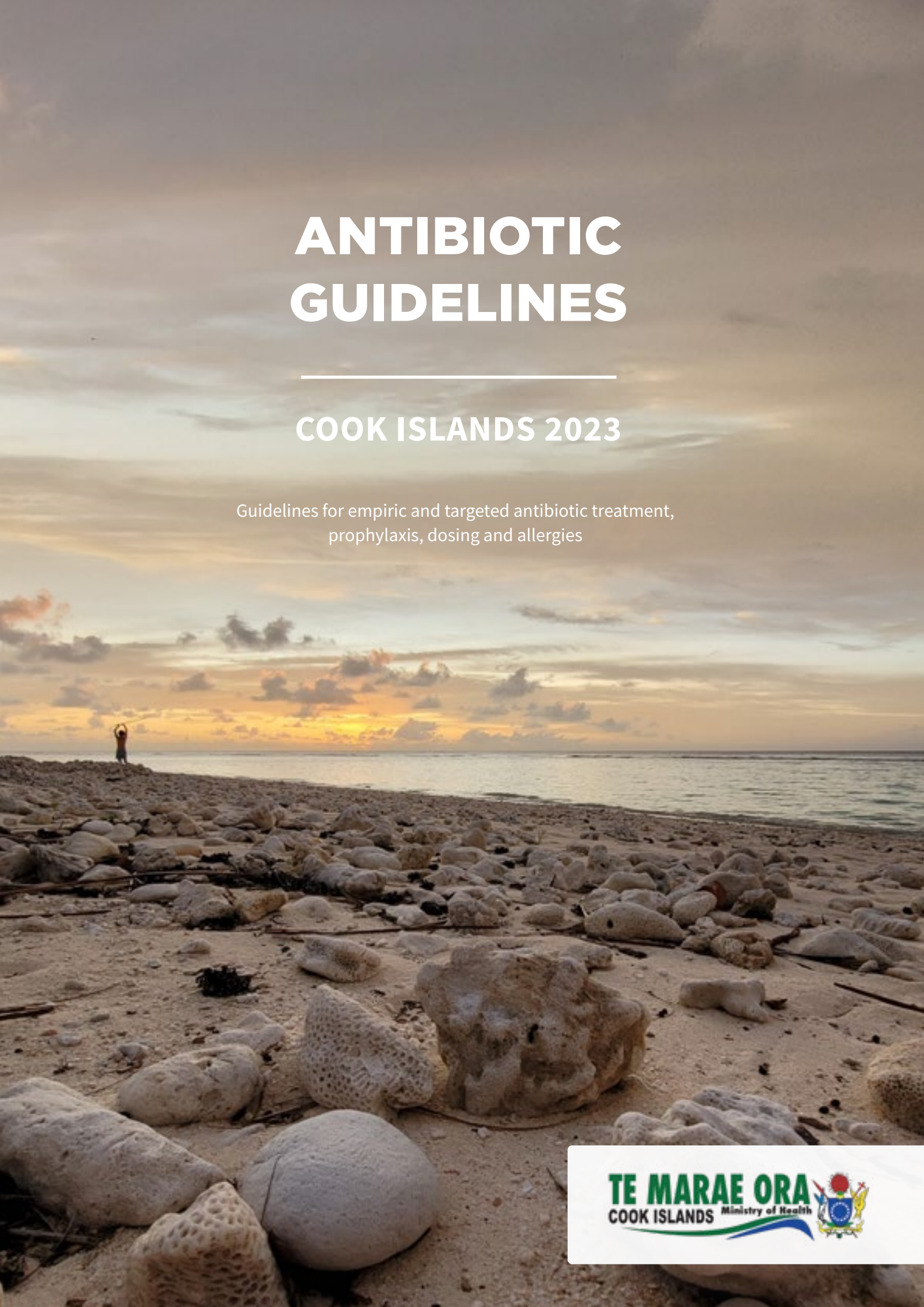


ANTIBIOTIC GUIDELINES

COOK ISLANDS 2023

Guidelines for empiric and targeted antibiotic treatment, prophylaxis, dosing and allergies

TE MARAE ORA
COOK ISLANDS Ministry of Health

September 2023

CONTENTS

FOREWORD

For best health outcomes, appropriate and safe use of antibiotics is important! Clinicians need guidance in making the right decision in prescribing antibiotics and dosage for patients.

Overuse and misuse of antibiotics means they may no longer work in the future especially when really required against resistant bacteria!

This document will be of significant value to the services provided by Te Mare Ora Ministry of Health (TMO) with better outcomes for the people in the Cook Islands. It can contribute to the development and implementation of a national antimicrobial resistance action plan and to raise awareness on appropriate use of antibiotics among the general public and in all sectors; development of surveillance and monitoring system of antibiotic use; and strengthen our health systems capacity to contain antimicrobial resistance.

Therefore it is my utmost pleasure to endorse this handbook as another great initiative of TMO in partnership with the World Health Organization which will help guide and support our clinicians in their treatment of their patients.

With strengthened commitment from the medical profession and general public I am confident this handbook will be utilised efficiently to gain best health outcome for our people.

I acknowledge the contribution from our own TMO staff to ensure this handbook is relevant and appropriate for use in the Cook Islands.

It is with immense gratitude that I acknowledge Dr Richard Everts who has been instrumental in reviewing the 2018 edition and the development of this handbook in collaboration with our clinical staff (laboratory and hospital) to improve the standard of services in the Cook Islands.

Meitaki ranuinui e Kia Manuia,

Mr Bob Williams
Secretary of Health

Te Marae Ora – Ministry of Health
Cook Islands

TE MARAE ORA
COOK ISLANDS Ministry of Health

INTRODUCTION

These guidelines are based on:

- Rarotonga Hospital microbiology laboratory results for culture isolates and antimicrobial susceptibility testing, from records going back as far as 1996 and up to December 2021 (see Isolates and Antibiogram section)
- Recent international guidelines, including the Australian Therapeutic Guidelines, WHO AWaRe antibiotic book, US Sanford Guide, and New Zealand Starship Children's Hospital guidelines
- The availability and cost of antibiotics in the Cook Islands
- Convenience and safety
- A low risk of antibiotic resistance in the future, in alignment with the World Health Organization's Global Action Plan for Antimicrobial Resistance, AWaRe (Access, Watch, Reserve) antibiotic book and tool and 2021 Essential Medicines Lists for adults and children. If this Cook Islands antibiotic handbook is followed, the Cook Islands should meet the WHO target of more than 60% of antibiotics nationally being from WHO's ACCESS list. This Cook Islands antibiotic handbook recommends no antibiotics from WHO's RESERVE list.

These guidelines are intended for use in the hospital and the community, by all prescribers, on all the Cook Islands. In individual patient circumstances, recommendations in these guidelines may be over-ruled by the prescriber's judgement or expert advice. For example, treatment of individual patients should take into account co-morbidities, drug tolerance, contra- indications and allergies, potential adverse drug interactions and patient living circumstances and wishes. Empiric antibiotic prescriptions should be modified when culture results become available and according to response.

The World Health Organization does not accept any legal liability or responsibility for loss, damages, costs or expenses incurred by the use of, reliance on, or interpretation of the information within this handbook.

Acknowledgements

These guidelines have primarily been developed by Dr Richard Everts, Infectious Diseases Specialist and Microbiologist (see Contacts). A special thanks to Andrew Orange for his thorough review and feedback. Thanks to my New Zealand Infectious Diseases, Respiratory and Paediatric Specialist colleagues and to Cook Islands Ministry of Health staff for their input. A special thanks to the Rarotonga Hospital and community microbiology laboratory, pharmacy and medical staff who have contributed.

The preparation of this handbook has been supported by the World Health Organization.

INAPPROPRIATE ANTIBIOTIC REQUESTS

DEALING WITH INAPPROPRIATE ANTIBIOTIC REQUESTS

Based on Brit J Psychol 2021; DOI: 10/1111/bjop.12494 and other references

Some patients request antibiotics from their doctor, nurse, or pharmacist, even though antibiotics are not appropriate. This antibiotic handbook contains evidence-based recommendations for which infections require antibiotics – see under each condition (e.g., bronchitis, pneumonia, COPD exacerbation, sinusitis, otitis media, conjunctivitis, and gastroenteritis). When patients request antibiotics outside of these recommendations, here's some suggestions for how you can deal with this:

Say 'no' to antibiotics

The healthcare worker is responsible for prescribing antibiotics, not the patient.

If you say 'no' to inappropriate antibiotic requests now, your patient, their family, and their community will be less likely to ask for inappropriate antibiotics in the future.

Give the patient something that will help

e.g., paracetamol, fluids, other symptom relief medication.

You are educating the patient about appropriate treatments.

Be thorough

e.g., a careful history and examination. Consider laboratory tests, a second opinion, and following the patient up in 2 – 3 days.

You are validating the time and money the patient has invested in seeing you, and reassuring the patient that you take their health concerns seriously.

Explain that antibiotics won't help

Antibiotics make little or no difference if the patient does not meet the criteria in the guideline. Don't try to explain the difference between viruses and bacteria, as research shows this does not help.

Explain that antibiotics can cause harm

Antibiotics cost money, and sometimes cause side effects. Antibiotics cause resistance such that they may not work if needed in the future.

ISOLATES AND ANTIBIOGRAM

The laboratory at Rarotonga Hospital in Avarua is the only microbiology laboratory for the Cook Islands (est. population 15,000). Samples sent to the laboratory in Rarotonga are mainly collected at the Hospital or from General Practitioners on Rarotonga, but may be collected from other islands.

The results of this antibiogram were generated from a range of clinical samples, including pus and wound swabs, aspirates, sputum, blood, and urine, collected up to the end of December 2021. Susceptibility testing from 2015 onwards was performed by disk diffusion according to EUCAST methods and interpretative criteria. Because clinical samples are collected on the minority of patients with infections, and disproportionately those patients who are failing antibiotic treatment, the below antibiogram will show more resistance than exists in unselected patients presenting with acute infection.

Susceptible results indicate high likely clinical success with that antibiotic, provided compliance, correct dosage and surgical intervention if needed.

A special thanks to Geoffrey Wuatai and Peia Ben, Microbiology Laboratory scientists, for their skill and many years of fine work in the Rarotonga Hospital microbiology laboratory. Their identification and susceptibility testing of thousands of clinical isolates is the basis of the below antibiogram, and all the clinical guidelines in this handbook. Thanks also to Dr Michael Loftus, Infectious Disease Specialist Physician at Monash University in Melbourne, who has analyzed the Cook Islands antibiotic susceptibility results from 2017 to 2021 for publication, as well as presentation below.

ISOLATES

Bloodstream infections – all ages

Isolates from blood, 8 July 1996 to 31 December 2022. There were 183 likely true isolates from 3175 sets (= 5.8% positive).

Likely 'true' isolates identified as: *Staphylococcus aureus* 80, *E. coli* 26, *Klebsiella* spp. 24, Group A streptococci 17, *Streptococcus pneumoniae* 13, *Pseudomonas aeruginosa* 6, other beta-haemolytic streptococci 5, other enteric gram-negative bacilli 3, other non-fermentative gram-negative bacilli 3, *Neisseria meningitidis* 2, *Salmonella typhi* 1, others 3.

Bloodstream infections – children

Isolates from blood, 8 July 1996 to 31 December 2022. Note: All coagulase-negative staphylococci were judged to be contaminants and not included in these results.

ORGANISM	< 1 MO	1 MO–1 YR	1 YR	2–4 YR	5–9 YR	10–14 YR	15–19 YR
Salmonella typhi	0	0	0	0	1	0	0
Staphylococcus aureus	4	6	1	5	1	8	4
Streptococcus pneumoniae	0	0	1	0	1	0	0
E. coli	2	1	0	0	0	1	3
Neisseria meningitidis	0	0	0	0	0	0	2

Chest infections

Isolates from sputum, January 2019 to 31 December 2022 (n= 94). Micro-organisms identified as: *Moraxella catarrhalis* 36, *Klebsiella pneumoniae* 13, *Pseudomonas aeruginosa* 11, *Streptococcus pneumoniae* 10, Group A streptococci 7, *Haemophilus influenzae* 5, *Stenotrophomonas multophilia* 3, *Staphylococcus aureus* 1, other enteric gram-negative bacilli 4, and other non-fermentative gram-negative bacilli 3.

Meningitis

Isolates from cerebrospinal fluid, 1996 to December 2022 (10 isolates): *Streptococcus pneumoniae* 6, *Haemophilus influenzae* type B 4.

Urinary organisms

The most common isolates from urine from 1 January 2019 to 31 December 2022: *E. coli* 330, *Klebsiella* spp. 63, *Proteus* spp. 12, *Staphylococcus aureus* 11, *Candida albicans* 6, beta-haemolytic streptococci 5, *Pseudomonas aeruginosa* 4, *Staphylococcus saprophyticus* 2, *Enterococcus faecalis* 1, and other enteric gram-negative bacilli 5.

ANTIBIOGRAM

Staphylococcus aureus

Isolates from all sources, January 2017 to December 2021.

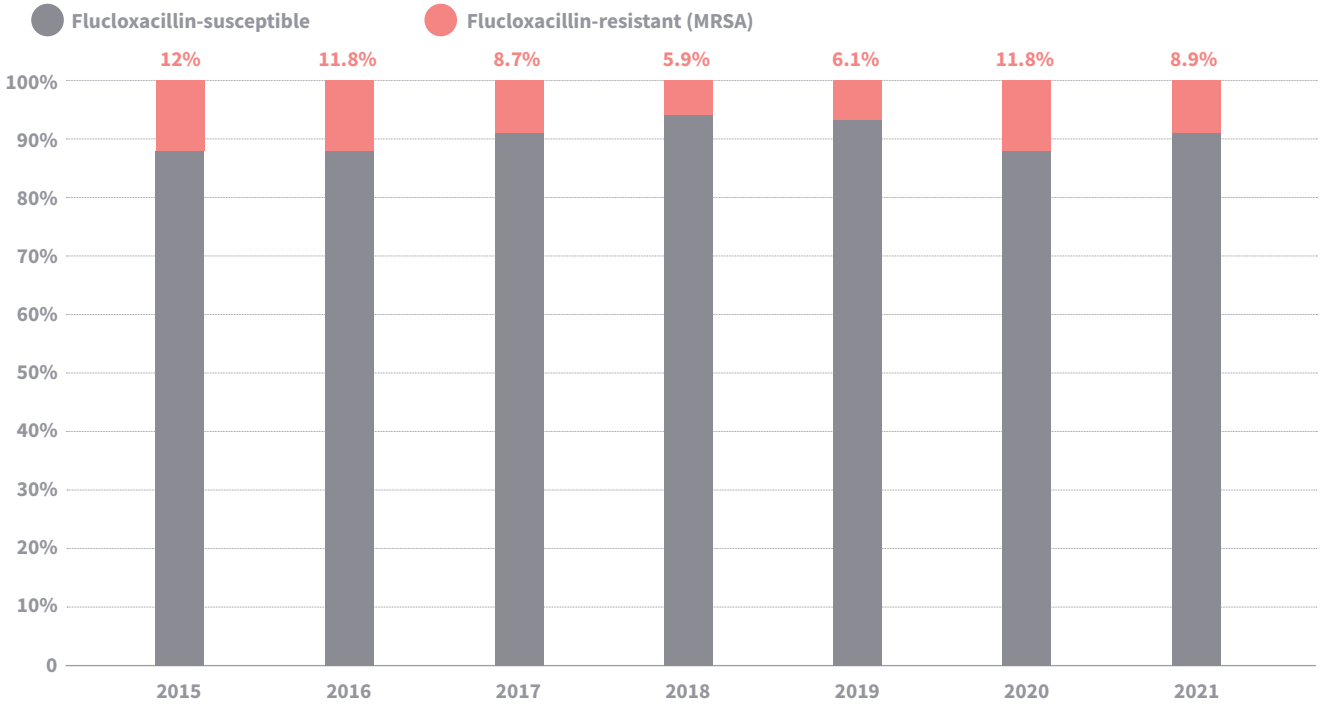
ANTIBIOTIC	SUSCEPTIBLE COOK ISLANDS 2017–2021 (NO. TESTED)
Amoxicillin, ampicillin and penicillin	7% (1989)
Chloramphenicol	97% (1437)
Clindamycin	93% (1862)
Doxycycline	98% (1854)
Erythromycin[1]	90% (1954)
Flucloxacillin[2]	92% (1975)
Trimethoprim+sulfamethoxazole (cotrimoxazole)	93% (1976)

1. Erythromycin susceptibility predicts susceptibility to other macrolides, such as azithromycin and roxithromycin

2. Flucloxacillin susceptibility (based on cefoxitin disk result) predicts susceptibility to flucloxacillin, amoxicillin+clavulanate, most cephalosporins (cefalexin, cefazolin, cefuroxime, ceftriaxone, and cefotaxime), and meropenem. Flucloxacillin resistance is described as 'methicillin-resistant Staphylococcus aureus' (MRSA) and means that the bacteria are resistant to all beta-lactam antibiotics except ceftaroline (which is not currently available in the Cook Islands).

MRSA (METHICILLIN-RESISTANT *STAPHYLOCOCCUS AUREUS*) RATE

Isolates from all sources. Based on oxacillin or cefoxitin disk zone size before 2015 and cefoxitin disk zone size (with EUCAST interpretative criteria) after 2015. The proportion of *Staphylococcus aureus* isolates that are susceptible or resistant to flucloxacillin in the Cook Islands from 2012 to 2021 were:



E. COLI

Isolates from all sources, January 2017 to December 2021.

ANTIBIOTIC	SUSCEPTIBLE COOK ISLANDS 2017–2021 (NO. TESTED)
Amoxicillin+clavulanate	51% (1160)
Cefalexin (urine only)	80% (885)
Ceftriaxone	95% (1149)
Ciprofloxacin	96% (49)
Gentamicin	93% (1109)
Nitrofurantoin (urine only)	79% (939)*
Trimethoprim+sulfamethoxazole (cotrimoxazole)	82% (1124)**

**Urinary* E. coli *nitrofurantoin susceptibility was over 95% in 2020, 2021 and 2022*

***Trimethoprim alone has similar susceptibility to trimethoprim+sulfamethoxazole, and causes fewer adverse effects, but is only effective for uncomplicated urinary tract infections*

KLEBSIELLA PNEUMONIAE

Isolates from all sources, January 2017 to December 2021.

ANTIBIOTIC	SUSCEPTIBLE COOK ISLANDS 2017–2021 (NO. TESTED)
Amoxicillin+clavulanate	44% (471)
Cefalexin (urine only)	83% (120)
Ceftriaxone	91% (473)
Ciprofloxacin	98% (121)
Gentamicin	97% (443)
Trimethoprim+sulfamethoxazole (cotrimoxazole)	87% (460)**

***Trimethoprim alone has similar susceptibility to trimethoprim+sulfamethoxazole, and causes fewer adverse effects, but is only effective for uncomplicated urinary tract infections*

PSEUDOMONAS AERUGINOSA

Isolates from all sources, January 2017 to December 2021.

ANTIBIOTIC	SUSCEPTIBLE COOK ISLANDS 2017–2021 (NO. TESTED)
Ceftazidime	98% (337)
Ciprofloxacin	99% (334)
Gentamicin	99% (343)
Meropenem	98% (117)

EMPIRIC AND TARGETED GUIDELINES

Based on Australian Therapeutic Guidelines 2022, with modification for Cook Islands antibiotic susceptibility results 2017 – 2021. See also the Starship Childrens' Hospital clinical guidelines for details on management of infections in children.

