture negativity is prior antibiotic treatment. The commonest cause of true culture-negative IE in South Africa is Bartonella spp[12] Other causes include *C. burnet*ti (Q Fever), *Brucella* spp, *Legionella spp*, *T. whipplei*, and in endemic countries like SA, tuberculosis..

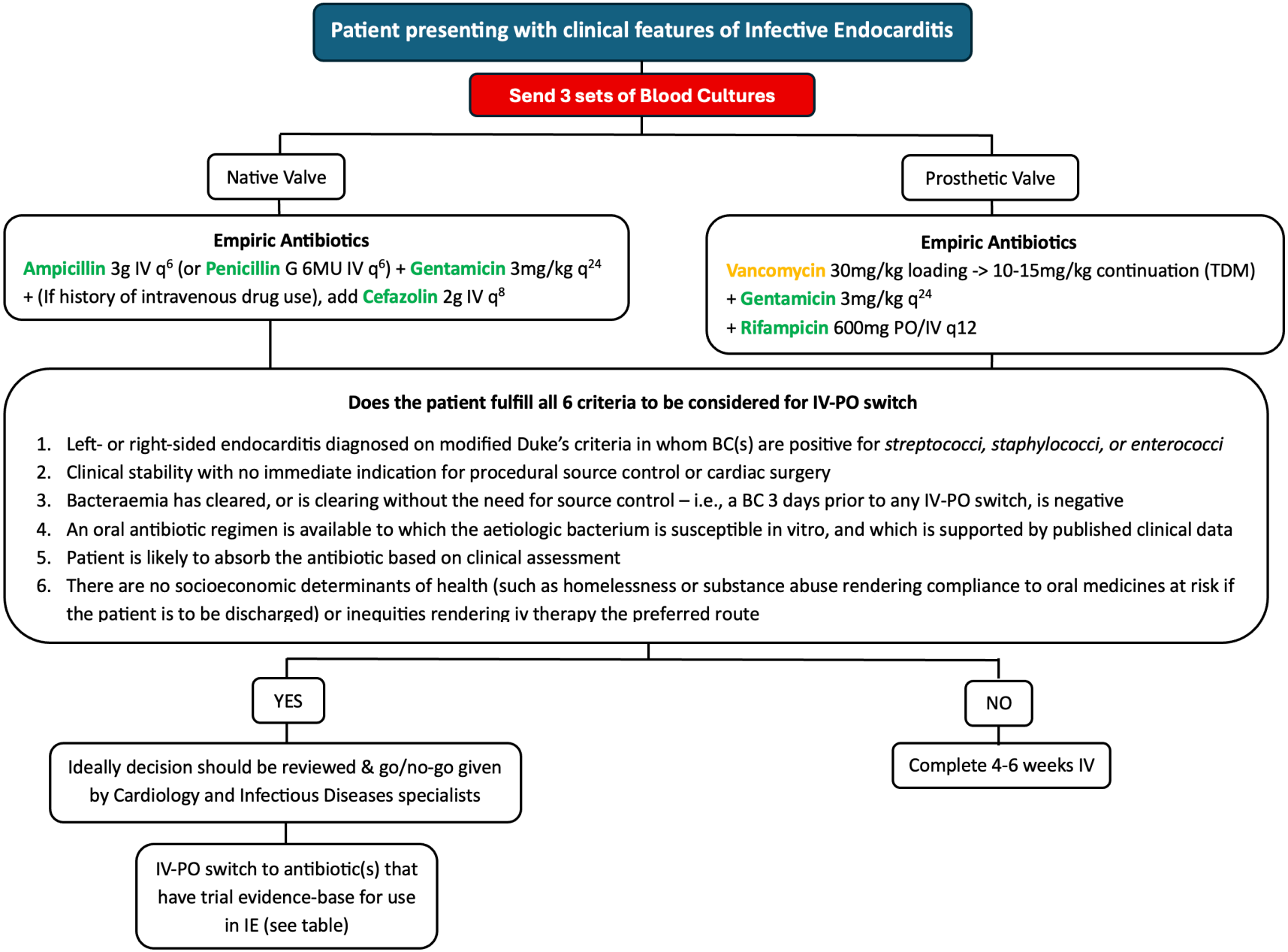
Investigations for culture-negative endocarditis

- Homelessness or cat exposure – Bartonella serology
- Occupational exposure to livestock such as farmers and veterinarians *Coxiella burnett*i serology – Look for Phase I antigen titre >1:800
- Ingestion of unpasteurized dairy products Brucella serology
- Constitutional symptoms or disseminated TB, investigate for tuberculosis

[10] See McDonald et al. https://jamanetwork.com/journals/jamanetworkopen/fullarticle/2807791

[11] Iversen et al. NEJM 2019;380:415-424. Stamboulian et al. Rev Infect Dis 1991;13(S2):@160-163. Heldman et al. Am J Med 1996;101(1):68-76. Tissot-Dupont et al. Int J Antimicrob Agents 2019;54(2):143-148