INFECTION	FIRST CHOICE	ALTERNATIVES	COMMENTS
Abdomen Infection associated with biliary or gut pathology, including cholecystitis, cholangitis, diverticulitis, liver abscess, perianal abscess, and secondary peritonitis *See also Pelvic inflammatory disease, spontaneous bacterial peritonitis*	**Mild:** amoxicillin+ clavulanate plus trimethoprim+ sulfamethoxazole (P) If failing, amoxicillin+clavulanate plus ciprofloxacin (P) (B) **Severe:** ceftriaxone plus metronidazole (B)	**Mild:** trimethoprim+ sulfamethoxazole (P) plus metronidazole (B) orally If failing, ciprofloxacin (P) (B) plus metronidazole (B) orally **Severe:** amoxicillin plus gentamicin plus metronidazole (B), or clindamycin plus gentamicin. If failing, amoxicillin+ clavulanate IV plus ciprofloxacin (P) (B), or meropenem[RESTRICTED] alone	If use gentamicin, replace after 48 to 72 hours. *See pages 88 and 89 for gentamicin dosing advice* Often need surgery or drainage for source control. Send pus for culture Liver abscess treatment duration 4 to 6 weeks
Ano-rectal discharge	If syndromic STI management only, treat for *Chlamydia trachomatis*, gonorrhoea, and, in clinically suggestive cases, herpes simplex virus (WHO 2021)		
Ano-rectal ulcers	*See Genital ulcers*		
Appendicitis	*See Abdomen*		
Arthritis septic	*See Joint*		
Bacteraemia Empiric choice when notified of positive blood culture Gram-stain (modify when identification and susceptibility results available)	**Gram-positive cocci, like staphylococci (in clusters)** – flucloxacillin or cefazolin. If high flucloxacillin and cefazolin allergy risk (*see page 98*), vancomycin. If prosthetic heart valve, or MRSA grown from any site in the last 6 months: vancomycin plus either cefazolin or flucloxacillin. Beware of the risk of nephrotoxicity when combining vancomycin plus flucloxacillin **Gram-positive cocci, like streptococci (in chains)** – benzylpenicillin (penicillin G) 1.8 to 2.4 g (3 to 4 MU) IV 4-hourly (child: 150 to 200 mg/kg/day in 6-hourly doses). Alternatives include vancomycin (if likely urine or abdominal source) or ceftriaxone 2 g IV 12-hourly (child: 50 mg/kg up to 2 g 12-hourly). If treating with penicillin or ceftriaxone and suspected meningitis, add vancomycin **Gram-negative cocci, like *Neisseria meningitidis*** – ceftriaxone 2 g IV 12-hourly (child: 50 mg/kg up to 2 g 12-hourly). If high ceftriaxone allergy risk (*see page 98*) use ciprofloxacin (P) (B) **Gram-negative bacilli** – ceftriaxone 2 g IV 12-hourly (child: 50 mg/kg up to 2 g 12-hourly) or gentamicin. If recent major infection with ceftriaxone-resistant gram-negative bacilli, use meropenem[RESTRICTED] instead of ceftriaxone. If high ceftriaxone and meropenem allergy risk (*see page 98*) use ciprofloxacin (P) (B) alone, gentamicin alone or both ciprofloxacin (P) (B) and gentamicin. If GFR < 20 mL/min, ceftriaxone plus ciprofloxacin (P) (B). *If use gentamicin, replace after 48 to 72 hours. See pages 88 and 89 for gentamicin dosing advice* **Gram-positive bacilli** – usually a contaminant. Continue empiric antibiotics based on likely clinical source. Add amoxicillin IV if suspect listeria (e.g., pregnancy, or immune- compromised with meningitis) **Yeast** – fluconazole (P) 400 mg orally daily (child: 12 mg/kg up to 400 mg daily)		

(P) *Contra-indicated or caution in pregnancy; see pages 101 – 102*

(B) *Contra-indicated or caution when breastfeeding; see pages 101 – 102*

INFECTION	FIRST CHOICE	ALTERNATIVES	COMMENTS
Bartholin's abscess	*Same antibiotics as Wound – abdo, pelvis*		
Biliary tract infection	*See Abdomen*		
Bite wound infection Animal or human, includes injury to fist from contact with teeth	Cover any recent *Staphylococcus aureus* isolates Amoxicillin+clavulanate. If failing add trimethoprim+ sulfamethoxazole (P), or doxycycline (P) **Severe:** ceftriaxone	Metronidazole (B) orally plus either doxycycline (P) or trimethoprim+ sulfamethoxazole (P), or clindamycin alone. If failing, clindamycin plus ciprofloxacin (P) (B) **Severe:** clindamycin plus gentamicin, or meropenem RESTRICTED	Clean, irrigate and debride non-viable tissue; submit pus or tissue for culture. Assess need for tetanus toxoid If use gentamicin, replace after 48 to 72 hours. *See pages 88 and 89 for gentamicin dosing advice* *For infected insect bites see Cellulitis – Limb or face* *For prophylaxis of animal or human bites see Prophylaxis – Bites*
Bladder infection	*See UTI – cystitis*		
Blastocystis hominis Gastroenteritis	Nil	Metronidazole (B) 2 g (child: 30 mg/kg up to 2 g) orally daily for 3 days, or metronidazole (B) 500 mg (child 10 mg/kg up to 500 mg) orally 3 times daily for 5 to 7 days Trimethoprim+ sulfamethoxazole (P) 960 mg 2 times daily for 7 days	Usually a non-pathogenic commensal. In patients with persistent abdominal symptoms and *B. hominis* detected in the stool, there is usually another cause for the symptoms. Give trial of antibiotic therapy only if persistent diarrhoea and no other cause found
Blepharitis	Nil Eyelid hygiene is the main treatment. Consider topical chloramphenicol	If posterior blepharitis, especially associated with rosacea, consider doxycycline (P), or a macrolide (azithromycin, roxithromycin or erythromycin)	If eyelid cellulitis, use doxycycline, trimethoprim+ sulfamethoxazole, or amoxicillin+clavulanate
Bloodstream infection	*See Bacteraemia, Staphylococcus aureus bloodstream infection, Sepsis – unknown cause, Immune-compromise and sepsis*		

(P) *Contra-indicated or caution in pregnancy; see pages 101 – 102*

(B) *Contra-indicated or caution when breastfeeding; see pages 101 – 102*

INFECTION	FIRST CHOICE	ALTERNATIVES	COMMENTS
Boils and skin or soft-tissue abscesses *See also recurrent staphylococcal skin infections, page 59*	Cover any recent *Staphylococcus aureus* isolates **Mild:** doxycycline (P), flucloxacillin, or cefalexin. If failing, amoxicillin+clavulanate plus either doxycycline (P) or trimethoprim+ sulfamethoxazole (P) **Severe:** amoxicillin+ clavulanate IV, or cefazolin	**Mild:** doxycycline (P), macrolides (azithromycin, roxithromycin or erythromycin), or trimethoprim+ sulfamethoxazole (P) **Severe:** flucloxacillin IV. If failing: vancomycin plus either cefazolin or ciprofloxacin (P) (B)	Small, uncomplicated, non-facial boils can often be treated with incision and drainage alone If failing, swab pus to screen for MRSA *Note: in 2018 the American Academy of Pediatrics advised that doxycycline does not cause tooth staining and can be safely given for up to 21 days to children of any age*
Bone – internal fixation Bone infection associated with metalware (screws, plates) or bone graft *See also Bone – vertebral, Bone – non-vertebral*	As for bone – vertebral in patient with risk factors for MRSA and enteric gram-negative bacilli		Get tissue samples for culture, at the time of surgical drainage, debridement and possible removal of metalware or graft. Metalware infection is difficult to cure without removal of metalware, and may require suppressive antibiotics Coagulase-negative staphylococci may be the true cause of bone infections associated with metalware
Bone – non- vertebral *See also Bone – vertebral, Bone – internal fixation, Diabetic foot sepsis*	Cover any recent *Staphylococcus aureus* isolates, such as MRSA **Low risk of MRSA:** IV cefazolin, or flucloxacillin **Moderate or high risk of MRSA, or high cefazolin and flucloxacillin allergy risk (*see page 98*):** vancomycin **Oral step-down options:** cefalexin, flucloxacillin, or trimethoprim+ sulfamethoxazole (P)	Clindamycin. If failing, vancomycin plus either ceftriaxone or ciprofloxacin (P) (B) **Oral step-down options:** clindamycin. If failing, cefalexin plus ciprofloxacin (P) (B)	Take blood cultures. Culture deep samples (e.g., bone, deep soft tissue, abscess), especially if surgical intervention or failing treatment Duration of treatment depends on severity, chronicity, source control (e.g., drainage of collections) and clinical response. In general, treat acute bone infection in adults with high-dose antibiotics (*IV or high-dose oral, see page 94*) for 2 to 4 weeks then switch to standard-dose oral antibiotics for total duration of 6 to 12 weeks In children, continue IV antibiotics until bacteraemia resolved, afebrile and clinical improvement, then switch to oral antibiotics for total duration of 3 to 6 weeks

(P) *Contra-indicated or caution in pregnancy; see pages 101 – 102*

(B) *Contra-indicated or caution when breastfeeding; see pages 101 – 102*

INFECTION	FIRST CHOICE	ALTERNATIVES	COMMENTS
Bone – vertebral Vertebral osteomyelitis, discitis, or epidural abscess *See also Bone – non-vertebral, Bone – internal fixation*	Cover any recent *Staphylococcus aureus* isolates, such as MRSA If no risk factor for MRSA or gram-negative bacilli, as per non-vertebral osteomyelitis If moderate or high-risk of MRSA, include vancomycin If risk factor for gram-negative bacillus infection (IV drug user, post-operative, healthcare-associated, recent urinary tract infection, prostatitis, or intra-abdominal infection), give vancomycin plus either ceftriaxone or ciprofloxacin P B **Oral step-down options:** amoxicillin+ clavulanate plus either trimethoprim+ sulfamethoxazole P or ciprofloxacin P B	If failing, vancomycin plus either ceftazidime[RESTRICTED] or ciprofloxacin P B **Oral step-down options:** ciprofloxacin P B plus either clindamycin, flucloxacillin, trimethoprim+ sulfamethoxazole P, or cefalexin	In adults, the range of causative organisms is wide, so take two sets of blood cultures and, if possible, spinal samples for culture. These should ideally be before starting antibiotics but may also be done after antibiotics have been started as the spinal samples often remain positive Duration as above for non-vertebral bone infections
Bordetella pertussis	*See Whooping cough*		
Brain abscess Primary or associated with sinusitis, otitis media or mastoiditis	Ceftriaxone plus metronidazole B If any isolate growing MRSA in the last 6 months, add vancomycin	Meropenem[RESTRICTED]	Aspiration for diagnostic material very useful if can be done safely. If > 2.5 cm or not responding to antibiotic alone, consider referral for neurosurgical drainage *See Dosing of vancomycin (pages 90 and 91) for recommendations for CNS or meningeal infection*
Brain abscess Post-traumatic or post-surgical	Vancomycin plus ceftriaxone	If penetrating trauma, or failing, substitute ceftazidime[RESTRICTED], ciprofloxacin P B or meropenem[RESTRICTED] for ceftriaxone. If unable to tolerate vancomycin, substitute clindamycin for vancomycin	*See Dosing of vancomycin (pages 90 and 91) for recommendations for CNS or meningeal infection*
Breast infection – implant-associated	Choose antibiotics based on culture results of deep tissue samples		Liaise with surgeon early

P *Contra-indicated or caution in pregnancy; see pages 101 – 102*

B *Contra-indicated or caution when breastfeeding; see pages 101 – 102*

INFECTION	FIRST CHOICE	ALTERNATIVES	COMMENTS
Breast infection – lactating Mastitis or abscess	If no systemic symptoms, may resolve with increased breastfeeding and gently expressing milk Cover any recent *Staphylococcus aureus* isolates **Mild:** flucloxacillin, or cefalexin **Severe:** flucloxacillin, or cefazolin. If recent MRSA or failing, vancomycin	**Mild:** clindamycin, doxycycline (P), or trimethoprim+ sulfamethoxazole (P) **Severe:** clindamycin	Continue breastfeeding or expressing milk throughout infection If failing, swab, and culture breast milk. If requires drainage, send pus for culture If *Candida* sp. grows, try topical imidazole (e.g., clotrimazole or miconazole) or oral fluconazole (P) 400 mg day 1 then 200 mg daily for 14 days
Breast infection – non-lactating Mastitis or abscess	Cover any recent *Staphylococcus aureus* isolates **Mild:** cefalexin, or amoxicillin+clavulanate **Severe:** cefazolin plus metronidazole (B). If failing, meropenem[RESTRICTED]	**Mild:** trimethoprim+ sulfamethoxazole (P) plus metronidazole (B) orally, or doxycycline (P) plus metronidazole (B) orally. If failing, ciprofloxacin (P) (B) plus either amoxicillin+ clavulanate or clindamycin **Severe:** clindamycin plus gentamicin	If use gentamicin, replace after 48 to 72 hours. *See pages 88 and 89 for gentamicin dosing advice* If requires drainage, send pus for culture
Bronchiectasis Infective exacerbation (cystic fibrosis or other cause)	Base antibiotic choice on recent sputum culture results, including *Pseudomonas aeruginosa*, *Haemophilus influenzae*, or *Staphylococcus aureus* **Not known previous *Pseudomonas aeruginosa* colonisation:** amoxicillin+clavulanate IV or orally **Known previous *Pseudomonas aeruginosa* colonisation:** if severe, ceftazidime[RESTRICTED] plus either oral ciprofloxacin (P) (B) or nebulised gentamicin. If mild, same as those without known *Pseudomonas aeruginosa* colonisation, but if not improving then ciprofloxacin (P) (B) plus trimethoprim+ sulfamethoxazole (P)	**Not known previous *Pseudomonas aeruginosa* colonisation:** if severe, ceftriaxone, or ciprofloxacin (P) (B) plus cefazolin. If mild, doxycycline (P), or trimethoprim+ sulfamethoxazole (P) **Known previous *Pseudomonas aeruginosa* colonisation:** if severe, meropenem[RESTRICTED] plus either oral ciprofloxacin (P) (B) or nebulised gentamicin. If mild, same as those not colonised with Pseudomonas aeruginosa, but if not improving then ciprofloxacin (P) (B) plus either cefalexin, amoxicillin+ clavulanate, or doxycycline (P)	Treat as a bacterial exacerbation if increased cough, sputum purulence and sputum volume Get sputum for culture each exacerbation. Treat for 10 to 14 days (mild, good response) or 14 to 21 days (severe, slow response) Promote sputum clearance and nutrition **If proven mild *Pseudomonas aeruginosa* infection:** ciprofloxacin (P) (B) 750 mg orally 2 times daily +/- nebulised gentamicin **If proven severe *Pseudomonas aeruginosa* infection:** ceftazidime[RESTRICTED] 2 g IV 8-hourly or meropenem[RESTRICTED] 2 g IV 8-hourly, plus gentamicin IV then nebulised If cystic fibrosis, use higher-than-usual doses of all antibiotics

(P) *Contra-indicated or caution in pregnancy; see pages 101 – 102*

(B) *Contra-indicated or caution when breastfeeding; see pages 101 – 102*

INFECTION	FIRST CHOICE	ALTERNATIVES	COMMENTS
Bronchiolitis Under 1 year old with "wheezy bronchitis"	Nil	Consider antibiotics only if very ill or consolidation on x-ray *See Pneumonia*	RSV and other respiratory viruses are the cause. Exclude from pre-school/school until coryzal phase is over
Bronchitis Acute in adults, no underlying lung disease	Nil		Most cases viral. Purulent sputum alone is not an indication for antibiotics. Give antibiotics only if suspect pneumonia (shortness of breath, persistent fever, rigors, tachycardia, tachypnoea, worsening after initial improvement, hypoxaemia, chest signs or CRP > 30)
Bronchitis Child, persistent	Amoxicillin+ clavulanate	Doxycycline, or trimethoprim+ sulfamethoxazole	Persistent or 'protracted' bronchitis in children is a wet cough lasting longer than 4 weeks, usually in children younger than 5 years. Consider asthma, exposure to cigarette smoke, post-nasal drip, TB, lung abscess and bronchiectasis Treat for 2 to 4 weeks. If failing, refer to Paediatrician *Note: in 2018 the American Academy of Pediatrics advised that doxycycline does not cause tooth staining and can be safely given for up to 21 days to children of any age*
Bronchitis Exacerbation in adults with COPD	Nil	*For antibiotic choice see Pneumonia – adult, community-acquired*	Benefit of antibiotics minimal if not pneumonia. Give antibiotics if increase in sputum volume and increase in purulence, especially if severe underlying COPD or signs of pneumonia (*see Bronchitis*)
Burn wound infection	If soon after the burn injury, follow guidelines for cellulitis, limb or facial in adult	If weeks after the burn injury, choose antibiotics based on culture results of correctly taken swabs, or tissue biopsy samples	Use antibiotics only if signs of invasive infection (redness, pain and swelling)
Bursitis	*See Joint*		

INFECTION	FIRST CHOICE	ALTERNATIVES	COMMENTS
Campylobacter Gastroenteritis	Nil – usually self-limited *See comments for indications for antibiotic treatment*	Azithromycin 500 mg (child: 10 mg/kg up to 500 mg) orally daily for 3 days or 1000 mg single dose If intolerant of azithromycin, give ciprofloxacin P B 500 mg (child: 10 mg/kg up to 500 mg) orally 2 times daily for 3 days, or doxycycline P 100 mg 2 times daily for 5 days	Treat only if severe (e.g., fever and bloody stools) or prolonged, immune-compromised, frail elderly, infants, food handler, child-care worker, or late pregnancy (nearing term, prevents exposure of neonate during delivery)
Candida Skin infection, vulvo-vaginal or oral *See also Urinary tract infection – Candida sp.*	Topical imidazole (e.g., miconazole or clotrimazole), or for oral candidiasis nystatin liquid	If failing topical treatment, use fluconazole P 150 mg orally weekly for 2 to 4 weeks (for skin infection), 150 mg orally daily on day 1 and day 4 (for vulvo- vaginitis), or 50 – 100 mg daily for 7 days (oro-pharyngeal infection)	If severe vaginal infection, repeat fluconazole P 150 mg every 72 hours for 2 or 3 doses Correct causative factors where possible (e.g., diabetes, antibiotics, inhaled steroids, poor denture hygiene). If resistant species (e.g., *Candida krusei*), seek expert advice
Cellulitis Facial in child *See also Sepsis – neonatal*	**Mild:** doxycycline, or amoxicillin+clavulanate **Severe:** ceftriaxone. If failing, amoxicillin+clavulanate plus either ciprofloxacin P B or doxycycline	**Mild:** trimethoprim+sulfamethoxazole P plus metronidazole B orally **Severe:** amoxicillin+clavulanate, or ciprofloxacin P B plus clindamycin	In neonate, almost all facial cellulitis is caused by beta-haemolytic streptococci and will be covered by the antibiotics given for neonatal sepsis *Note: in 2018 the American Academy of Pediatrics advised that doxycycline does not cause tooth staining and can be safely given for up to 21 days to children of any age*
Cellulitis Limb, or facial in adult *See also Wound infections – post-trauma, post-operative, Diabetic foot infection, Necrotising fasciitis, Ulcers, Cellulitis – orbital, or Recurrent cellulitis (page 58)*	Cover any recent *Staphylococcus aureus* isolates **Mild:** trimethoprim+sulfamethoxazole P, flucloxacillin or cefalexin **Severe:** flucloxacillin IV, or cefazolin	**Mild:** clindamycin **Severe:** vancomycin, or clindamycin	Swab any significant wound in the area affected by cellulitis Keep affected limb elevated. Do not use NSAIDs (increased risk of necrotising fasciitis) If cellulitis in patient with liver cirrhosis, end-stage renal failure, or other immune-suppression, especially if failing standard treatment, cover enteric gram-negative bacilli (e.g., switch to ceftriaxone. Add ciprofloxacin P B, or use trimethoprim+sulfamethoxazole P)