[12] Hunter et al. Open Heart 2025;12:e003463


Patient presenting with clinical features of Infective Endocarditis
Send 3 sets of Blood Cultures
Native Valve
Prosthetic Valve
Empiric Antibiotics
Ampicillin 3g IV q6 (or Penicillin G 6MU IV q6) + Gentamicin 3mg/kg q24
+ (If history of intravenous drug use), add Cefazolin 2g IV q8
Empiric Antibiotics
Vancomycin 30mg/kg loading -> 10-15mg/kg continuation (TDM)
+ Gentamicin 3mg/kg q24
+ Rifampicin 600mg PO/IV q12
Does the patient fulfill all 6 criteria to be considered for IV-PO switch
1. Left- or right-sided endocarditis diagnosed on modified Duke's criteria in whom BC(s) are positive for streptococci, staphylococci, or enterococci
2. Clinical stability with no immediate indication for procedural source control or cardiac surgery
3. Bacteraemia has cleared, or is clearing without the need for source control – i.e., a BC 3 days prior to any IV-PO switch, is negative
4. An oral antibiotic regimen is available to which the aetiologic bacterium is susceptible in vitro, and which is supported by published clinical data
5. Patient is likely to absorb the antibiotic based on clinical assessment
6. There are no socioeconomic determinants of health (such as homelessness or substance abuse rendering compliance to oral medicines at risk if the patient is to be discharged) or inequities rendering iv therapy the preferred route
YES
NO
Ideally decision should be reviewed & go/no-go given by Cardiology and Infectious Diseases specialists
Complete 4-6 weeks IV
IV-PO switch to antibiotic(s) that have trial evidence-base for use in IE (see table)

Summary of oral step-down antibiotics used in published clinical studies[a]

Antibiotic	Organism	Dose
Amoxicillin	Sensitive streptococci Enterococci (in combination with rifampicin or linezolid)	1g q6h
Levofloxacin[b]	Sensitive staphylococci (RCT in combination with rifampicin)	750mg q24h
Moxifloxacin	Sensitive streptococci, enterococci, or staphylococci (only in combination with amoxicillin, rifampicin, or linezolid)	400mg q24h
TMP-SMX	Sensitive staphylococci	1920mg q12h
Linezolid	Sensitive gram-positive cocci (alone or in combination with rifampicin, moxifloxacin or amoxicillin)[c]	600mg q12h
Rifampicin	Only as an adjunctive antibiotic	600mg q12h

[a]Combination regimens were used in the largest RCT; other published regimens have included either monotherapy or combination therapy regimens

[b]The study used ciprofloxacin rather than levofloxacin, the latter of which was not yet clinically available. However, in ensuing years, ciprofloxacin experienced rapid emergence of staphylococcal resistance. Levofloxacin or moxifloxacin are preferred, but only in combination with a 2nd agent

[c]For most patients in published studies, linezolid was used alone: but in some studies, linezolid was given in combination with rifampicin, moxifloxacin or amoxicillin

Oral step-down antibiotics by organism[a] – for antibiotics available in South Africa

Organism	**1st Line**	**2nd Line**
Streptococci – penicillin-sensitive (≤0.12 mg/mL)	Amoxicillin 1g q6h (native valve endocarditis only)[b] Amoxicillin 1g q6h + rifampicin 600mg q24h	Linezolid 600mg q12h +/- rifampicin 600mg q24h Moxifloxacin 400mg q24h + rifampicin 600mg q24 Moxifloxacin 400mg q24h + Linezolid 600mg q12h
Streptococci – penicillin-intermediate (MIC 0.25-1mg/mL) or amoxicillin - sensitive enterococcus	Amoxicillin 1g q6h + rifampicin 600mg q24h or	Amoxicillin 1g q6h + Linezolid 600mg q12 Linezolid 600mg q12h +/- rifampicin 600mg q24h Moxifloxacin 400mg q24h + rifampicin 600mg q24
Streptococci – penicillin-resistant	Linezolid 600mg q12h +/- rifampicin 600mg q24h	Moxifloxacin 400mg q24h + Linezolid 600mg q12h

(MIC ≥2mg/mL) or amoxicillin - resistant enterococcus		
Staphylococcus spp	TMP-SMX[c] 1920mg q12h	Levofloxacin 750mg q12h + rifampicin 600mg q24h Levofloxacin 750mg q12h + Linezolid 600mg q12h Linezolid 600mg q12h

[a]Combination regimens were used in the largest RCT; other published regimens have included either monotherapy or combination therapy regimens

[b]Amoxicillin monotherapy was studied in a 30-patient RCT with excellent outcomes, whereas dual therapy was used in a substantially larger RCT. Thus, not clear that rifampicin is needed for sensitive streptococci, but there are more data for the combination

[c]If used for transitioning from iv to oral therapy, the dosing of TMP-SMX is uncertain. The quasi-experimental study used very high dose equivalent of 3-double-strengt tablets q12h which had a relatively high rate of intolerance. Many WikiGuidelines authors prefer to use lower doses such as 1920mg q12h which has been selected here.