P *Contra-indicated or caution in pregnancy; see pages 101 – 102*

B *Contra-indicated or caution when breastfeeding; see pages 101 – 102*

INFECTION	FIRST CHOICE	ALTERNATIVES	COMMENTS
Cellulitis Orbital, post-septal	Cover any recent *Staphylococcus aureus* isolates **Mild:** amoxicillin+ clavulanate. If failing, amoxicillin+clavulanate plus either doxycycline (P) or ciprofloxacin (P) (B) **Severe:** ceftriaxone, or amoxicillin+clavulanate IV. If failing, add vancomycin	**Mild:** cefalexin **Severe:** ciprofloxacin (P) (B) plus clindamycin	Orbital cellulitis refers to post-septal (posterior) infections arising from sinuses or trauma. The patient may have visual or eye movement problems. *If pre- septal, see Cellulitis – limb or face*
Cervicitis	*See Chlamydia trachomatis, gonorrhoea*		
Chickenpox	*See Shingles and chickenpox*		
Chlamydia trachomatis And other non-gonococcal urethritis or cervicitis	Doxycycline (P) 100 mg orally 2 times daily for 7 days	Azithromycin 1 g (child: 10 mg/kg up to 1 g) orally single dose	Treat partners, even if asymptomatic Do test of cure at 3 weeks if pregnancy, anorectal infection, or pelvic infection **Notifiable**
Cholecystitis, cholangitis	*See Abdomen*		
Chorioamnionitis	*See Pelvic inflammatory disease (PID)*		
Clostridioides difficile Toxin-positive, antibiotic-associated diarrhoea Until recently called *Clostridium difficile*	Metronidazole (B) 400 mg (child: 10 mg/kg up to 400 mg) orally 3 times daily for 10 days If severe (shock, ileus), give metronidazole (B) 500 mg IV 8-hourly plus vancomycin 500 mg orally or via NG 4 times daily. If ileus, administer vancomycin 500 mg in 100 mL normal saline as enema 6-hourly	Vancomycin 125 mg (child: 5 mg/kg up to 125 mg) orally 4 times daily for 10 days	To administer vancomycin orally, dissolve 500 mg vancomycin powder from vial in 10 mL water and measure the appropriate dose (e.g., 125 mg = 2.5 mL) Stop other antibiotics if possible. If numerous relapses discuss stool transplant with Gastroenterologist or Infectious Diseases Physician
Coagulase-negative staphylococci	Usually contaminants, except if repeated isolation in presence of foreign material (e.g., central venous catheter, prosthetic joint)		For choice of antibiotic see *Staphylococcus aureus* infection

(P) *Contra-indicated or caution in pregnancy; see pages 101 – 102*

(B) *Contra-indicated or caution when breastfeeding; see pages 101 – 102*

INFECTION	FIRST CHOICE	ALTERNATIVES	COMMENTS
Common cold Upper respiratory tract viral infection *See also Sinusitis or Pneumonia*	Nil		Antibiotics do not prevent bacterial infection. Nasal purulence or discoloured sputum alone do not predict response to antibiotics
Conjunctivitis Bacterial (more likely if eyelids glued in morning or purulent discharge)	**Mild:** cleansing and lubricants **Moderate or severe:** chloramphenicol 0.5% eye drops during day +/- chloramphenicol 1% ointment at bedtime		Swab neonates or if suspect STI – treat chlamydial and gonococcal conjunctivitis systemically. Consult specialist if meningococcal conjunctivitis. If contact lens wearer swab and assess for keratitis **Notifiable**, especially outbreak
COPD	*See Bronchitis – Exacerbation in patients with COPD*		
Coral cuts Infected	*See Wound infection – water injuries (page 56). For prevention of secondary infection see Traumatic wound infection prophylaxis (page 71)*		
Croup	*See Laryngitis*		
Cystic fibrosis	*See Bronchiectasis*		
Cystitis	*See UTI – Cystitis*		
Dacryocystitis – acute Infection of the lacrimal sac, usually associated with duct obstruction	Cover any recent *Staphylococcus aureus* isolates Acute dacryocystitis: cefalexin, or amoxicillin+clavulanate	Acute dacryocystitis: trimethoprim+ sulfamethoxazole (P), or doxycycline (P) If failing, amoxicillin+ clavulanate plus either trimethoprim+ sulfamethoxazole (P) or ciprofloxacin (P) (B)	Often needs surgical management. Chronic infections may be caused by unusual organisms
Dental infection	*See Tooth abscess, gingivitis*		

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(B) *Contra-indicated or caution when breastfeeding; see pages 101 – 102*

INFECTION	FIRST CHOICE	ALTERNATIVES	COMMENTS
Dermatophytoses 'Tinea' or 'ringworm' of scalp or body *See also Tinea versicolor*	Topical imidazole (e.g., clotrimazole or miconazole 2% cream), or topical terbinafine 1% For tinea of the body: terbinafine 250 mg (child less than 20 kg: 62.5 mg; child 20 to 40 kg: 125 mg) orally, once daily for 2 weeks, or fluconazole P 150 mg (adult) orally, once weekly for 6 weeks, or itraconazole P B (dose depends on formulation) for 2 weeks (tinea cruris or tinea corporis) or 4 weeks (tinea pedis)	For tinea of the scalp caused by *Trichophyton* species: terbinafine as for first-choice therapy for 4 weeks If caused by *Microsporum canis*, use fluconazole P 6 mg/kg/day for 3 to 6 weeks. Griseofulvin and itraconazole P B regimens are also available	Oral treatment indicated if failing topical treatment, patient is very immune-compromised, or rash is widespread or involves scalp, palms, soles or nails Longer duration may be needed for tinea of the body that is hyperkeratotic or involving hairy areas
Diabetic foot infection Applies also to chronic ischaemic, venous, and pressure ulcer infections	Most chronic ulcers do not have active, invasive infection and do not benefit from antibiotic treatment. Give good ulcer care including topical antiseptics (*see pages 106 and 107*) Cover any recent *Staphylococcus aureus* isolates **Mild acute infection (cellulitis) and no recent antibiotics:** trimethoprim+ sulfamethoxazole P, or cefalexin **Mild chronic infection or acute infection despite recent antibiotics:** trimethoprim+ sulfamethoxazole P plus metronidazole B orally, or amoxicillin+clavulanate alone **Severe infection:** amoxicillin+clavulanate IV plus either ciprofloxacin P B or gentamicin	**Mild acute infection, no recent antibiotics:** flucloxacillin, or clindamycin **Mild chronic infection or acute infection despite recent antibiotics:** amoxicillin+ clavulanate plus trimethoprim+ sulfamethoxazole P. If failing, ciprofloxacin P B plus either amoxicillin+ clavulanate or clindamycin **Severe infection:** meropenem[RESTRICTED] alone, or clindamycin plus ciprofloxacin P B	Bone infection more likely if ulcer > 2cm^2, positive probe to bone, ESR > 70, substantially raised CRP or abnormal plain x-ray If unresponsive, investigate for surgically drainable abscess or surgically resectable infected dead tissue; collect deep samples for culture Do not swab non-infected ulcers. If infected, you may swab the superficial site but first cleanse/ wipe with saline to remove exudate Remember regular dressing changes, debridement, and management of venous or arterial insufficiency If using gentamicin, replace after 48 to 72 hours. *See pages 88 and 89 for gentamicin dosing advice*
Diarrhoea	*See Gastroenteritis or individual organism*		
Dientamoeba fragilis Gastroenteritis	If symptomatic, (*see comments*) doxycycline P 100 mg (child: 2 mg/kg up to 100 mg) orally 2 times daily for 10 days	Metronidazole B 400 to 600 mg (child: 10 to 15 mg/kg up to 600 mg) orally 3 times daily for 10 days	Almost all patients are asymptomatic and do not require treatment. In patients with persistent gastrointestinal symptoms, *D. fragilis* is usually not the cause

P *Contra-indicated or caution in pregnancy; see pages 101 – 102*

B *Contra-indicated or caution when breastfeeding; see pages 101 – 102*

INFECTION	FIRST CHOICE	ALTERNATIVES	COMMENTS
Discitis	See Bone – vertebral		
Diverticulitis	See Abdomen		
Eczema Infected (honey-coloured crusting, with folliculitis)	Dilute bleach 2 to 3 times a week *See page 106 for other topical antiseptic options*	If moderate-severe, prescribe short courses of oral antibiotics (see Cellulitis – limb or face). Swab if usual antibiotics failing	For bleach dilution instructions *see Topical antiseptic agents, page 107*. Soak or wipe over skin for 5 to 10 min, rinse in fresh water, dry and apply emollient +/- other prescribed medication Mupirocin effective for initial infection but resistance develops rapidly
Empyema	*See Pleural space infection*		
Endocarditis Cause known	If alpha-haemolytic ('viridans') streptococcus, ask laboratory to test penicillin MIC Seek expert advice on antibiotic choice, dose and duration and need for surgery. Treatment depends on bacterial species and MIC, location, and size of vegetations, native versus prosthetic valve, allergies, and renal function		If isolate *Streptococcus bovis*, send to reference lab for full identification as some species have a very strong association with colonic pathology or intra-abdominal cancer
Endocarditis Unknown cause or awaiting culture results	**Native valve:** benzylpenicillin 1.8 g (3 MU) (child: 50 mg/kg up to 1.8 g) IV 4-hourly plus flucloxacillin 2 g (child: 50 mg/kg up to 2 g) IV 4-hourly plus gentamicin IV once daily **Prosthetic valve, pacemaker or other intra-cardiac device:** cefazolin 2 g (child: 50 mg/kg up to 2 g) IV 8-hourly plus vancomycin plus gentamicin	**Native valve:** if high- risk of MRSA or if high penicillin and flucloxacillin allergy risk (*see page 98*): cefazolin 2 g (child: 50 mg/kg up to 2 g) IV 8-hourly plus vancomycin. Or vancomycin plus gentamicin	Take 3 sets of blood cultures before starting antibiotic treatment Gram-negative bacterial endocarditis is uncommon. Consider stopping gentamicin after 48 to 72 hours, or switching to ciprofloxacin *See pages 88 and 89 for gentamicin dosing advice*
Endometritis	*See Pelvic inflammatory disease (PID)*		

INFECTION	FIRST CHOICE	ALTERNATIVES	COMMENTS
Endophthalmitis	Ceftazidime[RESTRICTED] 2 mg/0.1 mL or 2.25 mg/0.1 mL by intravitreal injection plus vancomycin 1 mg/0.1 mL by intravitreal injection If suspect haematogenous seeding of bacteria to the eye (e.g., fever, systemically ill), treat with IV antibiotics (e.g., ceftriaxone) for systemic infection in addition to intra-vitreal antibiotics	If post-trauma to eye or post-cataract surgery, give ciprofloxacin P B 750 mg (child: 20 mg/kg up to 750 mg) orally 2 times daily if there is a delay in giving intravitreal injections If IV ceftriaxone failing for systemic infection, try IV vancomycin plus either meropenem[RESTRICTED] or ciprofloxacin P B	Culture intravitreous fluid before antibiotic injection
***Enterococcus* spp. infection**	Amoxicillin or penicillin	Vancomycin If urine infection and can't use amoxicillin, then use nitrofurantoin P, or ciprofloxacin P B. If wound infection (uncommon) and can't use amoxicillin or vancomycin then may try high-dose doxycycline P, azithromycin or ciprofloxacin P B (+/- rifampicin), but success is unpredictable	If endocarditis, add low-dose gentamicin or ceftriaxone according to protocol and expert advice
Epididymo-orchitis	Age < 35 years – more likely venereal – give ceftriaxone 500 mg IV (or IM in 1 or 2% lidocaine) as a single dose plus doxycycline P 100 mg 2 times daily for 14 days. In place of doxycycline P, may also use azithromycin 1 g orally as a single dose, then repeat 7 days later	> 35 years or after cystoscopy more likely enteric gram-negative rod – give ciprofloxacin P B orally, or IV ceftriaxone or gentamicin if infection severe. Oral cotrimoxazole is an option if urine isolate susceptible	Culture mid-stream urine in all. Test for chlamydia and gonorrhoea if at risk. Sexually transmitted diseases are **notifiable** Giving IM ceftriaxone without lidocaine is painful. If using ceftriaxone for IM injection, dilute 1.75 mL of lidocaine 2% with 1.75 mL of water for injection, then use this 3.5 mL solution to reconstitute a ceftriaxone 1g vial for IM use. Administer 2 mL of the reconstituted solution for 0.5 g dose and 4 mL for a 1 g dose
Epidural abscess	*See Bone – vertebral*		

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INFECTION	FIRST CHOICE	ALTERNATIVES	COMMENTS
Epiglottitis	Cover any recent *Staphylococcus aureus* isolates Ceftriaxone **Oral step-down options:** amoxicillin+clavulanate	Vancomycin plus ciprofloxacin (P) (B) **Oral step-down options:** ciprofloxacin (P) (B) plus clindamycin	Refer for hospital assessment It is common to add corticosteroids (e.g., dexamethasone 10 mg (child: 0.15 mg/kg up to 10 mg) IV as a single dose; repeat after 24 hours if required
Fungal infection	*See Candida, Dermatophytoses*		
Gallbladder	*See Abdomen*		
Gastroenteritis Acute, cause unknown *If bacterial cause found, see individual organism guideline*	Antibiotics seldom indicated Stool testing seldom indicated: consider if severe or persistent diarrhoea, blood in stool, typical of giardiasis or typhoid, following antibiotics or hospitalisation. If recent antibiotics or hospitalisation, test for Clostridioides difficile	If particularly severe (see comments) or immune-compromised, while awaiting stool results: azithromycin 500 mg (child 10 mg/kg up to 500 mg) daily for 3 days or ciprofloxacin (P) (B) 500 mg (child: 12.5 mg/kg up to 500 mg) orally 2 times daily for 3 to 5 days. If oral therapy not feasible, ceftriaxone If recent antibiotics or hospitalisation add metronidazole (B) 400 mg orally 3 times daily for 10 to 14 days	Fluid and electrolyte replacement and stabilisation of co- morbidities are the mainstays of treatment Features of severe diarrhoea include high fever, tachycardia, leucocytosis, severe abdominal pain or tenderness, high-volume diarrhoea, or blood in the stool. Do not give antibiotics to children with bloody diarrhoea without fever because can precipitate HUS if caused by enterohaemorrhagic E. coli Acute dysentery is **notifiable**
Genital ulcers Including ano-rectal ulcers	*If syndromic STI management only, treat for syphilis and herpes simplex virus (WHO 2021). Consider also LGV and chancroid*		
Giardiasis	Metronidazole (B) 400 mg (child: 10 mg/kg up to 400 mg) orally 3 times daily for 5 to 7 days	Metronidazole (B) 2 g (child 30 mg/kg up to 2 g) orally daily for 3 days	Treat if symptomatic. Do not treat if carrier, unless pregnant, immune-compromised, or food worker **Notifiable**
Gingivitis Inflammation or ulceration of the gums	**Mild:** chlorhexidine (0.12 to 0.2%) or hydrogen peroxide mouthwash (do not swallow)	**Moderate or severe (painful, ulcerative):** metronidazole (B) 400 to 600 mg orally 2 times daily	For severe gingivitis, it may be necessary to debride plaque and necrotic tissue Prevent recurrence with good oral hygiene and dental care, good nutrition and stopping smoking

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(B) *Contra-indicated or caution when breastfeeding; see pages 101 – 102*

INFECTION	FIRST CHOICE	ALTERNATIVES	COMMENTS
Gonorrhoea	Ceftriaxone 500 mg IV (or IM in 1 or 2% lidocaine) as a single dose plus azithromycin 1 g (for genital or ano-rectal infection) or 2 g (for pharyngeal infection) orally as a single dose	If amoxicillin-susceptible and no pharyngeal or ano-rectal infection, you may use amoxicillin 3 g orally plus probenecid 1 g orally plus azithromycin 1 g orally, all as single doses Ciprofloxacin P B and oral cephalosporins are no longer recommended	Giving IM ceftriaxone without lidocaine is painful. If using ceftriaxone for IM injection, dilute 1.75 mL of lidocaine 2% with 1.75 mL of water for injection, then use this 3.5 mL solution to reconstitute a ceftriaxone 1g vial for IM use. Administer 2 mL of the reconstituted solution for 0.5 g dose and 4 mL for a 1 g dose If disseminated gonococcal infection give ceftriaxone 2 g IV daily until 2 days after symptoms settled then switch to oral regime; total duration (IV plus oral) is at least 7 days Treat chlamydia (e.g., with concomitant azithromycin) in all patients, irrespective of the results of chlamydia testing **Notifiable**
Group A streptococci	*See Streptococcus pyogenes*		
Helicobacter pylori Eradication	Omeprazole 20 mg orally 2 times daily plus amoxicillin 1 g orally 2 times daily plus azithromycin 500 mg orally once daily, all for 14 days If penicillin allergy, omeprazole (dose as above) plus metronidazole B 400 mg orally 2 times daily, plus azithromycin (dose as above), all for 14 days	If failing first choice, discuss with pharmacy One option is four drugs (omeprazole plus amoxicillin plus azithromycin plus metronidazole B), with doses as per first-choice column, all for 14 days Another option is omeprazole plus amoxicillin (doses as per first-choice column) plus either moxifloxacin 400 mg orally daily, or rifabutin 150 mg orally 2 times daily, all for 10 days	Four comparative trials show azithromycin is as effective as clarithromycin Test of cure by stool antigen at 8 weeks post-treatment Metronidazole B resistance is now very high in Australia and New Zealand, so metronidazole B-containing regimens are no longer first choice
Herpes simplex Mucocutaneous	**Initial episode:** aciclovir 200 mg (child: 10 mg/kg up to 200 mg) orally 5 times daily for 7 days. Equally effective is valaciclovir 1 g 2 times daily for 7 days. If immune-compromised use aciclovir 400 mg 5 times a day, or valaciclovir as above but for up to 10 days	**For minor recurrence** use aciclovir 5% cream topically, 5 times daily for 5 days at the first sign of recurrence (adults and children) **For recurrences,** equally effective oral options are aciclovir 200 mg 5 times daily for 5 days, or valaciclovir 2 g orally 2 times daily for one day	Start antiviral medication as soon as possible, ideally within 3 days of onset; can start later if new lesions are developing or pain is severe Lidocaine 2% gel, benzydamine 1% gel, chlorhexidine ointment or paracetamol may help

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INFECTION	FIRST CHOICE	ALTERNATIVES	COMMENTS
Herpes zoster	*See Shingles*		
Immune-compromise and sepsis Neutropenia (absolute neutrophil count of < 0.5 x 109/L or < 1.0 x 109/L and likely to fall to < 0.5 x 109/L), splenectomy, hypo- gammaglobulinaemia, complement deficiency, cell-mediated immune-compromise (anti-cancer chemotherapy, high-dose prednisone, transplant, TNF-alpha inhibitor)	Vancomycin plus either ceftazidime[RESTRICTED] or ciprofloxacin (P) (B) Use meropenem[RESTRICTED] (+/- vancomycin) if severe and unresponsive, or infection with ceftriaxone-resistant gram-negative bacilli in recent past	Clindamycin plus either ceftazidime[RESTRICTED] or ciprofloxacin (P) (B) **Oral step-down options:** ciprofloxacin (P) (B) plus either doxycycline (P) or clindamycin	Take two sets of blood cultures and give antibiotics immediately If cell-mediated immune-compromise, consider Pneumocystis jirovecii pneumonia ('PJP'), TB, or Aspergillus spp. infection
Impetigo Localised; other minor streptococcal or staphylococcal skin infection	Povidone iodine 10%. Dilute bleach (sodium hypochlorite 0.005% to 0.025%, *see page 107 for dilution instructions*) is probably effective, non-toxic and very cheap	Apply gauze soaked in Microdacyn hydrogel or wound solution applied 1 to 3 times daily, hydrogen peroxide 1% to 3%, or chlorhexidine+cetrimide. Topical mupirocin works but resistance develops quickly	Wash crusts off. If widespread or severe, treat with oral agents (*see Cellulitis – Limb or face*) *See Eczema, page 26 for bleach application instructions*
Influenza	Nil	Give antibiotics if suspect secondary bacterial infection. See guidelines for pneumonia but ensure cover *Staphylococcus aureus*	Although widely used in Australia, oseltamivir (Tamiflu) is of little benefit and very expensive. It is not available in the Cook Islands **Notifiable**