Antibiotic Stewardship of IV-PO Switch

- Ideally, the patient should be managed by an Endocarditis Team comprising cardiologists, cardiothoracic surgeons, and Infectious Diseases specialist or experienced antibiotic steward
- Although there is trial evidence for both native and prosthetic valves, piloting patients with native valve IE first, would be prudent
- Making the IV-PO switch does not affect the duration of treatment, which will be determined by the type of IE
- Patients should have regular follow-up if treated as an outpatient, with weekly review while on treatment before routine review schedule thereafter
- Any patient failing oral antibiotic therapy should be immediately re-admitted, re-cultured, and re-reviewed by cardiothoracic surgeons, and complete a new course of IV antibiotics

Chapter 17
Bone and Joint Infection

Like the treatment of infective endocarditis, bone and joint infections have historically been managed solely with intravenous antibiotics. The landmark trial (OVIVA)[13] Further RCT evidence, systematic reviews and meta-analyses thereof, have shown that oral treatment is non-inferior to intravenous antibiotics[14]. Although the evidence is strongest for acute osteomyelitis, supportive observational studies and lessons from clinical practice show that international guidelines are advocating IV-PO switch as soon as the patient is improving for septic arthritis too.

Septic Arthritis

An infection of one or more joints, which typically presents with a hot, swollen joint(s) with pain ± restriction on movement ± signs of systemic infection

Commonest aetiology – *S. aureus*.
N. gonorrhoeae is an important cause of mono-arthritis (but can also present with polyarthritis). Ensure proper sexual history is taken. Commonest differential diagnoses include gout and reactive arthritis (history of urethritis, pelvic inflammatory disease or diarrhoea?

Tests - Blood culture and most important, MCS of joint aspirate, ± synovial biopsy

Management – See algorithm

Acute Osteomyelitis

An acute infection of bone, which may be endogenous through dissemination of a bacterial infection through the bloodstream (haematogenous) or exogenous relating to trauma or surgery. Contiguous osteomyelitis can occur from skin and soft tissue infections e.g., diabetic foot infection

Presentation is usually with sub-acute onset of pain/tenderness of the affected bone, +/- fever and systemic symptoms (especially in haematogenous spread).

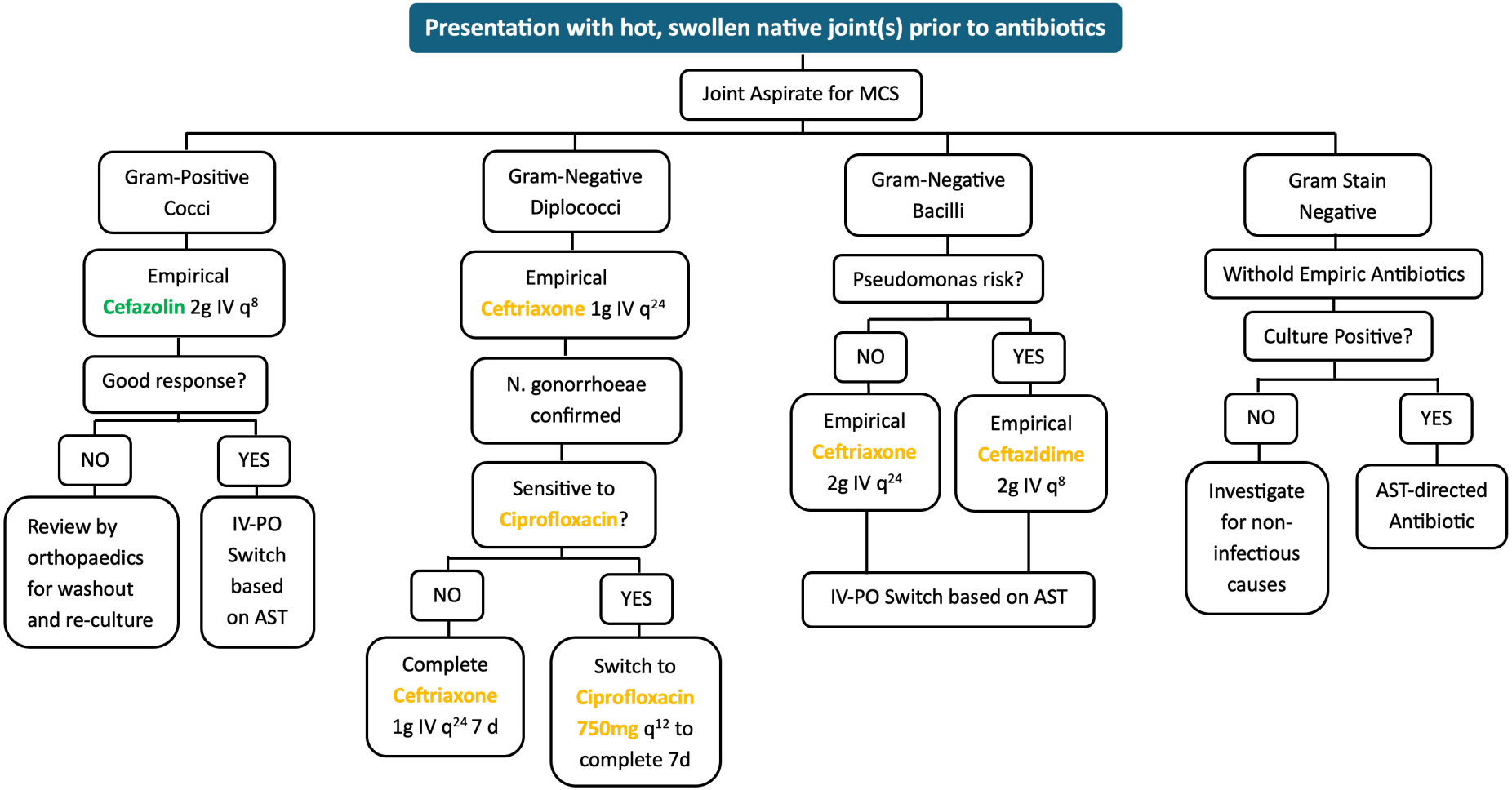
- Vertebral osteomyelitis presents with back pain. Always suspect in community-acquired *S. aureus* bacteraemia.