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INFECTION	FIRST CHOICE	ALTERNATIVES	COMMENTS
Intravascular catheter Central or peripheral, venous or arterial	Gentamicin plus vancomycin	Vancomycin plus either ceftriaxone or ciprofloxacin (P) (B)	Take 2 sets of blood cultures Most infected intravascular catheters should be removed, especially if the patient is severely unwell, there is a tunnel infection, DIC or the causative organism is *Staphylococcus aureus, Pseudomonas aeruginosa*, Bacillus cereus or Candida spp. In unusual circumstances, an infected catheter can be retained. Seek expert advice regarding antibiotic locks to sterilise the retained catheter *If using gentamicin, replace after 48 to 72 hours. See pages 88 and 89 for gentamicin dosing advice*
Joint infection – adult, native joint Septic arthritis, bursitis	Cover any recent *Staphylococcus aureus* isolates IV cefazolin. If failing, ceftriaxone plus vancomycin **Oral step-down options:** cefalexin, or trimethoprim+ sulfamethoxazole (P)	IV amoxicillin+ clavulanate, or vancomycin. If failing, vancomycin plus either ciprofloxacin (P) (B) or ceftriaxone **Oral step-down options:** clindamycin	Aspirate joint. *S. aureus* is most common (including MRSA) but consider gout, *Neisseria gonorrhoea* (may have rash and tenosynovitis), or TB Surgical washout often helpful Duration of treatment depends on severity and clinical response. In general, treat acute septic arthritis in adults with high-dose antibiotics (IV or oral, *see page 94*) for at least 2 weeks then switch to standard- dose oral antibiotics for total duration of 4 to 6 weeks
Joint infection – child Septic arthritis	Cover any recent *Staphylococcus aureus* isolates IV ceftriaxone, or amoxicillin+clavulanate **Oral step-down options:** amoxicillin+clavulanate	Clindamycin plus ciprofloxacin (P) (B) orally **Oral step-down options:** trimethoprim+ sulfamethoxazole (P), or a macrolide (azithromycin, roxithromycin or erythromycin)	Treat for 2 to 4 weeks

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INFECTION	FIRST CHOICE	ALTERNATIVES	COMMENTS
Joint infection – prosthetic	Cover any recent Staphylococcus aureus isolates If likely haematogenous source, cefazolin IV plus ciprofloxacin (P) (B) orally. If failing, ceftriaxone plus vancomycin If likely post-operative cause, ceftriaxone plus vancomycin **Oral step-down options:** choose based on blood, joint aspirate fluid, or deep tissue culture results. Empiric choices with reasonable cover include amoxicillin+clavulanate, cefalexin, or trimethoprim+ sulfamethoxazole (P). If failing, amoxicillin+ clavulanate plus trimethoprim+ sulfamethoxazole (P)	Vancomycin plus ciprofloxacin (P) (B)	Involve surgeons early, as debridement is a key component of management and deep samples for culture are usually needed to guide antibiotic choice The choice, route of administration and duration of antibiotics is beyond the scope of this guideline. Seek expert advice
Keratitis Bacterial	Chloramphenicol 0.5% eye drops. No subconjunctival or systemic antibiotics are needed, unless has spread to sclera	If *Pseudomonas aeruginosa* grows, use framycetin (Soframycin), or ciprofloxacin (P) (B) 0.3% eye drops	Refer immediately to an eye specialist. Swab or get scraping to detect cause. If fungal, seek expert help
Keratitis Herpes simplex	HSV – topical aciclovir		VZV ophthalmicus – *see Shingles*
Kidney infection	*See UTI – Pyelonephritis, Perinephric abscess*		
Laryngitis / Croup	For croup, prednisone 1 mg/kg (up to 50 mg) orally, as a single dose, or dexamethasone 0.15 mg/kg (up to 12 mg) as a single dose	If severe and suspect bacterial infection, *see Pneumonia*	Almost always viral

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INFECTION	FIRST CHOICE	ALTERNATIVES	COMMENTS
Leptospirosis	Doxycycline (P) 100 mg (child: 2 mg/kg up to 100 mg) orally, 2 times daily for 7 days	Benzylpenicillin, amoxicillin or ceftriaxone. Total duration of treatment is 7 days	Start within 1 week of onset **Notifiable**
Liver abscess	*See Abdomen*		
Lung abscess	Cover any recent *Staphylococcus aureus* isolates **Mild:** amoxicillin+ clavulanate. If failing, amoxicillin+clavulanate plus either doxycycline (P) or trimethoprim+ sulfamethoxazole (P) **Severe:** Ceftriaxone +/- either metronidazole (B) or vancomycin	**Mild:** clindamycin alone, or a macrolide (azithromycin, roxithromycin) plus metronidazole (B) orally If failing, ciprofloxacin (P) (B) plus clindamycin **Severe:** ciprofloxacin (P) (B) orally plus clindamycin. If failing, meropenem[RESTRICTED] and screen for MRSA	Treat for at least 4 weeks Consider TB or malignancy
Lymphadenitis, cervical See also pharyngitis, tooth abscess, and mouth, para-pharyngeal and deep neck infections	Cover any recent *Staphylococcus aureus* isolates **Mild:** flucloxacillin, or cefalexin. If failing, amoxicillin+clavulanate (not if possible EBV infection) **Severe:** ceftriaxone. If failing, ceftriaxone plus vancomycin	**Mild:** trimethoprim+ sulfamethoxazole (P) plus metronidazole (B) orally, or clindamycin alone **Severe:** clindamycin	Many infective and non-infective causes in children. Acute bilateral usually viral. If chronic, consider cat-scratch disease, toxoplasmosis, mycobacteria – surgical excision may be needed for diagnosis Avoid amoxicillin if suspect EBV infection
Mastitis	*See Breast Infections*		
Mastoiditis Acute	Cover any recent *Staphylococcus aureus* isolates Ceftriaxone **Oral step-down phase:** amoxicillin+clavulanate	Amoxicillin+ clavulanate IV, vancomycin **Oral step-down options:** a macrolide (azithromycin, roxithromycin or erythromycin), doxycycline (P), or trimethoprim+ sulfamethoxazole (P)	If chronic, get samples for culture. May need treatment for MRSA (e.g., vancomycin) or *Pseudomonas aeruginosa* (e.g., ciprofloxacin (P) (B), ceftazidime[RESTRICTED], meropenem[RESTRICTED]), in conjunction with debridement and drainage surgery

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(B) *Contra-indicated or caution when breastfeeding; see pages 101 – 102*

INFECTION	FIRST CHOICE	ALTERNATIVES	COMMENTS
Meningitis Cause unknown, adult and child > 1 month *For child < 1 month, see Neonatal sepsis*	Dexamethasone (*see comments*) plus ceftriaxone 2 g (child: 50 mg/kg up to 2 g) IV 12-hourly Add vancomycin (loading dose 25 to 30 mg/kg then *see Dosing of vancomycin – pages 90 and 91*) if risk factors for penicillin-resistant *Streptococcus pneumoniae* (*see comments*) or if *S. pneumoniae* or *Staphylococcus aureus* is likely on CSF microscopy or culture Add benzylpenicillin 2.4 g (child: 60 mg/kg up to 2.4 g) IV, 4-hourly or amoxicillin 50 mg/kg 4- to 6-hourly if risk factors for listeria (> 50 years old, < 3 months old, pregnant, or immune-compromised (poorly controlled diabetes, alcoholism, high-dose steroids)) until listeriosis ruled out	If high penicillin, amoxicillin and ceftriaxone allergy risk (*see page 98*): vancomycin plus high-dose ciprofloxacin P B If listeria risk factors (*see first choice column*) and high penicillin or cephalosporin allergy risk (*see page 98*), give high-dose oral trimethoprim+ sulfamethoxazole P (*see page 94*) in place of vancomycin.	In all adults and children over 6 weeks old initially give dexamethasone 0.15 mg/kg (up to 10 mg) IV starting before or with the first dose of antibiotic then 6-hourly for 2 days Stop dexamethasone if meningitis is not caused by *Streptococcus pneumoniae*, *Haemophilus influenzae* type B, TB or an eosinophilic disease Risk factors for penicillin-resistant *S. pneumoniae* include recent penicillin or cephalosporin use, otitis media or sinusitis *See Dosing of vancomycin (pages 90 and 91) for recommendations for CNS or meningeal infection* **Notifiable**
Meningitis Healthcare-associated or after head injury	Ceftazidime[RESTRICTED] plus vancomycin (loading dose 25 to 30 mg/kg then *see Dosing of vancomycin pages 90 and 91*)		Healthcare-associated meningitis includes infections developing after neurosurgery, spinal surgery, or insertion of an intracranial device, or in patients with CSF shunts *See Dosing of vancomycin (pages 90 and 91) for recommendations for CNS or meningeal infection*
Meningitis *Haemophilus influenzae* type B	Ceftriaxone (dose above)	If susceptible to penicillin, use benzylpenicillin If high ceftriaxone and penicillin allergy risk (*see page 98*): high-dose ciprofloxacin P B	Treat for 7 days **Notifiable**

P *Contra-indicated or caution in pregnancy; see pages 101 – 102*

B *Contra-indicated or caution when breastfeeding; see pages 101 – 102*

INFECTION	FIRST CHOICE	ALTERNATIVES	COMMENTS
Meningitis *Neisseria meningitidis*	Benzylpenicillin 2.4 g (child: 60 mg/kg up to 2.4 g) IV, 4-hourly for 5 days	Ceftriaxone 2 g (child: 50 mg/ kg up to 2 g) IV 12-hourly If high penicillin and ceftriaxone allergy risk (*see page 98)*: high-dose ciprofloxacin P B	If *Neisseria meningitidis* infection is confirmed, stop dexamethasone Treat for 5 days Prophylaxis is essential for certain close contacts and for patients who only received benzylpenicillin treatment **Notifiable**
Meningitis *Streptococcus pneumoniae*	Dexamethasone (*see comments in Meningitis – cause unknown*) plus ceftriaxone plus vancomycin until MIC (minimum inhibitory concentration) known. Ask laboratory to test MIC for penicillin and ceftriaxone	If penicillin MIC < 0.125 mcg/ mL, use benzylpenicillin alone (*see doses above*). If penicillin MIC ≥ 0.25 mcg/mL, do not use benzylpenicillin If ceftriaxone MIC < 1, may use ceftriaxone alone (*see doses above*). If ceftriaxone MIC 1 to 2 use ceftriaxone plus vancomycin If ceftriaxone MIC > 2 use vancomycin alone and seek expert advice If high penicillin and ceftriaxone allergy risk (*see page 98*): vancomycin plus ciprofloxacin P	For doses, see Meningitis, cause unknown (above) Treat for 10 to 21 days, depending on response and presence of brain abscess or mastoiditis **Notifiable**
Mouth, para-pharyngeal and deep neck infections Includes spreading dental infections, quinsy (peri-tonsillar abscess), floor of mouth cellulitis (Ludwig's angina), necrotising pharyngitis (Vincent's angina), and Lemierre's syndrome *See also Gingivitis, Lymphadenitis – cervical*	**Mild:** amoxicillin+ clavulanate. If failing, amoxicillin+clavulanate plus trimethoprim+ sulfamethoxazole P **Severe:** metronidazole B plus either ceftriaxone or cefazolin	**Mild:** trimethoprim+ sulfamethoxazole P plus metronidazole B orally, or cefalexin alone, or clindamycin alone **Severe:** clindamycin plus ciprofloxacin P B	Incise and drain if infected collection, especially if airway threatened. Send pus for culture *If retro-pharyngeal infection starting in cervical spine, see Bone – vertebral*

P *Contra-indicated or caution in pregnancy; see pages 101 – 102*

B *Contra-indicated or caution when breastfeeding; see pages 101 – 102*

INFECTION	FIRST CHOICE	ALTERNATIVES	COMMENTS
MRSA Methicillin-resistant *Staphylococcus aureus*	*See Staphylococcus aureus infection, Staphylococcus aureus – bloodstream infection*		
Muscle infection	*See Pyomyositis*		
Mycotic aneurism	Cover any recent *Staphylococcus aureus* isolates Vancomycin plus ceftriaxone. If failing, cefazolin plus ciprofloxacin (P)	Amoxicillin+ clavulanate, or ciprofloxacin (P) (B) plus clindamycin	Take 3 sets of blood cultures
Necrotising fasciitis, necrotising cellulitis or necrotising myositis	Call surgeon immediately for debridement and culture of deep tissue samples Meropenem[RESTRICTED] 1 g infused over 3 to 4 hours (child: 25 mg/kg up to 1 g) IV 8-hourly plus vancomycin plus clindamycin 900 mg (child: 15 mg/kg up to 600 mg) 8-hourly Add ciprofloxacin (P) (B) if water-associated infection **Proven Group A streptococcal disease:** benzylpenicillin (1.8 to 2.4 g (3 to 4 MU) (child: 50 mg/kg up to 2.4 g) IV 4-hourly) plus clindamycin	If unsure or meropenem[RESTRICTED] not available, ceftriaxone plus vancomycin plus clindamycin. Other options include ceftazidime[RESTRICTED] plus clindamycin, or cefazolin plus gentamicin, or ciprofloxacin (P) (B) plus clindamycin **Proven Group A streptococcal disease:** cefazolin plus clindamycin	Clues to necrotising infections: very severe pain and tenderness; rapid progression; local signs (e.g., haemorrhagic blisters, skin black or dusky colour, gas in tissues, stinky discharge); systemic toxicity (shock, acute kidney injury, confusion, acidosis) If IV clindamycin not available, try to administer orally. Clindamycin may have anti-toxin benefit even when Group A streptococci are 'resistant' *in-vitro* If using gentamicin, replace after 48 to 72 hours. *See pages 88 and 89 for gentamicin dosing advice*

(P) *Contra-indicated or caution in pregnancy; see pages 101 – 102*

(B) *Contra-indicated or caution when breastfeeding; see pages 101 – 102*

INFECTION	FIRST CHOICE	ALTERNATIVES	COMMENTS
Neonatal sepsis Includes bacteraemia, meningitis and pneumonia in child < 1 month	Moderate and no suspicion of meningitis: amoxicillin 50 mg/kg 6- to 12-hourly plus gentamicin (4 to 7 mg/kg IV 24- to 36-hourly) Severe or suspicion of meningitis: amoxicillin (dose as above) plus cefotaxime 50 mg/kg IV 8- to 12-hourly. If cefotaxime not available, may use ceftriaxone 25 to 50 mg/kg 12-hourly but watch for hyperbilirubinaemia and do not co-administer within 48 hours of IV calcium-containing products (e.g., TPN) If within 72 hours of birth, as above but give benzylpenicillin instead of amoxicillin Add vancomycin if mother MRSA-positive in recent past then stop vancomycin at 48 to 72 hours if no MRSA isolated *See Dosing for newborns, page 75*	If failing, consider meropenem[RESTRICTED]. If high penicillin and cephalosporin allergy risk (*see page 98*), consider vancomycin plus ciprofloxacin P B	Consider adding aciclovir 20 mg/kg IV 8-hourly until herpes simplex encephalitis has been excluded Can give gentamicin, benzylpenicillin, cefotaxime or ceftriaxone IM while awaiting IV or intra-osseous access Add a macrolide (azithromycin or erythromycin) if *Chlamydia trachomatis* (co-existent conjunctivitis) or *Bordetella pertussis* (paroxysmal cough, apnoea) pneumonia is suspected If using gentamicin, replace after 48 to 72 hours. *See pages 88 and 89 for gentamicin dosing advice* Meningitis, chlamydia and pertussis are **notifiable**
Neutropenia	*See Immune deficiency and Sepsis – Neutropenia*		
Orchitis	*See Epididymo-orchitis*		
Osteomyelitis	*See Bone*		

P *Contra-indicated or caution in pregnancy; see pages 101 – 102*

B *Contra-indicated or caution when breastfeeding; see pages 101 – 102*

INFECTION	FIRST CHOICE	ALTERNATIVES	COMMENTS
Otitis externa Acute diffuse	Flumetasone+clioquinol 0.02%+1% ear drops, 3 drops 2 times daily (e.g., Locorten-Vioform) Dexamethaone+ framycetin+gramicidin 0.05%+0.5%+0.005% (Sofradex®) is effective but more expensive. Use 2 to 3 drops in the ear(s) 3 to 4 times daily If swabs show fungal infection (*Candida* or *Aspergillus* spp.), use a product containing anti-fungal agents (e.g., clioquinol, nystatin)	If fever, spread to pinna, folliculitis or suspect necrotising infection then swab for culture and treat with antibiotics to cover *Staphylococcus aureus* (e.g., flucloxacillin, cefalexin, or trimethoprim+ sulfamethoxazole P) and *Pseudomonas aeruginosa* (e.g., ciprofloxacin P B 750 mg (child: 20 mg/kg up to 750 mg) orally 2 times daily Look for results of previous ear swabs as these may guide antibiotic choice If necrotising ('malignant') otitis externa (usually diabetics, immune-compromise), cover *Pseudomonas aeruginosa* with ciprofloxacin P B, ceftazidime[RESTRICTED], or meropenem[RESTRICTED]	Use dry techniques to keep ear canal as dry as possible and remove discharge and debris (e.g., dry mop the ear with rolled tissue spears). Do not syringe with water. Keep the ear canal dry during and for 2 weeks after treatment (e.g., use a shower or bathing cap, avoid swimming, block ear canal with Blu Tack)
Otitis media Acute *See also Mastoiditis*	Antibiotic treatment is usually unnecessary (*see comments*) Amoxicillin 30 mg/kg up to 1 g 2 times daily for 5 days (7 to 10 days if age < 2 years, underlying medical condition or perforated ear drum). These high doses are needed for resistant *Streptococcus pneumoniae* strains Consider alternative antibiotic if recent amoxicillin use or recurrent acute otitis media	Not improving at 2 to 3 days: amoxicillin+ clavulanate. If still failing, amoxicillin+ clavulanate plus either doxycycline P or ciprofloxacin P B If high amoxicillin allergy risk (*see page 98*): trimethoprim+ sulfamethoxazole P. Azithromycin may also work. Doxycycline P may work but unproven and formulation not convenient Decongestants, antihistamines, and oral corticosteroids are <u>not</u> beneficial for otitis media	Spontaneous resolution is common. Antibiotics overall cause harm more often than benefit Give antibiotics only if infant younger than 6 months, child younger than 2 years with bilateral infection, otorrhoea, immune-compromise, or systemic symptoms (pale, very irritable, lethargy – fever alone is not an indication for antibiotics) For most, educate and give paracetamol and antibiotic prescription to redeem or start taking only if symptoms persist at 48 to 72 hours or worsen *Note: in 2018 the American Academy of Pediatrics advised that doxycycline does not cause tooth staining and can be safely given for up to 21 days to children of any age*

P *Contra-indicated or caution in pregnancy; see pages 101 – 102*

B *Contra-indicated or caution when breastfeeding; see pages 101 – 102*

INFECTION	FIRST CHOICE	ALTERNATIVES	COMMENTS
Otitis media Chronic suppurative, with or without grommets	Locorten-Vioform 2 to 3 drops 2 times daily	Ciprofloxacin P B plus hydrocortisone ear drops	Dry aural toilet in all. If perforation < 6 weeks treat with oral antibiotics (*see Otitis media – Acute*) and topical steroid/ antibiotic; if perforation > 6 weeks give topical only. If prolonged, refer to ENT Specialist
Parotitis	*See Salivary gland infections*		
Pelvic inflammatory disease (PID) PID refers to infections of the upper female genital tract, including endometritis, chorioamnionitis, salpingitis, tubo-ovarian abscess, and pelvic cellulitis and peritonitis	**Mild:** trimethoprim+ sulfamethoxazole P plus metronidazole B orally **Severe:** ceftriaxone plus metronidazole B In addition to the above treatment, and whether likely sexually acquired or not, test patient for sexually transmitted pathogens and consider empirical treatment for STI (*see page 48*), such as doxycycline P or azithromycin, and at least one dose of ceftriaxone	**Mild:** amoxicillin+ clavulanate. If failing, amoxicillin+ clavulanate plus ciprofloxacin P B **Severe:** amoxicillin plus gentamicin plus metronidazole B, or gentamicin plus clindamycin *See comment in first-choice column regarding additional STI management*	It is difficult to distinguish between those cases caused by sexually acquired pathogens (*Chlamydia trachomatis*, *Neisseria gonorrhoeae* or *Mycoplasma genitalium*) and those caused by vaginal flora (anaerobes, streptococci, enteric gram- negative bacilli, or *Mycoplasma hominis*) Non-sexually transmitted PID occurs after pregnancy termination, vaginal delivery, pelvic procedures (including hysterectomy, caesarean section) or IUCD insertion Giving IM ceftriaxone without lidocaine is painful. If using ceftriaxone for IM injection, dilute 1.75 mL of lidocaine 2% with 1.75 mL of water for injection, then use this 3.5 mL solution to reconstitute a ceftriaxone 1g vial for IM use. Administer 2 mL of the reconstituted solution for 0.5 g dose and 4 mL for a 1 g dose If using gentamicin, replace after 48 to 72 hours. *See pages 88 and 89 for gentamicin dosing advice* Puerperal fever, chlamydia and gonorrhoea are **notifiable**
Perianal abscess	*See Abdomen*		
Perinephric abscess Renal abscess, kidney abscess	Ceftriaxone If suspect caused by *Staphylococcus aureus* bacteraemia, use cefazolin plus ciprofloxacin P B	Metronidazole B plus either ciprofloxacin P B or gentamicin If suspect caused by *Staphylococcus aureus* bacteraemia, use vancomycin plus clindamycin	Collect blood and urine for culture Drain abscesses over 3 cm and send pus for culture If use gentamicin, replace after 48 to 72 hours. *See pages 88 and 89 for gentamicin dosing advice*

P *Contra-indicated or caution in pregnancy; see pages 101 – 102*

B *Contra-indicated or caution when breastfeeding; see pages 101 – 102*

INFECTION	FIRST CHOICE	ALTERNATIVES	COMMENTS
Peritonitis	*See Abdomen, Spontaneous bacterial peritonitis*		
Pertussis	*See Whooping cough*		
Pharyngitis / Tonsillitis *See also Mouth, para-pharyngeal and deep neck infections*	For empiric treatment of Group A streptococcus (GAS) infection to prevent rheumatic fever: Amoxicillin 50 mg/kg (up to 1000 mg) once daily orally for 10 days (not if suspect EBV infection), or Penicillin V 500 mg (child: 15 mg/kg up to 500 mg) orally 2 times daily for 10 days, or Benzathine penicillin G IM single dose (expensive!): child 6 to 10 kg 337.5 mg (0.45 MU), 10 to 20 kg 450 mg (0.6 MU), > 20 kg or adult 900 mg (1.2 MU). Consider mixing with 0.25 mL lidocaine 2% Consider stopping antibiotics if swab negative and low clinical suspicion of GAS infection	Cefalexin 1 g (child: 25 mg/kg up to 1 g) orally, 2 times daily for 10 days, or Azithromycin 500 mg (child 12 mg/kg up to 500 mg) orally, daily for 5 days Consider adding oral corticosteroids if symptoms very severe (e.g., swallowing, drooling)	GAS pharyngitis cannot reliably be clinically distinguished from viral pharyngitis. GAS infection is more likely if there is rigors or fever, tender cervical adenitis, tonsillar exudates, and age 3 to 14 years. Viral infections are more likely if there is cough, hoarse voice, conjunctivitis, nasal congestion, anterior stomatitis, viral skin rash or diarrhoea Consider also EBV or HSV infection Swab throat and give antibiotics for GAS if: • Pacific or Maori person aged 3 to 40 years • Past personal, close family or household history of rheumatic fever or rheumatic heart disease (treat at any age) • Scarlet fever. **Notifiable**
Pleural space infection / Empyema Complicating community-acquired pneumonia	**Mild:** amoxicillin+ clavulanate. If failing, amoxicillin+clavulanate plus either trimethoprim+ sulfamethoxazole (P) or ciprofloxacin (P) (B) **Severe:** Ceftriaxone +/- either metronidazole (B), clindamycin or vancomycin	**Mild:** clindamycin. If failing, clindamycin plus ciprofloxacin (P) (B) **Severe:** clindamycin plus ciprofloxacin (P) (B)	Treat for 3 to 6 weeks Drain empyema (gross purulence) and most complicated parapneumonic effusions (pleural fluid pH < 7.2, LDH > 1000, glucose < 2.2 or < 25% serum glucose, >30,000 WC/mm3, culture or Gram-stain positive) Consider TB
Pleural space infection/ Empyema Hospital-onset or post-trauma	Cover any recent *Staphylococcus aureus* isolates **Mild:** amoxicillin+clavulanate plus ciprofloxacin (P) (B) **Severe:** ceftriaxone plus vancomycin, or amoxicillin+clavulanate plus either ciprofloxacin (P) (B) or gentamicin	**Mild:** ciprofloxacin (P) (B) plus either clindamycin, cefalexin or doxycycline (P). Or trimethoprim+ sulfamethoxazole (P) plus metronidazole (B) orally **Severe:** ciprofloxacin (P) (B) plus either cefazolin or clindamycin	If use gentamicin, replace after 48 to 72 hours. *See pages 88 and 89 for gentamicin dosing advice*

(P) *Contra-indicated or caution in pregnancy; see pages 101 – 102*

(B) *Contra-indicated or caution when breastfeeding; see pages 101 – 102*

INFECTION	FIRST CHOICE	ALTERNATIVES	COMMENTS
Pneumonia Adult, aspiration	**Mild:** trimethoprim+ sulfamethoxazole (P) plus either metronidazole (B) or amoxicillin, all orally. If failing, amoxicillin plus ciprofloxacin (P) (B) **Severe:** ceftriaxone. If failing, add ciprofloxacin (P) (B), or switch to meropenem[RESTRICTED] alone	Ciprofloxacin (P) (B) plus clindamycin	In most patients after an aspiration event, no antibiotic is needed. A chemical pneumonitis may develop within hours of the aspiration event – this does not require antibiotic treatment and generally improves within 24 to 48 hours. Antibiotics are indicated for patients with a delayed onset of pneumonia features
Pneumonia Adult, community-acquired	**Mild/outpatient:** amoxicillin 1 g orally 3 times daily. If failing, amoxicillin plus either doxycycline (P) or a macrolide (azithromycin or roxithromycin). If still failing, amoxicillin plus ciprofloxacin (P) (B) **Moderate/inpatient:** penicillin 1.2 g IV 6-hourly or amoxicillin (IV or orally), plus doxycycline (P) 200 mg daily. If unable to tolerate doxycycline (P), give penicillin or amoxicillin plus a macrolide (azithromycin, roxithromycin or erythromycin) **Severe:** ceftriaxone plus azithromycin Substitute meropenem[RESTRICTED] for ceftriaxone if failing, immune-compromised, *Pseudomonas aeruginosa* in sputum, or recent known multi-drug-resistant gram-negative rod (GNR)	**Mild/outpatient:** doxycycline (P), trimethoprim+ sulfamethoxazole (P), or a macrolide (azithromycin or roxithromycin). If failing, ciprofloxacin (P) (B) plus clindamycin **Moderate-severe/ inpatient:** ceftriaxone plus either doxycycline (P) or azithromycin. Or clindamycin plus ciprofloxacin (P) (B)	90 to 95% of patients with acute cough do not benefit from antibiotics, even if purulent sputum. Shortness of breath, fever, rapid pulse or breathing, chest crackles or dullness and raised CRP predict benefit from antibiotics If multi-focal, cavitary or pneumatocoeles (suspect *S. aureus*) and known MRSA+ then cover MRSA until culture results known. Consider TB Treat for 5 to 7 days – longer if severe, slow response, empyema, lung abscess (4 to 6 weeks), *S. aureus* infection (3 to 4 weeks), enteric gram-negative bacillus infection (3 to 6 weeks)

(P) *Contra-indicated or caution in pregnancy; see pages 101 – 102*

(B) *Contra-indicated or caution when breastfeeding; see pages 101 – 102*

INFECTION	FIRST CHOICE	ALTERNATIVES	COMMENTS
Pneumonia Adult, hospital-acquired	Cover any recent *Staphylococcus aureus* isolate **Mild:** ciprofloxacin P B plus amoxicillin+clavulanate **Severe:** ceftriaxone, or amoxicillin+clavulanate IV, plus either ciprofloxacin P B or gentamicin	**Mild:** ciprofloxacin P B plus either trimethoprim+ sulfamethoxazole P, doxycycline P or clindamycin. Or amoxicillin+ clavulanate plus either trimethoprim+ sulfamethoxazole P or doxycycline P **Severe:** ciprofloxacin P B plus either clindamycin or vancomycin	If use gentamicin, replace after 48 to 72 hours. *See pages 88 and 89 for gentamicin dosing advice*
Pneumonia Child < 1 month	*See Neonatal sepsis*		
Pneumonia Child > 1 month	**Mild:** amoxicillin. If moderately severe, consider adding either doxycycline P or a macrolide (azithromycin, roxithromycin or erythromycin). If failing, amoxicillin plus ciprofloxacin P B **Severe:** penicillin IV plus doxycycline P. Or ceftriaxone +/- either doxycycline P or azithromycin. If failing, amoxicillin plus ciprofloxacin P B	**Mild:** a macrolide or doxycycline P **If failing or severe:** ciprofloxacin P B plus either clindamycin or vancomycin	In all age groups, most pneumonia is viral; only 25% to 60% is caused by bacteria. Consider antibiotics if the child looks very sick, is short of breath, or has chest auscultation or x-ray signs of pneumonia *Note: in 2018 the American Academy of Pediatrics advised that doxycycline does not cause tooth staining and can be safely given for up to 21 days to children of any age*
Prostate Sepsis after transrectal ultra-sound (TRUS)-guided prostate biopsy	Meropenem RESTRICTED	Gentamicin plus either ciprofloxacin P B or ceftazidime RESTRICTED	Take 2 sets of blood cultures Consider prostate ultrasound to identify abscess if failing to settle If use gentamicin, replace after 48 to 72 hours. *See pages 88 and 89 for gentamicin dosing advice*
Prostatitis Acute	**Mild:** trimethoprim+ sulfamethoxazole P. If failing, ciprofloxacin P B **Severe:** ciprofloxacin P B alone, or amoxicillin plus gentamicin	Ceftriaxone. If failing, meropenem RESTRICTED	Check and treat for sexually-acquired pathogens if < 35 years or sexually active Treat for 2 to 4 weeks depending on severity and response If use gentamicin, replace after 48 to 72 hours. *See pages 88 and 89 for gentamicin dosing advice*

P *Contra-indicated or caution in pregnancy; see pages 101 – 102*

B *Contra-indicated or caution when breastfeeding; see pages 101 – 102*

INFECTION	FIRST CHOICE	ALTERNATIVES	COMMENTS
Prostatitis Chronic bacterial	Ciprofloxacin P B 500 mg orally 2 times daily for 4 weeks	Trimethoprim P 300 mg orally daily for 4 weeks, or trimethoprim+ sulfamethoxazole P 160+800 orally 2 times daily for 4 weeks	90 to 95% of chronic prostate pain is not due to infection and has no proven treatment – avoid repeated courses of empiric antibiotics. Test urine and expressed prostatic secretions and treat if positive. Consider sexually-acquired pathogens
***Pseudomonas aeruginosa* infection**	**Mild:** ciprofloxacin P B **Moderate to severe:** ceftazidime RESTRICTED	If ceftazidime-resistant, use meropenem RESTRICTED If bladder infection, doxycycline P may be effective (despite resistance by laboratory testing)	Avoid IV gentamicin – worse outcome as single therapy and no benefit in combination, except infective flares of bronchiectasis. For *P. aeruginosa* flare of bronchiectasis consider adding gentamicin (nebulised or IV) (*see pages 88 and 89*) to ciprofloxacin P B or ceftazidime
Puerperal fever	*See Mastitis – lactating, Pelvic inflammatory disease, or* Streptococcus pyogenes *infection*		
Pyelonephritis	*See UTI – Pyelonephritis*		
Pyomyositis	Cover any recent *Staphylococcus aureus* isolates Cefazolin. If failing, vancomycin plus ceftriaxone	Vancomycin, or clindamycin	
Quinsy	*See Mouth, para-pharyngeal and deep neck infections*		
Renal abscess	*See Perinephric abscess*		
Ringworm	*See Dermatophytoses*		
Salivary gland infection Acute bacterial / suppurative	Cover any recent *Staphylococcus aureus* isolates **Mild:** cefalexin, or amoxicillin+clavulanate. If failing, amoxicillin+ clavulanate plus either doxycycline P, trimethoprim+ sulfamethoxazole P or ciprofloxacin P B **Severe:** ceftriaxone. If failing, add vancomycin, or use meropenem RESTRICTED alone	**Mild:** trimethoprim+ sulfamethoxazole P plus metronidazole B, doxycycline P plus metronidazole B orally, or clindamycin alone **Severe:** cefazolin plus metronidazole B, or clindamycin alone. If failing, ciprofloxacin P B plus clindamycin	Culture pus if draining from salivary gland duct

P *Contra-indicated or caution in pregnancy; see pages 101 – 102*

B *Contra-indicated or caution when breastfeeding; see pages 101 – 102*

INFECTION	FIRST CHOICE	ALTERNATIVES	COMMENTS
Salmonella gastroenteritis	Nil. Antibiotics are of no benefit in mild or moderate illness. Treat with antibiotics only in high-risk groups (*see comments*)	If antibiotic therapy indicated, use azithromycin 1 g (child: 20 mg/kg up to 1 g) orally on the first day then 500 mg (child: 10 mg/kg up to 500 mg) orally daily for a further 4 to 6 days. If susceptible, alternatives are ciprofloxacin P B 500 mg (child 12.5 mg/kg up to 500 mg) orally 2 times daily for 5 to 7 days, or trimethoprim+ sulfamethoxazole P 160+800 mg 2 times daily for 10 to 14 days If oral therapy not feasible and for bacteraemia or child < 3 months: ceftriaxone IV	Treat if neonate or child < 3 months, person of any age with severe illness, bacteraemia, prosthetic vascular graft or immune-compromise. Consider treatment if prosthetic joint Treat for 14 days if immune-compromised **Notifiable**
Salpingitis	*See Pelvic inflammatory disease*		
Sepsis Unknown source in adult *See also Immune-compromise and sepsis – page 30*	Gentamicin plus flucloxacillin Add ceftriaxone or ciprofloxacin P B if suspect meningitis Add metronidazole B if suspect intra-abdominal or pelvic infection If failing or hospital-acquired, meropenem[RESTRICTED] plus vancomycin	If ceftriaxone-resistant gram-negative bacilli in past, meropenem[RESTRICTED] If unable to tolerate gentamicin (e.g., acute kidney injury), replace gentamicin with ciprofloxacin P B Replace flucloxacillin with cefazolin or vancomycin if high allergy risk (*see page 98*), or with vancomycin if high MRSA risk	Suspect if fever or hypothermia, rapid respiratory rate, respiratory distress, rapid heart rate, altered mental status, systolic hypotension, reduced urine output, low platelets, raised bilirubin or acute kidney injury If transporting to hospital and delay is likely to be greater than 30 minutes, then give ceftriaxone 100 mg/kg (up to 2 g) IV or IM single dose before or during transport If use gentamicin, replace after 48 to 72 hours. *See pages 88 and 89 for gentamicin dosing advice*

P *Contra-indicated or caution in pregnancy; see pages 101 – 102*

B *Contra-indicated or caution when breastfeeding; see pages 101 – 102*

INFECTION	FIRST CHOICE	ALTERNATIVES	COMMENTS
Sepsis Unknown source in child *If < 1 month see Neonatal sepsis*	Vancomycin plus ceftriaxone plus gentamicin If failing, meropenem[RESTRICTED] plus vancomycin	Vancomycin plus ciprofloxacin (P) (B) plus gentamicin Non-vancomycin regimens (if low MRSA and low-meningitis risk) include meropenem[RESTRICTED] alone, ceftriaxone plus metronidazole (B), or ciprofloxacin (P) (B) plus either cefazolin or clindamycin	If transporting to hospital and delay is likely to be greater than 30 minutes, then give ceftriaxone 100 mg/kg (up to 2 g) IV or IM single dose before or during transport If use gentamicin, replace after 48 to 72 hours. *See pages 88 and 89 for gentamicin dosing advice*
Shigella gastroenteritis	Wait for susceptibility test results, or give trimethoprim+ sulfamethoxazole (P) 160+800 mg (child 1 month or older: 4+20 mg/kg up to 160+800 mg) orally 2 times daily for 5 days If oral therapy not feasible, ceftriaxone IV	Ciprofloxacin (P) (B) 500 mg (child: 12.5 mg/kg up to 500 mg) orally 2 times daily for 5 days, or Azithromycin 500 mg (child: 10 mg/kg up to 500 mg) orally on day one then 250 mg (child 5 mg/kg up to 250 mg) orally daily for a further 4 days	Treatment is indicated for most cases for both clinical and public health reasons **Notifiable**
Shingles and chickenpox Varicella-zoster virus infection	Aciclovir 800 mg (child: 20 mg/kg up to 800 mg) orally 5 times a day for 7 days If immune-compromised (chickenpox, or trigeminal or multi-dermatome shingles), third trimester pregnancy, or VZV pneumonia give aciclovir IV initially (10 to 12.5 mg/kg (child 12 years or younger: 500 mg/m2) IV, 8-hourly)	Valaciclovir 1 g 3 times daily for 7 days	Treating shingles with antiviral medication is especially important in older adults, or if involvement of face or eye Treating chickenpox with antiviral medication is especially important in children with pre-existing lung or skin diseases (e.g., eczema) and in adults who are pregnant or immune-compromised If immune-competent, start aciclovir only if less than 72 hours after onset of rash If immune-compromised or herpes zoster ophthalmicus with active vesicles present, start aciclovir regardless of duration of rash If immune-compromised consider treating shingles for longer duration, until crusting of all lesions If bacterial super-infection of chickenpox or shingles, treat as for Cellulitis If acute shingles very painful or > 50 years old, consider prednisone (60 mg daily for 7 days then taper over 14 days) in addition to aciclovir. Caution in diabetes **Chickenpox is notifiable**