Commonest aetiology – *S. aureus* is by far the most common*. Streptococci and Enterobacterales* are also recognized causes

Tests - MCS bone biopsies and blood culture.

Management – as for joint infections, evidence shows that oral treatment is non-inferior to intravenous antibiotics, and IV-PO switch should be undertaken ASAP

[13] Scarborough et al Health Technol Assess. 2019 Aug;23(38):1-92
[14] Spellberg et al. https://jamanetwork.com/journals/jamanetworkopen/fullarticle/2792124


Presentation with hot, swollen native joint(s) prior to antibiotics
Joint Aspirate for MCS
Gram-Positive Cocci
Empirical Cefazolin 2g IV q8
Good response?
NO
YES
Review by orthopaedics for washout and re-culture
IV-PO Switch based on AST
Gram-Negative Diplococci
Empirical Ceftriaxone 1g IV q24
N. gonorrhoeae confirmed
Sensitive to Ciprofloxacin?
NO
YES
Complete Ceftriaxone 1g IV q24 7 d
Switch to Ciprofloxacin 750mg q12 to complete 7d
Gram-Negative Bacilli
Pseudomonas risk?
NO
YES
Empirical Ceftriaxone 2g IV q24
Empirical Ceftazidime 2g IV q8
IV-PO Switch based on AST
Gram Stain Negative
Withold Empiric Antibiotics
Culture Positive?
NO
YES
Investigate for non-infectious causes
AST-directed Antibiotic

NB – in chronic osteomyelitis, it is critical that any antibiotics the patient may be on are stopped 2 weeks prior to biopsy.

Prosthetic Joint Infection (PJI)

An infection involving a joint replacement (arthroplasty), which may involve the prosthetic components +/- surrounding tissues. Presentation may include pain, swelling, limitation of movement, fever, a sinus tract +/- discharge

Commonest aetiology – *S. aureus*, Streptococcal spp, *Enterobacterales*

Antibiotic Stewardship

- Key to management of PJI is correct biopsy and laboratory diagnostics. Evidence shows that 5 separate deep tissues should be biopsied using 5 separate sets of biopsy equipment after full debridement and cleaning. Each biopsy must be placed in a separate specimen pot and sent to the laboratory for MCS.
- A significant pathogen is one that is cultured from ≥2 biopsy specimens. If a single biopsy cultures a bacterium, interpretation depends on its probability of causing a PJI and the clinical circumstances.
- Some bacteria are fastidious and may take longer to grow in culture e.g., *C. acnes*
- Due to the presence of foreign body, antibiotic choice should include the use of antibiotics that are active in biofilms and to which the infecting pathogen is sensitive. Key biofilm antibiotics include
    - **Rifampicin** – for *S. aureus* PJI
    - **Ciprofloxacin** – for Gram-negative PJI
    - **Linezolid** – for Gram-positive PJI if rifampicin is resistant
- **Rifampicin** monotherapy is not recommended for S. aureus PJI. Furthermore, when using **Rifampicin** in combination, do not start this antibiotic until the wound is closed (including any drain, which must be out). This is to reduce the risk of **rifampicin**-resistant S. aureus entering the wound.
- **Flucloxacillin** is not recommended for treatment of S. aureus PJI.
- Oral therapy is encouraged as soon as directed therapy with an antibiotic that penetrates bone and synovium can be started.
- Oral antibiotic options include:
    - *S. aureus* – **Trimethoprim-Sulfamethoxazole** 1920mg PO q^{12} ; **Clindamycin** 600mg PO q^{6} ; Linezolid 600mg PO q^{12}
    - *Enterobacterales* – **Ciprofloxacin** 750mg PO q^{12} ; **Trimethoprim-Sulfamethoxazole** 1920mg PO q^{12}
- Duration of treatment depends on the surgical approach.
    - Debridement and retention of implant (DAIR) – 12 weeks
    - One-stage revision – 6 weeks
    - Two-stage revision – 6 weeks after explantation. Antibiotics after stage 2 depends on culture results of 5 biopsies re-taken prior to the new implant being sited.