(P) *Contra-indicated or caution in pregnancy; see pages 101 – 102*

(B) *Contra-indicated or caution when breastfeeding; see pages 101 – 102*

INFECTION	FIRST CHOICE	ALTERNATIVES	COMMENTS
Sinusitis Acute	Analgesia (e.g., paracetamol, NSAIDs), saline irrigation, decongestant for 3 to 5 days, nasal steroid (especially if underlying allergic cause)	Cover any recent *Staphylococcus aureus* isolates **Mild:** doxycycline P. Alternatives: amoxicillin+ clavulanate, or trimethoprim+ sulfamethoxazole P +/- metronidazole B orally. If failing, amoxicillin plus ciprofloxacin P B **Severe:** ceftriaxone, or amoxicillin+ clavulanate IV. If high ceftriaxone or amoxicillin allergy risk (*see page 98*): ciprofloxacin P B plus clindamycin. If failing, ceftriaxone plus vancomycin, or meropenem[RESTRICTED] alone	Most cases are viral or resolve spontaneously within 2 weeks without antibiotics. Consider antibiotics if severe symptoms (high fever plus either purulent nasal discharge or facial pain), or symptoms persist for more than 7 to 10 days or worsen after initial improvement *Note: in 2018 the American Academy of Pediatrics advised that doxycycline does not cause tooth staining and can be safely given for up to 21 days to children of any age*
Skin infections in injection drug users	Cover any recent *Staphylococcus aureus* isolates **Mild:** amoxicillin+ clavulanate. If failing, add trimethoprim+ sulfamethoxazole P **Severe:** ceftriaxone, or cefazolin plus metronidazole B. If failing, ceftriaxone plus vancomycin	**Mild:** cefalexin, clindamycin, or both a macrolide (azithromycin or roxithromycin) plus metronidazole B orally **Severe:** clindamycin	Injection drug users, also known as IVDU or intravenous drug users, use a needle and syringe to inject drugs intravenously, intramuscularly or subcutaneously. Contaminated equipment or poor skin disinfection often leads to infection
Sore throat	*See Pharyngitis*		
Spontaneous bacterial peritonitis In patients with liver cirrhosis and ascites	**Mild:** amoxicillin plus trimethoprim+ sulfamethoxazole P. If failing amoxicillin plus ciprofloxacin P B **Severe:** ceftriaxone plus amoxicillin. If failing, vancomycin plus ciprofloxacin P B, or meropenem[RESTRICTED] alone	**Mild:** ciprofloxacin P B alone **Severe:** amoxicillin plus gentamicin	Inoculate peritoneal fluid directly into blood culture bottles. Ascitic fluid total white cell count of more than 0.5 x 109/L is diagnostic of spontaneous bacterial peritonitis Avoid gentamicin as high risk of nephrotoxicity in patients with cirrhosis and SBP. If use gentamicin, replace after 48 to 72 hours. *See pages 88 and 89 for gentamicin dosing advice*

P *Contra-indicated or caution in pregnancy; see pages 101 – 102*

B *Contra-indicated or caution when breastfeeding; see pages 101 – 102*

INFECTION	FIRST CHOICE	ALTERNATIVES	COMMENTS
Spinal infection	*See Bone – vertebral*		
Splenectomy	*See Immune-compromise and Sepsis*		
Staphylococcus aureus Including MRSA	**Flucloxacillin-susceptible:** Depending on dose, cefazolin, flucloxacillin, cefalexin and amoxicillin+ clavulanate are the most potent **Flucloxacillin-resistant (MRSA):** See alternative comment for first-choice oral antibiotics. Vancomycin is most potent and should be used if severe sepsis, endocarditis, meningitis, brain abscess or neutropenic sepsis	Trimethoprim+ sulfamethoxazole (P), doxycycline (P), clindamycin, and macrolides (azithromycin, roxithromycin or erythromycin) are effective when the laboratory reports the isolate is susceptible	Drain any pus Add rifampicin 300 mg orally 2 times daily for metalware infections (e.g., orthopaedic internal fixation) if susceptible (ask laboratory to test). Beware of drug interactions with rifampicin. Never use rifampicin alone *For* Staphylococcus aureus *bloodstream infection, see below* *For high-dose oral regimens, see page 94* If laboratory reports *Staphylococcus lugdunensis*, treat the same as *S. aureus*
***Staphylococcus aureus* bacteraemia** Bloodstream infection	Cefazolin 2 g IV 8-hourly or flucloxacillin 2 g IV 4-hourly Do not add gentamicin. Add rifampicin if prosthetic valve endocarditis and if rifampicin susceptible (ask lab to test). Beware of drug interactions with rifampicin	If patient has high allergy risk that precludes using cefazolin or flucloxacillin (*see page 98*): vancomycin If MRSA: vancomycin (especially if suspect endocarditis, meningitis, brain abscess or neutropenia)	Remove or replace all IV catheters present during bloodstream infection Echocardiogram (if available) and repeat blood culture 48 to 72 hours after starting IV antibiotics in all patients. Look for source and metastatic infection (30%), especially joint or bone. 10 – 20% have endocarditis. Predictors of endocarditis include underlying cardiac conditions (previous endocarditis, prosthetic valve, pacemaker, pre-existing native valve disease), community-acquired, IV drug user, cerebral or peripheral emboli, meningitis, and persistent positive blood culture despite 48 to 72 hours of antibiotics Can switch from IV to oral antibiotic at 7 days if no evidence of endocarditis or deep metastatic infection, no prosthetic valve, fever settled and 72-hour blood cultures negative. See *VIRSTA score* (*see references*) See individual infection type (e.g., joint infection) for advice on antibiotic duration. See also sections on intravenous to oral switching (*page 92*), high-dose oral antibiotics in adults (*page 94*) and probenecid (*page 95*) to help choose the best ongoing antibiotic regimen

(P) *Contra-indicated or caution in pregnancy; see pages 101 – 102*

INFECTION	FIRST CHOICE	ALTERNATIVES	COMMENTS
STI (Sexually transmitted infection)	*See Chlamydia, Gonorrhoea, Herpes Simplex, Syphilis or Trichomoniasis*		
***Streptococcus anginosis* group**	Penicillin or amoxicillin	Ceftriaxone, or vancomycin	Clindamycin, doxycycline (P) and trimethoprim+ sulfamethoxazole (P) efficacy uncertain and difficult to predict
Streptococcus pyogenes infection Group A streptococci Guidelines also apply to Group B streptococci (*S. agalactiae*) and Group C and G streptococci (*Streptococcus dysgalactiae* subsp. *equisimilis*)	Penicillin or amoxicillin Flucloxacillin also highly active for Group A, C and G streptococci but not reliable for Group B streptococci For severe Group B streptococcal infections, consider adding low-dose gentamicin for synergy For severe Group A streptococcal infections, consider adding clindamycin for synergy	Cefazolin, cefalexin, or ceftriaxone Macrolides (azithromycin, roxithromycin or erythromycin) or clindamycin – if susceptible Always susceptible to vancomycin Trimethoprim+ sulfamethoxazole (P) or doxycycline (P) may be active but should not be used for strep throat	Puerperal fever, scarlet fever and rheumatic fever are **notifiable** *For strep throat, see Pharyngitis. Only some antibiotics can eradicate Group A streptococci from the throat which is required to prevent rheumatic fever*
Syphilis Primary, secondary or latent < 2 years duration	Benzathine benzylpenicillin G 1.8 g (2.4 MU) IM single dose	Ceftriaxone 1 g IV or IM daily for 10 to 14 days Non-pregnant: doxycycline (P) 100 mg 2 times daily for 14 days	The efficacy of ceftriaxone is uncertain If high penicillin allergy risk (*see page 98*), attempt to desensitise (*see page 100*) then give a penicillin Consider mixing benzathine benzylpenicillin and ceftriaxone with 1 or 2% lidocaine for IM administration Azithromycin resistance is now widespread, and this antibiotic is no longer recommended **Notifiable**
Syphilis Latent > 2 years or unknown duration	Benzathine benzylpenicillin G 1.8 g (2.4 MU) IM, once weekly for 3 weeks	Non-pregnant: doxycycline (P) 100 mg orally 2 times daily for 28 days	Do lumbar puncture to test for neurosyphilis if neurologic symptoms, treatment failure, HIV infection, or eye or ear involvement If high penicillin allergy risk (*see page 98*), attempt to desensitise (*see page 100*) then give a penicillin Consider mixing benzathine benzylpenicillin with 1 or 2% lidocaine for IM administration **Notifiable**

(P) *Contra-indicated or caution in pregnancy; see pages 101 – 102*

INFECTION	FIRST CHOICE	ALTERNATIVES	COMMENTS
Syphilis Tertiary > 2 years or unknown duration with cardiovascular, CNS, or skin and bone (gummatous) disease	Benzylpenicillin 1.8 to 2.4 g (3 to 4 MU) IV 4-hourly for 15 days	Desensitise (*see page 100*) if high penicillin allergy risk (*see page 98*) Ceftriaxone 1 to 2 g IV or IM daily for 10 to 14 days	For cardiovascular syphilis or neurosyphilis, consider adding prednisone 30 to 60 mg orally daily for 3 doses with penicillin to reduce the risk of a Jarisch-Herxheimer reaction
Syphilis In pregnancy	Use same penicillin regimens for mother as for non-pregnant patients (see above). Risk to fetus is low if mother and her sexual partner are adequately and simultaneously treated 4 weeks or longer before delivery		Do not use doxycycline (P) or azithromycin Do fetal ultrasound after 20 weeks gestation. Warn mother than treatment might precipitate premature labour Seek expert advice on assessment and treatment of neonates born to mothers with syphilis **Notifiable**
Testes	*See Epididymo-orchitis*		
Throat	*See Pharyngitis/tonsilitis*		
Thrush	*See Candida*		
Tinea versicolor Also known as pityriasis versicolor or 'white spots' Caused by *Malassesia furfur* or *Pityrosporum orbiculare* *See also Dermatophytoses*	Selsun shampoo (selenium sulphide) 2.5% lotion or shampoo. Apply to wet skin and leave on for at least 10 minutes or overnight, once daily for 7 to 10 days	Miconazole 2% shampoo, apply once daily for 10 minutes then wash off, for 10 days Ketoconazole 1 to 2 % shampoo, apply once daily for 5 minutes then wash off, for 5 days If does not respond to topical therapy: fluconazole (P) 400 mg orally single dose	If extensive disease, can give a second dose of fluconazole (P) 400 mg after 7 days. Itraconazole (P) (B) 400 mg orally as a single dose or 200 mg daily for 7 days is also effective
Tonsillitis	*See Pharyngitis/tonsillitis*		
Tooth abscess *If severe, spread to neck, or airways compromise, see Mouth, para-pharyngeal and deep neck infections*	If localised infection and surgically managed, no antibiotic is required **Mild:** amoxicillin. If failing, add metronidazole (B) or switch to amoxicillin+ clavulanate alone **Severe:** penicillin or amoxicillin IV, plus metronidazole (B) orally. Or amoxicillin+clavulanate alone	**Mild:** clindamycin **Severe:** ceftriaxone alone, cefazolin plus metronidazole (B), or clindamycin alone	Antibiotic treatment is only indicated if there is likely to be a delay in receiving surgical dental treatment or there is face swelling, systemic symptoms, or fever

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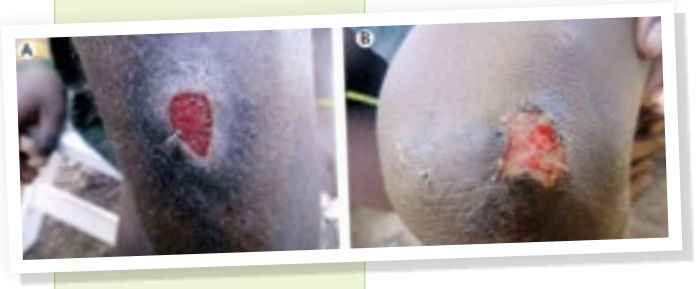
(B) *Contra-indicated or caution when breastfeeding; see pages 101 – 102*

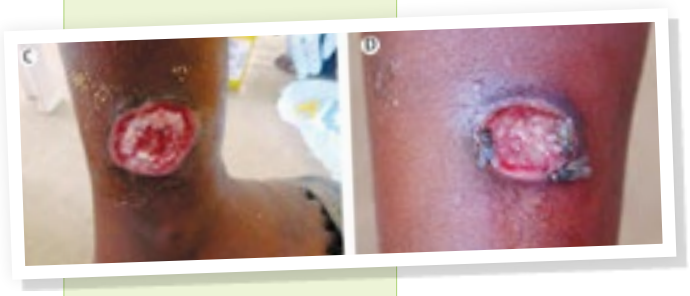
INFECTION	FIRST CHOICE	ALTERNATIVES	COMMENTS
Trichomoniasis	Metronidazole B 2 g orally single dose	If relapse, metronidazole B 400 mg orally 2 times daily for 5 to 7 days	Treat partners, even if asymptomatic **Notifiable**
Typhoid (Proven, highly likely or on the advice of the Public Health doctor)	Azithromycin 1 g (child: 20 mg/kg up to 1 g) orally daily for 5 days, or Ciprofloxacin P B 500 to 750 mg (child 20 mg/kg up to 500 mg) orally 2 times daily for 5 to 7 days **Severe:** ceftriaxone 2 g daily IV	Ceftriaxone, IV amoxicillin, oral amoxicillin for 14 days, or oral trimethoprim+ sulfamethoxazole P 4+20 mg/kg up to 160+800 mg orally 2 times daily for 10 to 14 days	Use higher dose of ciprofloxacin P B if severe infection (until improved) or weight > 120 kg (for first 2 days). Use lower dose of ciprofloxacin P B if renal impairment If severe, consider dexamethasone 3 mg/ kg IV just before first dose of antibiotic then 1 mg/kg 4 times daily for 2 days. A once daily dose regimen of dexamethasone, or oral corticosteroids (e.g., prednisone) may work equally well Perform CSF analysis in all neonates and children < 3 months to exclude neurological disease; in this age group, treat IV for 10 days **Notifiable**
Ulcers Chronic foot, leg, pressure, vascular, diabetic	*See Diabetic foot sepsis*		
Ulcers *Haemophilus ducreyi*	Azithromycin 1 g (child: 20 mg/kg up to 1 g) orally as a single dose	Ceftriaxone 500 mg (child > 1 month: 50 mg/kg up to 1 g) IV (or IM in 1 or 2% lidocaine) as a single dose, or ciprofloxacin P B 500 mg (child: 12.5 mg/kg up to 500 mg) orally 2 times daily for 3 days A single dose of IM penicillin (dose as for streptococcal pharyngitis) may also be effective	If using ceftriaxone for IM injection, dilute 1.75 mL of lidocaine 2% with 1.75 mL of water for injection, then use this 3.5 mL solution to reconstitute a ceftriaxone 1g vial for IM use. Administer 2 mL of the reconstituted solution for 0.5 g dose and 4 mL for a 1 g dose Persistent, tender, shallow leg ulcers in children. Found recently in Fiji, Samoa, Vanuatu, PNG and Solomon Islands. Usually a clinical diagnosis. Laboratory testing is not currently available in the Rarotonga laboratory *Images from Lancet Glob Health 2014; 2: e235-41*



P *Contra-indicated or caution in pregnancy; see pages 101 – 102*

B *Contra-indicated or caution when breastfeeding; see pages 101 – 102*

INFECTION	FIRST CHOICE	ALTERNATIVES	COMMENTS
Ulcers Yaws, *Treponema pallidum* subsp. *pertenue*	Benzathine penicillin G IM single dose: child < 10 years 450 mg (0.6 MU), 10 years of older 900 mg (1.2 MU). Consider mixing with 0.25 mL lidocaine 1 or 2%	Azithromycin 2 g (child: 30 mg/kg up to 2 g) orally as a single dose, or Doxycycline (P) 100 mg orally 2 times daily for 15 days	Persistent, circular, deep ulcers with moist granulation and indurated edges, mostly on legs and in children. Can be multiple. Found recently in Solomon Islands, PNG, and Vanuatu. Usually a clinical diagnosis. Can test syphilis serology *Note: in 2018 the American Academy of Pediatrics advised that doxycycline does not cause tooth staining and can be safely given for up to 21 days to children of any age* *Images from Lancet Glob Health 2014; 2: e235-41*
Urethral discharge	If syndromic STI management only, treat for *Chlamydia trachomatis* and gonorrhoea (WHO 2021)		
Urinary tract infection *Candida* sp.	Fluconazole (P) 200 mg (child: 3 mg/kg up to 200 mg) orally daily for 14 days and ideally change or remove urinary catheter or stent	If pyelonephritis or neutropenic, use fluconazole (P) 400 mg (child 6 mg/kg up to 400 mg) orally daily for 14 days and consider candidaemia (which requires additional treatment)	Frequently a contaminant or meaningless coloniser, especially with indwelling catheter. Treat if symptomatic, neutropenic, imminent urological manipulation or infant of low birth weight Some *Candida* species and strains are resistant to fluconazole (P). Seek expert advice
Urinary tract infection Cystitis in adult men	As for cystitis in women, but recommended duration of treatment with nitrofurantoin, cefalexin, trimethoprim, or trimethoprim+ sulfamethoxazole is 7 days for men	As for cystitis in women, but recommended duration of course of ciprofloxacin (P) (B) treatment would is 5 to 7 days for men	Culture urine before starting treatment Often underlying urinary tract abnormality or co-existent prostatitis or epididymitis. Investigate males with UTI for underlying anatomical or functional abnormality *If suspect acute prostatitis (pain, tenderness, early relapse of UTI), see Prostatitis*



(P) *Contra-indicated or caution in pregnancy; see pages 101 – 102*

INFECTION	FIRST CHOICE	ALTERNATIVES	COMMENTS
Urinary tract infection Cystitis in adult women *See also recurrent UTI (page 59)*	Nitrofurantoin (P) 50 mg 4 times daily (or 100 mg 3 times daily) for 5 days (not if GFR < 40 mL/min), or Cefalexin 500 mg 2 times daily for 5 days, or Trimethoprim (P) 300 mg orally daily for 3 days	Ciprofloxacin (P) (B) 500 mg orally 2 times daily for 3 days if proven or suspected resistance to first-line antibiotics Nitrofurantoin is also available in a modified-release formulation. If this is used, the dose is 100 mg 2 times daily for 5 days	2 times daily cefalexin dosing is appropriate for cystitis, not other infections Culture urine before starting treatment if pregnant, very elderly, recent antibiotics, recurrent infection, previous resistant bacteria in urine, other complicating illnesses or recent travel to Asia, Africa, Middle East or Southern Europe Asymptomatic bacteriuria common and usually harmless in women, especially elderly; treat only if pregnant or before urological procedure In pregnancy, test urine then treat for 7 days with cefalexin or nitrofurantoin (P). Repeat urine culture 1 to 2 weeks after treatment and at subsequent ante-natal checks to confirm cure *Staphylococcus aureus* in the urine often indicates non-urine source (e.g., bone, joint, skin and soft tissues)
Urinary tract infection Cystitis, child	Nitrofurantoin 1.5 mg/kg up to 50 mg orally 4 times daily (or 100 mg 3 times daily) for 3 days (7 days in moderate to severe infection) Trimethoprim+ sulfamethoxazole (P) 4+20 mg/kg up to 160+800 mg 2 times daily for 3 days, or Cefalexin 12.5 mg/ kg up to 500 mg orally 4 times daily for 3 days, or Trimethoprim (P) 4 mg/kg up to 150 mg orally, 2 times daily for 3 days If recent resistant isolate or failed first- line antibiotics, use ciprofloxacin (P) (B) (*see alternatives*)	If susceptible bacteria isolated, you may use amoxicillin+ clavulanate 15 mg/kg up to 500+125 mg 3 times daily for 3 days If bacteria resistant to all the above antibiotics or *Pseudomonas aeruginosa*, use ciprofloxacin (P) (B) 12.5 mg/ kg up to 500 mg orally, 2 times daily for 3 days	Always try to culture urine before starting treatment. Do not treat asymptomatic bacteriuria in infants or children Treat as pyelonephritis if fever or loin pain or tenderness. If age <1 month, treat with IV antibiotic (*see UTI – pyelonephritis, child*). Consider admission to hospital if age < 3 to 6 months If recurrent UTI, consider prophylactic antibiotics and urinary tract imaging