Fracture-Related Infection (FRI)

Osteomyelitis developing as a result of contamination of an open fracture.
Common, occurring in ~25% of open fractures and leading to amputation in 3%.

Commonest aetiology – *S. aureus, coagulase-negative Staphylococci,* aerobic Gram-negative bacilli. Water exposure: consider *Pseudomonas, Aeromonas,* and *Vibrio spp*

Diagnosis[15] (Do NOT send superficial wound swabs from the ward setting)
Confirmatory criteria

1. Fistula, sinus, or other wound breakdown
2. Purulent discharge or the presence of pus
3. Phenotypically-indistinguishable pathogens identified by culture from ≥2 separate deep tissue/implant specimens taken in theatre
4. Presence of microorganisms in deep tissue specimens confirmed by histopathological examination

Suggestive criteria

1. Clinical signs – redness, fever etc.
2. Radiological and/or nuclear imaging such as WBC-scintigraphy
3. New-onset joint effusion
4. Elevated serum inflammatory markers – WBC, CRP, ESR
5. Persistent, increasing or new-onset wound drainage
6. Pathogenic bacterium identified by culture from a single deep-tissue/implant specimen

Duration of treatment – 6 weeks – non-inferior to 12 or 24 weeks in observational studies and had fewer adverse reactions.[16]

[15] Metsemakers WJ. https://www.aofoundation.org/trauma/about-aotrauma/blog/2023_06-blog-fracture-related-infection

[16] De Oliveira Campos TV et al. Eur J Orthop Surg Traumatol. 2024 Dec;34(8):3995-4000

Chapter 18
Ophthalmic Infections

Conjunctivitis
Infection of the conjunctiva, which covers the sclera and lines the eyelids.

Common infectious causes and management
Viruses (80%) - follicular conjunctivitis with watery discharge, minimal itching ('Pink eye') ± associated symptoms of fever, sore throat and lymphadenopathy. Adenoviruses cause 65-90% Highly contagious. Testing is usually unnecessary.

Bacterial – often papillary, purulent discharge (eye matting) ± sore, gritty, ± swelling of the eyelids. Associated symptoms are less common. **Chloramphenicol** 1% ointment topical q^6. If Gonococcal conjunctivitis is considered (rapid onset and progressive, hyperpurulent discharge), **Ceftriaxone** 250mg IM Stat + **Azithromycin** 1g PO Stat and urgent referral to ophthalmologist and (less urgent to) STI clinic.

Endophthalmitis
Sight-threatening intra-ocular infection of the aqueous and/or vitreous humour, nearly all of which are caused by bacteria or fungi, presenting with vision loss and eye pian of sudden onset

Exogenous endophthalmitis is caused by penetrating injury, post-eye surgery (cataract commonest) or intravitreal injections and generally only affects the traumatized eye. Commonest cause is CoNS and less so, *S. aureus*.

Endogenous endophthalmitis follows bacteraemia or fungaemia, bilateral in 20% ± systemic symptoms. Commonest causes are also CoNS, and less so, *S. aureus*, but *Streptococci, K. pneumoniae* are also recognised.

Tests
Intraocular cultures for MCS BC (endogenous). Vitrectomy samples have the highest yield on culture followed by vitreous and then aqueous humour.

Management – Ocular emergency. Refer to ophthalmologist.
Intravitreal injection of antibiotics is the cornerstone either by 'tap and inject' from and into the vitreous humour, or after vitrectomy. Systemic antibiotics (endogenous)

Endogenous Endophthalmitis - **Ceftriaxone** 2g IV q24 + **Ceftazidime** 2.25mg Intravitreal Stat + **Vancomycin** 1mg Intravitreal Stat
Exogenous Endophthalmitis
Ceftazidime 2.25mg Intravitreal Stat + **Vancomycin** 1mg Intravitreal Stat

Consider repeat of intravitreal dosing after 48 hours depending on AST results and response.