(P) *Contra-indicated or caution in pregnancy; see pages 101 – 102*

(B) *Contra-indicated or caution when breastfeeding; see pages 101 – 102*

INFECTION	FIRST CHOICE	ALTERNATIVES	COMMENTS
Urinary tract infection Indwelling catheter	Nil unless symptomatic Wait for culture results before prescribing unless patient moderately ill. Recent culture results may be helpful	Cefalexin, nitrofurantoin (P) or trimethoprim+ sulfamethoxazole (P) if the patient can't wait for results of culture Doxycycline (P) may cure *Pseudomonas aeruginosa* cystitis, despite in-vitro resistance Ideally, change the indwelling urinary catheter during the antibiotic treatment	Asymptomatic bacteriuria and pyuria are common and should not be treated. Cloudy or smelly urine are not reliable signs of urine infection Culture urine +/- treat only if: • Symptoms (fever, rigors, mental status changes without other explanation, flank pain or tenderness, acute haematuria, pelvic discomfort), or • Imminent surgery involving urinary tract. Ideally, culture urine by removing the indwelling catheter then obtaining a mid-stream urine sample or replacing the catheter and collecting a sample through the new catheter. Do not collect urine from the drainage bag for culture
Urinary tract infection Pyelonephritis, adult	**Mild (low fever, no tachycardia or hypotension, and no nausea or vomiting):** ciprofloxacin (P) (B) 500 mg orally 2 times daily for 7 days **Severe:** gentamicin plus amoxicillin 2 g IV 6-hourly	**Mild:** if susceptible: trimethoprim+ sulfamethoxazole (P) 160+800 mg orally 2 times daily for 10 to 14 days **Severe:** ceftriaxone alone, or gentamicin alone	Culture urine before starting treatment Switch to oral treatment when responded. Duration (IV + oral) of treatment usually 10 to 14 days but may be up to 21 days if delayed response If pregnant, repeat urine culture 1 to 2 weeks after treatment to confirm cure, then repeat urine culture at subsequent ante-natal checks Ultrasound if recurrent pyelonephritis, slow response or *Proteus mirabilis* infection *Staphylococcus aureus* in the urine often indicates non-urine source (e.g., bone, joint, skin and soft tissues) If use gentamicin, replace after 48 to 72 hours. *See pages 88 and 89 for gentamicin dosing advice*

(P) *Contra-indicated or caution in pregnancy; see pages 101 – 102*

(B) *Contra-indicated or caution when breastfeeding; see pages 101 – 102*

INFECTION	FIRST CHOICE	ALTERNATIVES	COMMENTS
Urinary tract infection Pyelonephritis, child	**Mild (no tachycardia or hypotension, and no nausea or vomiting):** ciprofloxacin P B 12.5 mg/ kg up to 500 mg orally, 2 times daily for 10 days **Severe:** ceftriaxone 50 mg/ kg up to 1 g IV daily. Add gentamicin if not responding	**Mild:** trimethoprim+ sulfamethoxazole P 4+20 mg/kg up to 160+800 mg orally, 2 times daily for 7 to 10 days **Severe:** amoxicillin plus gentamicin	Critically ill children may need higher doses Cover ceftriaxone-resistant gram-negative bacilli if urine infection with those bacteria in past Switch to oral treatment when responded. Total duration of treatment (IV + oral) for acute pyelonephritis is 7 to 10 days Consider antibiotic prophylaxis for 6 months in infants or children with severe or recurrent UTI. Consider urinary tract imaging in infants and children with urinary tract infection, especially if severe, recurrent or atypical *Staphylococcus aureus* in the urine often indicates non-urine source (e.g., bone, joint, skin and soft tissues) If use gentamicin, replace after 48 to 72 hours. *See pages 88 and 89 for gentamicin dosing advice*
Vaginal discharge	If syndromic STI management only, treat for *Chlamydia trachomatis*, gonorrhoea, bacterial vaginosis, trichomoniasis, and, in clinically suggestive cases, candida infection (WHO 2021)		
Vaginosis Bacterial	Metronidazole B 400 mg orally 2 times daily for 5 days	Metronidazole B 2 g orally single dose (if fails, use 7-day regimen), or clindamycin 300 mg orally 2 times daily for 7 days	Avoiding sex or using condoms increases cure rate. Treating sexual partners is not required Group B streptococcal pyogenic vulvovaginitis is rare but if suggested by microscopy and culture, treat with penicillin or amoxicillin
Vascular graft infection	Cover any recent *Staphylococcus aureus* isolates Ceftriaxone plus vancomycin	Ciprofloxacin P B plus either clindamycin or vancomycin	Take blood cultures. Involve a surgeon as soon as possible to consider debridement, drainage and obtaining deep tissue or pus samples to determine microbial cause. Most patients require life-long antibiotic suppression

P *Contra-indicated or caution in pregnancy; see pages 101 – 102*

B *Contra-indicated or caution when breastfeeding; see pages 101 – 102*

INFECTION	FIRST CHOICE	ALTERNATIVES	COMMENTS
Whooping cough Bordetella pertussis	Azithromycin. Adult: 500 mg orally day 1 then 250 mg orally daily for 4 days. Child over 6 months: 10 mg/kg/day up to 500 mg orally day 1 then 5 mg/kg/day up to 250 mg orally daily for 4 days. Neonate and child younger than 6 months: 10 mg/kg orally, daily for 5 days	Trimethoprim+ sulfamethoxazole (P) 160+800 mg (child > 1 month: 4+20 mg/kg up to 160+800) 2 times daily for 7 days For children > 1 month of age, erythromycin ethylsuccinate 10 mg/kg (up to 400 mg) 4 times daily for 14 days	Treatment after paroxysmal cough phase (approximately 21 days) has no effect on illness or infectivity **Notifiable**
Wound infection After trauma *See also Diabetic foot infection, Ulcers, Wound infection – post-operative (surgical site), Wound infection – water injuries*	Cover any recent *Staphylococcus aureus* isolates **Mild:** trimethoprim+ sulfamethoxazole (P) plus metronidazole (B) orally, or amoxicillin+clavulanate alone. If failing, ciprofloxacin (P) (B) plus amoxicillin+clavulanate **Severe:** cefazolin plus metronidazole (B)	**Mild:** cefalexin, or clindamycin **Severe:** amoxicillin+ clavulanate IV alone, or clindamycin plus either ciprofloxacin (P) (B) or gentamicin	Drain pus – this may be all that is needed for small, mild infected wounds Culture pus or deep tissue samples to guide antibiotic choice If penetrating wound through foot-ware, add cover for *Pseudomonas aeruginosa* (e.g., ciprofloxacin (P) (B), gentamicin, ceftazidime[RESTRICTED], or meropenem[RESTRICTED]) while awaiting results of culture of deep samples If use gentamicin, replace after 48 to 72 hours. *See pages 88 and 89 for gentamicin dosing advice* Give tetanus toxoid if indicated
Wound infection Post-operative (surgical site) 'clean' (e.g., orthopaedic or breast surgery) *See also Diabetic foot infection, Ulcers, Wound infection – post-trauma, Wound infection – water injury*	Cover any recent *Staphylococcus aureus* isolates **Mild:** cefalexin **Severe:** cefazolin (add vancomycin if MRSA risk). If failing, ciprofloxacin (P) (B) plus vancomycin	**Mild:** trimethoprim+ sulfamethoxazole (P), or amoxicillin+ clavulanate. If failing, ciprofloxacin (P) (B) plus either doxycycline (P), cefalexin, clindamycin or amoxicillin+ clavulanate **Severe:** ciprofloxacin (P) (B) plus either vancomycin or clindamycin	Drain pus – this may be all that is needed for small, mild infected wounds Culture pus or deep tissue samples to guide antibiotic choice

(P) *Contra-indicated or caution in pregnancy; see pages 101 – 102*

(B) *Contra-indicated or caution when breastfeeding; see pages 101 – 102*

INFECTION	FIRST CHOICE	ALTERNATIVES	COMMENTS
Wound infection Post-operative (surgical site) 'clean-contaminated' (e.g., head and neck surgery) *See also Diabetic foot infection, Ulcers, Wound infection – post-trauma, Wound infection – water injury*	**Mild:** trimethoprim+ sulfamethoxazole (P) plus metronidazole (B) orally, or amoxicillin+clavulanate alone. If failing, amoxicillin+clavulanate plus ciprofloxacin (P) (B) **Severe:** ceftriaxone. If failing, amoxicillin+ clavulanate plus ciprofloxacin (P) (B)	Ciprofloxacin (P) (B) plus clindamycin	Drain pus – this may be all that is needed for small, mild infected wounds Culture pus or deep tissue samples to guide antibiotic choice
Wound infection Post-operative (surgical site) 'contaminated' (e.g., abdomen, pelvis, gynaecologic) *See also Diabetic foot infection, Ulcers, Wound infection – post-trauma, Wound infection – water injury*	**Mild:** amoxicillin+ clavulanate plus trimethoprim+ sulfamethoxazole (P). If failing, amoxicillin+ clavulanate plus ciprofloxacin (P) (B) **Severe:** ceftriaxone plus metronidazole (B)	**Mild:** trimethoprim+ sulfamethoxazole (P) plus metronidazole (B) orally. If failing, ciprofloxacin (P) (B) plus metronidazole (B) orally **Severe:** amoxicillin plus gentamicin plus metronidazole (B). Or clindamycin plus gentamicin. If failing, amoxicillin+ clavulanate IV plus ciprofloxacin (P) (B), or meropenem[RESTRICTED] alone	Drain pus – this may be all that is needed for small, mild infected wounds Culture pus or deep tissue samples to guide antibiotic choice If use gentamicin, replace after 48 to 72 hours. *See pages 88 and 89 for gentamicin dosing advice*
Wound infection Water injuries (coral cuts, skin trauma in lagoon, fisherman hand injuries)	Cover any recent *Staphylococcus aureus* isolates **Seawater injury infections:** doxycycline (P) plus either cefalexin or flucloxacillin. If **severe**: ciprofloxacin (P) (B) plus either cefazolin, flucloxacillin or vancomycin **Fresh, brackish, aquarium or soil- or sewage-contaminated water injury infections:** trimethoprim+ sulfamethoxazole (P) add metronidazole (B) orally if possible sewage exposure. If **severe**, as per seawater injury infections, but if possible sewage exposure, then ceftazidime[RESTRICTED] plus metronidazole (B)	**Seawater injury infections:** trimethoprim+ sulfamethoxazole (P) alone. Or ciprofloxacin (P) (B) plus either flucloxacillin, cefalexin or clindamycin. If **severe**, ciprofloxacin (P) (B) plus clindamycin **Fresh, brackish, aquarium or soil- or sewage-contaminated water injury infections:** ciprofloxacin (P) (B) plus either cefalexin or flucloxacillin – add metronidazole (B) orally if possible sewage exposure. If **severe**: ciprofloxacin (P) (B) plus clindamycin, or ciprofloxacin (P) (B) plus vancomycin plus metronidazole (B)	Drain and culture pus Hand cellulitis 2 to 7 days after injury handling fish, crabs or shrimps – cover *Erysipelothrix* with penicillin, amoxicillin, ceftriaxone, or doxycycline (P) If *Aeromonas* sp. isolated, treat with trimethoprim+ sulfamethoxazole (P) or ciprofloxacin (P) (B) If *Vibrio* sp. isolated, treat with doxycycline (P) or ciprofloxacin (P) (B). Add ceftriaxone if severe. Often requires multiple debridements
Yaws	*See Ulcers – Yaws*		

(P) *Contra-indicated or caution in pregnancy; see pages 101 – 102*

(B) *Contra-indicated or caution when breastfeeding; see pages 101 – 102*

PREVENTING RECURRENT INFECTIONS

RECURRENT CELLULITIS

Mostly occurs on legs, but occasionally arms or chest wall (after breast cancer treatment) or the abdomen (in obesity). Each attack of cellulitis increases the risk of more attacks. To reduce the risk of cellulitis recurrence:

- Treat underlying causes of stasis (oedema) if possible – control blood pressure, lose weight, diuretics for general fluid overload, surgical repair of varicose veins. Leg elevation and compression stockings can help.
- Control diabetes.
- Manage leg ulcers well, including antiseptic agents or dressings.
- Treat skin conditions in the area of recurrent cellulitis, e.g., eczema, psoriasis, scabies.
- Treat fungal infection between the toes or on the feet.
- Prevent injury to skin (e.g., scratches, insect bites) in area of recurrent cellulitis – wear long pants when in the garden, take care cutting nails, avoid animal scratches or insect bites.
- Antiseptic soap may be more effective than unmedicated soap.
- Put antiseptic ointment (like iodine) on skin injuries to stop infection starting (*see page 106*).
- Take a swab from a skin wound at the time of an episode of cellulitis to try to find out which bacteria might be causing the recurrent infections. Then prescribe antibiotics for the patient to have available to quickly start treatment in the future if they feel they are developing cellulitis. The first clue might be rigors. Common oral antibiotics for acute cellulitis in the Cook Islands are cefalexin, flucloxacillin and trimethoprim+sulfamethoxazole. To prevent hospitalisation, give a big dose for the first 2 days. For example, you may prescribe cefalexin or flucloxacillin at a dose of 1 g 4 times daily, together with probenecid 500 mg 4 times daily for the first 2 days. Make sure the patient takes each dose of the antibiotic and probenecid with food (to prevent nausea). This will be the equivalent of IV cefazolin or IV flucloxacillin (*see page 94 – High-dose oral antibiotics*). For recurrent MRSA cellulitis or patients with allergies, high-dose oral options for the first 2 days would be trimethoprim+sulfamethoxazole 1920 mg (4 tabs) 2 times daily or clindamycin 300 mg 4 times daily.
- As a last resort for a patient who keeps getting cellulitis, prescribe low-dose suppressive antibiotics for 3 to 12 months. For example, flucloxacillin 500 mg daily.

RECURRENT *STAPHYLOCOCCUS AUREUS* SKIN INFECTIONS

Includes folliculitis, boils, abscesses, and wound infections. *See page 58 for recurrent cellulitis*. Some types of skin abscess in the armpits and groin (hidradenitis suppurativa) are not primarily infectious and management is different. To reduce the risk of *Staphylococcus aureus* skin infection recurrence:

- Treat underlying skin conditions, e.g., eczema, psoriasis, scabies, ulcers.
- Antiseptic soap may be more effective than unmedicated soap.
- Regular change and wash of bath towels, bed linen, and clothing.
- Cover infected skin infections or rashes with a dressing.
- Put antiseptic ointment (like iodine) on skin injuries to stop infection starting (*see page 106*).
- Take a swab at the time of a skin infection to find out the susceptibility of the *Staphylococcus aureus* causing the problem. Then prescribe antibiotics for the patient to have available to quickly start treatment in the future if they feel they are getting another skin infection. Common oral antibiotics for staphylococcal skin infections in the Cook Islands are flucloxacillin, cefalexin, trimethoprim+sulfamethoxazole, and doxycycline (P).
- Drain the pus out of a boil or abscess, before it gets too big or spreads elsewhere in the body.
- As a last resort for someone who keeps getting recurrent staphylococcal skin infections, prescribe low-dose suppressive antibiotics for 3 to 12 months. For example, flucloxacillin 500 mg daily.

RECURRENT URINARY TRACT INFECTION

To reduce the risk of urinary tract infection recurrence:

- Consider ultrasound of the renal tract to look for surgically correctable cause, such as prostatic hypertrophy in men.
- Control diabetes and constipation.
- Patient should drink plenty of water, including at night.
- Women should pass urine after sexual intercourse.
- In post-menopausal women, topical oestrogen cream applied regularly to the vulva is very likely to reduce recurrences.
- Hiprex (methenamine hippurate) and D-mannose reduce recurrences in women of all ages. These are only available from a private pharmacy. No prescription is needed.
- It's not certain if cranberry juice, cranberry products, or probiotics make any difference to the risk of recurrent urinary tract infection.
- Test the urine at the time of an infection to find out which bacteria are causing the problem and which antibiotics will treat them. Then prescribe antibiotics for the patient to have available to quickly start treatment of recurrent urinary tract infection. Common oral antibiotics for urinary tract infection in the Cook Islands are cefalexin 500 mg 2 times daily, nitrofurantoin (P) or trimethoprim (P).
- As a last resort, prescribe low-dose suppressive antibiotics for 3 to 12 months. For example, trimethoprim (P) 150 mg at night, 3 to 7 nights/week. Nitrofurantoin (P) 50 mg at night may be more effective but do not use for more than 6 months. Warn older patients to stop nitrofurantoin (P) and seek advice if they develop unexplained persistent shortness of breath.

(P) *Contra-indicated or caution in pregnancy; see pages 101 – 102*

PROPHYLAXIS

BITE (ANIMAL OR HUMAN) PROPHYLAXIS

All animal and human bites require cleaning, debridement, irrigation and consideration for tetanus prophylaxis. In addition, give antibiotic prophylaxis for 5 days if the bite is from a cat (80% get infected), severe or deep; on the hands, feet or face; close to bone, tendon or joint; in an area of venous or lymphatic stasis; or in an immune-compromised patient (e.g., poorly controlled diabetes, splenectomy, alcohol excess or liver disease).

FIRST CHOICE	ALTERNATIVES
Amoxicillin+clavulanate 500+125 mg (child: 15 to 30 mg of amoxicillin, with clavulanate) orally 3 times daily for 5 days	Cat or dog bites (need to cover *Pasturella multocida* and *Capnocytophaga canimorsus*): metronidazole B plus doxycycline P, metronidazole B plus trimethoprim+sulfamethoxazole P Human bites: metronidazole B plus a macrolide (roxithromycin, azithromycin or erythromycin), or clindamycin alone

P *Contra-indicated or caution in pregnancy; see pages 101 – 102*

B *Contra-indicated or caution when breastfeeding; see pages 101 – 102*

BURN PROPHYLAXIS

Silver sulphadiazine cream 1% applied 1 to 2 times daily has been widely used but is now known to be less effective and causes resistance. Better options include dilute bleach (*see page 107 for bleach dilution instructions*), slow-release silver, or Microdacyn.

ENDOCARDITIS PROPHYLAXIS FOR DENTAL TREATMENT

The most important way to prevent endocarditis in people with high-risk heart valve conditions is to maintain good oral health and hygiene. It is not known if prophylactic antibiotics before dental procedures in people with high-risk heart valve conditions is effective. International guidelines and experts disagree on whether endocarditis prophylaxis is needed and in which patients. The 2016 NICE guidelines (UK), 2008 New Zealand guidelines and 2022 Australian guidelines recommend prophylaxis for patients at the highest risk, including for underlying rheumatic heart disease (which is common in the Cook Islands). Dentists in the Cook Islands may choose to give antibiotic prophylaxis, depending on their own perspective, the patient's wishes, and the risks involved in the individual case (type of procedure, underlying heart condition).

Heart valve conditions

Consider prophylaxis for patients with one or more of the following heart valve conditions:

- Rheumatic heart disease that has been confirmed on echocardiography (not for those with previous rheumatic fever without heart involvement)
- Prosthetic heart valves (biological or mechanical), or when prosthetic material is used to repair a valve
- Previous endocarditis
- Unrepaired cyanotic congenital heart disease (includes palliative shunts and conduits)
- Surgical or catheter repair of congenital heart disease within 6 months of repair or with residual defects.

Prophylaxis is not recommended for patients with non-rheumatic valvular heart disease (including mitral valve prolapse), septal defects or cardiac implantable electronic devices. Some patients with a heart transplant should have endocarditis prophylaxis.

Dental care and procedures

Patients with these high-risk heart valve conditions should have good oral and dental health and care. Prophylactic antibiotics may be given before procedures that involve manipulation of gingival tissue or the peri-apical region of teeth (e.g., extraction) or perforation of the oral mucosa (e.g., tonsillectomy and adenoidectomy).

Procedures that do NOT require prophylaxis include routine anaesthetic injections through non-infected tissue, taking dental radiographs, restorative dentistry (fillings), fitting of dentures, placement of removable prosthodontic or orthodontic appliances, adjustment of orthodontic appliances, placement of orthodontic brackets, shedding of deciduous teeth and bleeding from trauma to the lips or oral mucosa.