Chapter 19
An Approach to Hospital-Acquired Infection

A hospital-acquired infection (HAI) is an infection whose symptoms and signs start ≥48 hours after presentation to hospital with no evidence of being present or incubating prior to admission, and/or clinical infection in a patient who has been admitted to hospital within the last 30 days (90 days if related to a surgical implant).

HAI carries increase risk of being caused by an antibiotic-resistant bacterium, knowing your LOCAL resistance profile of the major bacterial pathogens that cause HAI is critical in choosing an empirical regimen.

E. faecium, S. aureus, K. pneumoniae, A, baumannii, P, aeruginosa, and *Enterobacter spp* (ESKAPE) bacteria are the major causes of HAI in most clinical settings. *Clostridioides difficile* is also a common HAI.

However, many other bacteria, including *M. tuberculosis* and *L. pneumophilia* for example, Candida spp (*C. auris*), and viruses (measles, VZV, Influenza, SARS-CoV2 etc) can be HAI. Rarely, bloodborne pathogens *P. falciparum* e.g., can be transmitted in hospital.

Infection Prevention and Control (IPC) is key to prevention of HAI and IPC bundles are commonly implemented in ICUs and general wards. Hospital surveillance of HAIs is critical to identifying outbreaks and instigation of mitigation interventions.

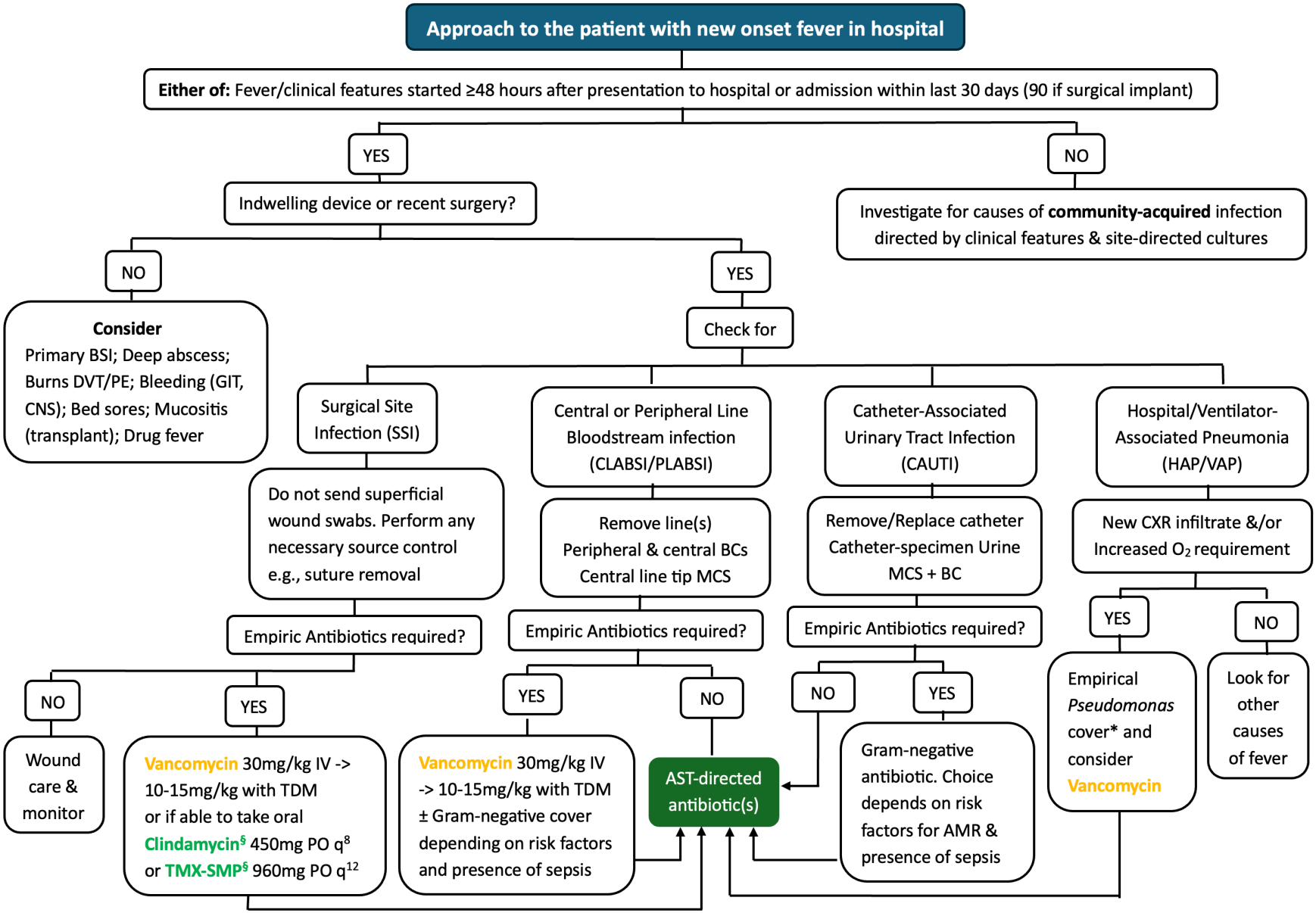
Antibiotic stewardship

- Avoid anti-pseudomonal antibiotics unless the patient has risk factors for pseudomonal infection (neutropenia, mechanical ventilation, cystic fibrosis, malignant otitis externa, severe burns, recent ertapenem exposure)
- Only de-escalate on the basis of the antibiogram
- Some units (bone marrow transplant, ICUs) perform screening cultures (rectal or otherwise) but this is not routinely performed. Consider in patients transferred from abroad or from private hospitals in the state sector

Examples of empirical regimens for HAI

Empirical regimens for HAI will depend on

- Your Hospital's AMR rates in ESKAPE pathogen surveillance mainly blood cultures taken from patients developing an HAI
- Patient risk factors for *Pseudomonas* infection
- Whether a patient is clinically stable or has sepsis/septic shock



§Depending on oral options for MRSA cover in your hospital. *Meropenem 1-2g IV q8 or Imipenem 500mg-1g q8 or Piperacillin-tazobactam 4.5

Taking an example from Groote Schuur Hospital, University of Cape Town

- In 2015, Sensitivity to piperacillin-tazobactam of ESBL-producing *E. coli* and *K. pneumoniae* from all sites in 2015 was 75% and 48.3% respectively, and to amikacin was 96.7% and 94.9% respectively.
- At the time, the % of carbapenem-resistant Gram-negative bacteria causing HAI was <1%
- Hence, the empirical choice of antibiotics for an HAI prior to de-escalation on the basis of an antibiogram was:

Pseudomonas Risk	eGFR >50 ml/min	eGFR ≤50 ml/min
NO	**Piperacillin-Tazobactam** 4.5g IV q^8 5 days PLUS, **Amikacin** 25mg/kg loading dose (If in sepsis or septic shock) followed by Amikacin >15mg/kg/day complete 3 days	**Ertapenem** 1g IV q24 5 days (If eGFR ≤30 – 1g loading dose followed by 500mg IV q^{24}
YES	**Piperacillin-Tazobactam** 4.5g IV q^6 5 days PLUS, **Amikacin** 25mg/kg loading dose (if in sepsis or septic shock) followed by Amikacin >15mg/kg/day complete 3 days	**Meropenem** 1-2g IV q8 given over 3-hour infusion
If significant MRSA risk	Add **Vancomycin** 30mg/kg loading dose followed by renally adjusted continuation doses (Chapter 14)	

Chapter 20
Stewardship of Reserve Antibiotics

Reserve antibiotics are last-line antibiotics, which are used to treat Difficult-to-Treat-resistant bacterial infections where no other options exist. Reserve antibiotics require the highest level of stewardship and are rarely available outside of tertiary hospitals in South Africa's public health system.

Reserve antibiotics (in alphabetical order) registered for use in SA are:

Ceftazidime-Avibactam

- Dosing – 2.5g (Ceftazidime 2g / avibactam 0.5g) IV q8 over 2 hours
- Activity against ESBLs, AmpC, KPC, and some OXA-48 and OXA-like carbapenemases. No activity against metallo-betalactamases (would require addition of **Aztreonam** if dual infection)
- **Not indicated for *A. baumannii* *infec*tion** due to presence of OXA-23, OXA-24/40 and OXA-58 enzymes that are not inhibited by avibactam.
- Poor anaerobic cover, hence, for intra-abdominal infection, add **Metronidazole**
- Cross-resistance displayed to **cefiderocol** (not currently registered in SA)

Ceftolozane-Tazobactam

- Dosing – 1.5-3g IV over 1-hour q^{8}
- Although active against ESBLs, Ceftolozane-tazobactam's niche is treatment of MDR-*Pseudomonas* infection

Colistin (Polymyxin E)

- Dosing - Loading dose 9-12 MU IV followed by maintenance 4.5 MU IV q12 or renally adjusted by eGFR
- Excellent antibiotic for cUTI/AP but variable Pk/Pd makes it less reliable than **Polymyxin B** (not available in SA) for disseminated and other site infections
- Despite in vitro synergy between colistin and carbapenems, there is no high-quality evidence that combination therapy of colistin paired with either a carbapenem, (or indeed, tigecycline or rifampicin) improves outcome when treating CR-GNB. There are 2 observational studies reporting retrospective cohorts of CR-*K. pneumoniae* BSI, showing lower mortality of combination when carbapenem MICs were <8 mg/L.

Linezolid

- An important antibiotic in RR-TB regimen in SA, but also a reserve antibiotic for treatment of resistant Gram-positive bacteria such as *S. aureus, E. faecium* etc.
- Dosing – 600mg PO/IV q^{12}

- Major adverse events include reversible myelosuppression. If Hb ≤8g/dL, then transfuse prior to starting therapy and monitor Hb closely. Peripheral neuropathy and lactic acidosis is also recognised
- Has good activity against bacteria in biofilms and thus useful in device-related infections such as prosthetic joint infection

Tigecycline

- Dosing – 100mg loading (or in severe illness, 200mg) IV followed by 50-100mg IV q^{12}
- Inactive against *Pseudomonas, Proteus, and Morganella* infections
- Carries black box warning for XS all-cause mortality compared to comparators at standard dose. Higher dosing (200mg stat followed by 100mg IV bd showed lower mortality and higher clinical cure rates compared to standard dosing.
- Good tissue penetration making it a useful antibiotic in complicated intra-abdominal infection
- Good activity against anaerobes including *Clostridiodies difficile*

Cefiderocol, Meropenem-Varborbactam, Plazomicin, and **Polymyxin B** are the other WHO AWaRe list Reserve antibiotics but are unavailable in South Africa as of July 2026.

Use of a reserve antibiotic should be under the management or co-management of an Infectious Diseases specialist or specialist in antibiotic stewardship.

Chapter 21
Prophylaxis

Surgical Site Infection

Antibiotic prophylaxis to prevent surgical site infection has 3 major interventions to optimise prevention

1. Antibiotic should be given between 60 mins pre-incision (ideally between 30-60min)
2. Single dose of antibiotic(s) should be given unless
    a. Blood loss during surgery ≥ 1.5L
    b. Prolonged surgery (>2 x half-life of the antibiotic) which normally equates to re-dosing if surgery lasts >4 hours.
3. Weight-based dosing e.g., **Cefazolin** 2g IV <120kg vs 3g IV if >120kg

Single dose antibiotic(s) will suffice

In a meta-analysis of 52 randomised controlled trials involving over 19,000 patients globally, there is **NO EVIDENCE to support increased duration of antibiotic treatment** for SSI other than single dose unless excess blood loss or duration of surgery (see above)

Recommended antibiotics for surgical site infection (SSI) prophylaxis

Type of surgery	Prophylaxis
Cardiothoracic Upper GI Neurosurgery Orthopaedic (elective non-trauma)	**Cefazolin** 2g iv
Lower limb amputation Open fracture Colorectal Biliary Pelvic ENT Penetrating abdominal trauma	**Cefazolin** 2g iv PLUS **Metronidazole** 500mg iv
Cataract surgery	Intracameral **Cefuroxime** (at end of surgery)
ERCP with obstruction	**Ciprofloxacin** 500mg po 2h prior procedure or **Cefuroxime** 1.5g iv 1h prior procedure or **PIP/TZ** 4.5g iv 1h prior procedure
Surgery for the implantation of any permanent prosthetic material	**Cefazolin** 2g iv or **cefuroxime** 1.5g iv or **vancomycin** 1g iv as single dose

Infective Endocarditis Prophylaxis for Dental/Gingival Procedures

The evidence base is weak, and country-level and international guidelines are largely based on expert opinion, which differs between countries and region. South African

guidelines from South African Heart Association Position Statement[17] (endorsed by the South African Dental Association) recommends prophylaxis for:

Risk Level	Condition	Prophylaxis
Highest	Prosthetic valve Prior IE Unrepaired cyanotic CHD	Always
High	RHD with significant valve dysfunction Mixed valve disease	Recommended
Moderate	Mild RHD Mitral Valve Prolapse with regurgitation Bicuspid Aortic Valve	Consider (Clinician Discretion)
Low/Negligible	Isolated Atrial Septal Defect Repaired* Ventricular Septal Defect Repaired* Patent Ductus Arteriosus Functional murmurs	Not recommended

CHD = Cyanotic Heart Disease; RHD = Rheumatic Heart Disease

Procedures requiring prophylaxis
Dental procedures involving manipulations if the gingival or periapical region of the teeth or perforating the oral mucosa:

- Tooth extraction
- Periodontal procedures – scaling, root planning
- Dental cleaning where bleeding is anticipated
- Dental implant placement
- Endodontic (root canal) beyond the apex
- Initial placement of orthodontic bands

Single dose **Amoxicillin** 2g PO or if serious penicillin allergy, **Clindamycin** 600mg PO

NB – for genitourinary, gastrointestinal or biliary biopsy, **Ampicillin** 2g iV + **Gentamicin** 1.5mg/kg single doses should be given. If penicillin allergic, substitute **Vancomycin** 1g IV for the **Ampicillin**.

Compound Skull Fracture

Compound depressed skull fractures and penetrating spinal cord injuries do require pre-emptive treatment e.g. **Ceftriaxone** 2g IV plus **Metronidazole** IV/PO for 5 days.

[17] Jankelow et al. S. Afr. Dent. J. 2018;73:94-97