Antibiotic choice

Antibiotic regimens for dental procedures and for tonsillectomy/adenoidectomy:

- Amoxicillin 2 g (child: 50 mg/kg up to 2 g), administered:
  - » Orally, 60 minutes before the procedure, or
  - » IV, within the 60 minutes before the procedure, or
  - » IM, 30 minutes before the procedure.
  - » Administer parenterally if unable to take medication orally; administer IV if IV access is readily available.
- High penicillin allergy risk (*see page 98*): cefalexin 2 g (child: 50 mg/kg up to 2 g) orally, 60 minutes before the procedure; or cefazolin 2 g (child: 30 mg/kg up to 2 g) IV, within the 60 minutes before the procedure, or IM, 30 minutes before the procedure)
- High penicillin allergy risk (*see page 98*) or if penicillin-group or cephalosporin-group antibiotic has been taken more than once in the previous month (including those on long-term penicillin prophylaxis for rheumatic fever) then give clindamycin 600 mg (child: 20 mg/kg up to 600 mg) orally, 60 to 120 minutes before the procedure, or IV, within the 120 minutes before the procedure.

Those unable to take any of the above options could use azithromycin 500 mg (child 12 mg/kg up to 500 mg) orally, or, as a last resort, erythromycin 500 mg (child: 10 mg/kg up to 500 mg). If the antibiotic agent is inadvertently not administered before the procedure, it may be administered up to 2 hours after the procedure.

GROUP B STREPTOCOCCAL ANTENATAL PROPHYLAXIS

Based on the Australian Therapeutic Guidelines 2022

Streptococcus agalactiae (Group B streptococci, GBS) is a normal commensal of the gut and genital tract in up to 30% of healthy young women. Giving antibiotics to pregnant women who carry GBS before delivery reduces transmission to the baby and reduces neonatal GBS infection.

Risk-based strategy or laboratory screening?

A risk-based GBS strategy is used in New Zealand and Australia, as it is more clinically and cost effective than routine laboratory screening. If laboratory screening is chosen, take vaginal or anorectal swabs at 35 to 37 weeks gestation or 3 to 5 weeks before the anticipated delivery date.

Which mothers get intra-partum antibiotic prophylaxis?

Those who do not already have active chorioamnionitis (e.g., fever, uterine tenderness) but who have any one or more of the following risk factors:

- Invasive neonatal GBS infection in a previous pregnancy
- GBS bacteriuria of any count during any trimester of the current pregnancy (even if successfully treated at the time)
- GBS identified during the current pregnancy by screening cultures from vaginal or rectal swabs
- Pre-term (< 37 weeks) labour and imminent birth
- Intra-partum fever (≥ 38°C)
- Prolonged membrane rupture (≥ 18 hours).

Intra-partum antibiotic prophylaxis for GBS is not indicated for women with intact membranes undergoing a caesarean section, irrespective of their GBS results on urine or screening cultures, provided that labour has not started. However, surgical pre-op prophylaxis is indicated (*see page 67, Pre-operative prophylaxis*).

Choice of intra-partum antibiotic

For GBS prophylaxis, give:

- Benzylpenicillin (penicillin G) 3 g (5 MU) IV for the first dose then 1.8 g (3 MU) IV 4-hourly until delivery
  - » Based on kinetics of oral amoxicillin and susceptibility of GBS to amoxicillin, oral amoxicillin 1 g 3 times daily would be as effective as IV benzylpenicillin or IV amoxicillin. Consider switch from IV benzylpenicillin to oral amoxicillin if prophylaxis ongoing. (Note: this is not mentioned in the Australian 2022 guidelines)
- Penicillin allergy with low risk of cross-reaction (*see page 98*): cefazolin 2 g IV 8-hourly until delivery
  - » Based on kinetics of oral cefalexin and susceptibility of GBS to cefalexin, oral cefalexin 1 g 4 times daily would be as effective as IV cefazolin in almost all cases. Consider switch from IV cefazolin to oral cefalexin if prophylaxis ongoing and there is not a high cefalexin allergy risk (*see page 98*). (Note: this is not mentioned in the Australian 2022 guidelines)
- High risk of penicillin, amoxicillin, cefazolin and cefalexin allergy (*see page 98*): vancomycin 1 g 12-hourly until delivery
  - » If colonising GBS known to be susceptible to macrolides, consider switch to oral azithromycin 500 mg daily if prophylaxis ongoing. Oral trimethoprim+sulfamethoxazole (P) 160+800 mg 2 times daily is another option that is very likely to be successful based on kinetics and susceptibility. The risk of trimethoprim+sulfamethoxazole (P) causing kernicterus in newborn babies is theoretical and not proven. (Note: macrolides and trimethoprim+sulfamethoxazole are not discussed in the Australian 2022 guidelines)

(P) *Contra-indicated or caution in pregnancy; see pages 101 – 102*

Timing of intra-partum antibiotic

Start antibiotic prophylaxis for GBS on admission to hospital for labour, induction of labour, or rupture of membranes. Ideally, start prophylaxis 4 hours before delivery. These antibiotics have moderate benefit if given at least an hour before delivery and high benefit if given 2 hours before delivery.

Continue GBS prophylaxis until the baby is born. Discontinue prophylactic antibiotics if pre-term labour does not establish (and membranes are intact).

Management of the newborn baby

Neonates with maternal risk factors for early-onset neonatal GBS infection, whether the mother was given intrapartum antibiotic prophylaxis or not, should be watched for signs of neonatal GBS infection for at least 48 hours, including respiratory distress, apnoea, unstable temperature, tachycardia, lethargy, poor-feeding, shock or 'unwell'. Any baby with these signs should be evaluated (e.g., full blood count, blood cultures, +/- lumbar puncture) and given empiric treatment for at least 48 hours – *see Neonatal sepsis*.

PROPHYLAXIS FOR PRE-TERM, PRE-LABOUR RUPTURE OF MEMBRANES (PPROM)

Based on the Australian Therapeutic Guidelines 2022

PPROM is membrane rupture before 37 weeks gestation and before the onset of uterine contractions. PPROM may be caused by pre-existing subclinical or overt chorioamnionitis. Clinically assess for chorioamnionitis (e.g., maternal fever, rapid pulse, low blood pressure, purulent vaginal discharge, fundal tenderness, CRP rise, or fetal tachycardia) and manage if diagnosed. PPROM may also be associated with other pre-existing infections, so screen for urinary tract infection and sexually transmitted infections. If not already done, screen for GBS colonisation.

When there is no evidence of pre-existing infection, prophylaxis is given to reduce the risk of micro-organisms entering the uterus and causing chorioamnionitis, fetal and neonatal infection, and to prolong the pregnancy. Antibiotic prophylaxis for PPROM is given in addition to any other prophylaxis the patient requires, such as for GBS risk, imminent surgery, or recurrent urinary tract infection.

Indications for PPROM prophylaxis

PPROM prophylaxis is indicated for women without suspected chorioamnionitis, when delivery is not imminently planned, and gestational age is at or before 36 weeks. Monitor women closely for signs of chorioamnionitis.

Recommended regimens

- Amoxicillin 2 g IV 6-hourly for 48 hours, then amoxicillin 250 mg orally 3 times daily for 7 days (IV plus oral) or until delivery (whichever is sooner), plus
- Erythromycin 400 mg (ethyl succinate) orally 4 times daily for 7 days or until delivery (whichever is sooner).

If the patient is unable to take amoxicillin because of allergy (*see page 98*), the Australian 2022 guidelines recommend giving erythromycin alone. Azithromycin is stated to be an alternative to erythromycin by some experts – an appropriate dose would be 500 mg on the first day then 250 mg daily. There is clinical evidence to support the use of cephalosporins for PPROM prophylaxis, but do not give cefalexin to any patient with an amoxicillin allergy as there is a high cross-reaction risk.

PRE-OPERATIVE ANTIBIOTIC PROPHYLAXIS

Pre-operative antibiotic prophylaxis reduces the risk of wound infections by 15 to 50%, reduces post-operative pneumonia and urinary infections, and shortens length of stay. Pre-operative antibiotic prophylaxis for surgical patients in developing countries reduces average antibiotic consumption by those patients by 63%. Only certain procedures require antibiotic prophylaxis.

Based on the Australian Therapeutic Guidelines 2022

General recommendations:

- Give IV prophylactic antibiotics 0 to 60 minutes before knife to skin incision (ideally 15 to 30 minutes). Remember, vancomycin requires a slow infusion: 1 g at 10 mg/minute = 100 minutes.
- Give oral prophylactic antibiotics at least 1 to 2 hours before incision, with a sip of water.
- Indwelling drains and IV catheters do not indicate a need for prolonged prophylaxis.
- Extended oral or IV prophylaxis beyond 24 hours adds no benefit and increases adverse effects.
- WHO global guidelines 2016 include patient skin cleansing with chlorhexidine 2% to 4% in the hours before the operation for most patients and use of skin prep with both 70 – 74% ethanol and chlorhexidine 0.5 to 2% (ethanol plus iodine also acceptable).

ANTIBIOTIC	RECOMMENDED DOSE FOR:		RECOMMENDED RE-DOSING INTERVAL DURING PROLONGED SURGERY (HRS) [1,2]
	ADULTS	PAEDIATRICS	
Amoxicillin + Clavulanate	2.4 g IV	50 mg/kg (of amox)	2
Cefalexin	1 g orally	25 mg/kg up to 1 g	2
Cefazolin	2 g (3 g if > 120 kg) IV	30 mg/kg up to 2 g	4
Clindamycin	450 to 600 mg orally	15 mg/kg up to 600 mg	6
Doxycycline P	200 mg orally[3]	4 mg/kg up to 200 mg	10
Gentamicin *(IV push over 3 to 5 minutes)*	2 mg/kg for short procedures; 5 mg/kg for 5- to 6-hour procedures	2 mg/kg	Redosing not required
Metronidazole B	800 mg orally or 500 mg IV	12.5 mg/kg (oral or IV) (7.5 mg/kg if < 1200 g)	12
Trimethoprim+ sulfamethoxazole P	160+800 mg orally	4+20 mg/kg up to 160+800 mg oral	10
Vancomycin *(infuse over 1 to 2 hours)*	1 g up to 70 kg, then 15 mg/kg IV	15 mg/kg	12

1. Based on 2 half-lives of drug; normal renal function assumed. Also if > 1500 mL blood loss.

2. Give same re-dose as initial dose.

3. Take doxycycline with at least half a cup of water then sit up for 2 hours, to avoid oesophageal and stomach upset.

P *Contra-indicated or caution in pregnancy; see pages 101 – 102*

B *Contra-indicated or caution when breastfeeding; see pages 101 – 102*

PROCEDURE	FIRST CHOICE	ALTERNATIVES	COMMENTS
Gastrointestinal (open or laparoscopic) Oesophageal, gastric, duodenal, liver or biliary tract surgery	Cefazolin (if bowel obstruction add metronidazole B)	Trimethoprim+ sulfamethoxazole P plus metronidazole B, gentamicin plus clindamycin	No prophylaxis required for endoscopic upper GI procedures If GI lumen not entered, only give prophylaxis if high-risk (e.g., morbid obesity, gastric outlet obstruction, GI bleeding, malignancy, perforation)
Colorectal (appendicectomy), pancreatic surgery, acute laparotomy	Cefazolin plus metronidazole B	Trimethoprim+ sulfamethoxazole P plus metronidazole B, gentamicin plus clindamycin, gentamicin plus metronidazole B	No prophylaxis required for endoscopic lower GI procedures
Hernia repair With or without mesh If bowel lumen entry is expected, *see Gastrointestinal – colorectal (above)*	Cefazolin	Trimethoprim+ sulfamethoxazole P plus metronidazole B, vancomycin alone	If MRSA grown from any site in the last 6 months, use a regimen that covers this strain
Obstetrics / Gynae Hysterectomy (abdominal or vaginal), prolapse repair, gynaecological laparotomy, gynaecological oncology procedures	Cefazolin plus metronidazole B	Trimethoprim+ sulfamethoxazole P plus metronidazole B, gentamicin plus clindamycin, gentamicin plus metronidazole B	Test and treat for bacterial vaginosis first No prophylaxis required for hysteroscopy, D and C (except termination of pregnancy), endometrial biopsy or ablation, insertion of IUD, cervical tissue excision procedure (LLETZ, biopsy, curettage), or laparoscopic procedures that do not enter the bowel or the vagina
Caesarean section (elective or emergency)	Cefazolin plus metronidazole B	Trimethoprim+ sulfamethoxazole P plus metronidazole B, gentamicin plus metronidazole B, gentamicin plus clindamycin	Give antibiotics before incision (not after cord clamp). Consider a further 48 hours of oral amoxicillin+clavulanate, or cefalexin plus metronidazole B prophylaxis in very obese patients If MRSA grown from any site in the last 6 months, use a regimen that covers this strain
Termination of pregnancy	Doxycycline 100 mg pre-op, 200 mg post-op	Doxycycline 400 mg orally, with food, 10 to 12 hours before the procedure, or metronidazole B 2 g plus azithromycin 1 g orally within the 120 minutes before the procedure	Test and treat for bacterial vaginosis and chlamydia first

P *Contra-indicated or caution in pregnancy; see pages 101 – 102*

B *Contra-indicated or caution when breastfeeding; see pages 101 – 102*

PROCEDURE	FIRST CHOICE	ALTERNATIVES	COMMENTS
Instrumented/assisted vaginal delivery	Amoxicillin+ clavulanate	Cefazolin plus metronidazole B, trimethoprim+ sulfamethoxazole P plus metronidazole B	Especially with episiotomy or perineal injury. Give antibiotics immediately after delivery
Repair of a third- or fourth-degree perineal tear during vaginal delivery	Cefazolin plus metronidazole B	Clindamycin, trimethoprim+ sulfamethoxazole P plus metronidazole B	If anal sphincter requires repair give amoxicillin+clavulanate 500+125 mg orally 3 times daily for 7 days after repair (if amoxicillin allergy (*see page 98*): cefalexin plus metronidazole B, or trimethoprim+ sulfamethoxazole P plus metronidazole B)
Orthopaedic Orthopaedic Spinal surgery, prosthetic large joint replacement or implantation of any foreign material (screws, plates, anchors, pins, nails, allograft)	Cefazolin (3 doses, 8- hourly, for 24 hours max). If high-risk (morbid obesity, extensive metalware), give cefazolin (3 doses) plus vancomycin (single dose)	Vancomycin, doxycycline P. If high-risk, vancomycin plus gentamicin	Treat skin, urine, dental or any other infections before elective surgery. Allow 5 minutes between dose and tourniquet Give nasal povidone iodine pre-op in all cases If MRSA grown from any site in the last 6 months, use a regimen that covers this strain
Vascular or pacemaker insertion Aorta or lower limb artery reconstruction, or grafting	Cefazolin plus vancomycin	Gentamicin plus vancomycin, gentamicin plus clindamycin	No prophylaxis required for varicose vein surgery, or for brachial or carotid artery procedures not involving insertion of prosthetic material If MRSA grown from any site in the last 6 months, use a regimen that covers this strain
Urological	Test all elective patients pre-op for urine infection, even if asymptomatic, and treat based on culture results. In catheterised patients, collect samples using a new catheter to avoid contamination of the sample by organisms colonising the old catheter.		
Vasectomy, scrotal surgery, varicocoele ligation, urodynamics, extra-corporeal shock-wave lithotripsy, simple diagnostic cystoscopy or ureteroscopy (without manipulation) in low-risk patients	Nil	Nil	If clinical or dipstick evidence of infection on day of surgery, give gentamicin 3 mg/kg pre-op; alternatives include cefalexin, trimethoprim+ sulfamethoxazole P

P *Contra-indicated or caution in pregnancy; see pages 101 – 102*

B *Contra-indicated or caution when breastfeeding; see pages 101 – 102*

PROCEDURE	FIRST CHOICE	ALTERNATIVES	COMMENTS
Endoscopic intra-renal and ureteric stone procedures, cystoscopy in high-risk patients (see comments), resection of large tumours, likely heavy bleeding TURP	Gentamicin 2 mg/kg IV, with or without amoxicillin 1 g orally	Cefazolin or cefalexin (with or without amoxicillin), trimethoprim+ sulfamethoxazole (P)	High-risk patients for simple cystoscopy include those with bladder outlet obstruction with incomplete emptying or other anatomic abnormality, urinary stones, indwelling or externalised catheter
Open or laparoscopic procedures in which the urinary tract is entered, but GI tract entry is not expected	Cefazolin plus gentamicin	Vancomycin plus gentamicin Clindamycin plus gentamicin Trimethoprim+ sulfamethoxazole (P) plus metronidazole (B)	If inadvertent bowel injury, add metronidazole (B) 500 mg IV immediately
If entering the GI tract (ileal conduit, rectocoele repair)	*See Gastrointestinal – colorectal (above)*		
Amputations Lower limb	Cefazolin (plus metronidazole (B) if ischaemic limb)	Amoxicillin+ clavulanate, trimethoprim+ sulfamethoxazole (P) plus metronidazole (B), vancomycin plus gentamicin (plus metronidazole (B) if ischaemic limb)	If MRSA grown from any site in the last 6 months, use a regimen that covers this strain If already receiving antibiotics for infection pre-amputation, stop antibiotics 2 to 5 days after amputation if the infected bone and tissue has been removed
Breast or plastic surgery Any procedure in high-risk patient (e.g., wires, immune-compromised, implants, revision)	Cefazolin	Trimethoprim+ sulfamethoxazole (P), doxycycline (P), vancomycin	No prophylaxis required for diagnostic excision biopsy, stand-alone sentinel node biopsy, or lumpectomy (with or without needle or wire localisation) If MRSA grown from any site in the last 6 months, use a regimen that covers this strain
ENT / Head and neck Major ear surgery, complex septorhinoplasty, revision sinus surgery, laryngectomy, tympanomastoid surgery, hearing implant procedures, head/neck procedures involving insertion of prosthetic material, head/neck malignancy dissection or reconstructive procedures	Cefazolin plus metronidazole (B)	Trimethoprim+ sulfamethoxazole (P) plus metronidazole (B), gentamicin plus clindamycin	No prophylaxis required for nasal packing, uncomplicated nose or sinus surgery (including endoscopic procedures), uncomplicated ear surgery, otoplasty, stapedectomy, tonsillectomy, adenoidectomy, thyroidectomy, simple lymph node excision, parotidectomy, or other clean procedures. There is insufficient evidence to recommend antibiotic prophylaxis for insertion of tympanostomy tubes (grommets).

(P) *Contra-indicated or caution in pregnancy; see pages 101 – 102*

(B) *Contra-indicated or caution when breastfeeding; see pages 101 – 102*

RHEUMATIC FEVER PROPHYLAXIS

Based on the Australian Therapeutic Guidelines 2022 and the New Zealand 2014 Guidelines for Rheumatic Fever

After an episode of acute rheumatic fever (ARF) or diagnosis of rheumatic heart disease, patients should have long-term follow up that includes regular echocardiograms and specialist medical and dental reviews.

For patients after probable or definite acute rheumatic fever give benzathine penicillin G (adult and child > 20 kg: 900 mg (1.2 MU); child 10 to 20 kg: 450 mg (0.6 MU)) IM, every 3 or 4 weeks. Give every 3 weeks if severe rheumatic heart disease, a history of cardiac valve surgery, or confirmed recurrence of acute rheumatic fever or Group A streptococcal infection (e.g., pharyngitis, impetigo) despite adherence to 4-weekly dosing. Can be given after 14 days to aid compliance with events, such as travel.

Oral prophylaxis may be less effective than IM penicillin and is more difficult to comply with but is available for those who refuse IM dosing. First choice oral option is penicillin V. For children < 20 kg, give penicillin V 250 mg 2 or 3 times daily. For children and adults over 20 kg give 500 mg 2 or 3 times daily. If penicillin-allergic, consider desensitisation to penicillin or amoxicillin (*see page 100*), or give erythromycin ethyl succinate (EES) 400 mg (child 1 month or older: 20 mg/kg up to 400 mg) orally 2 times daily. Cefalexin, roxithromycin or azithromycin may also be effective, but this has not been proven.

The duration of secondary prophylaxis depends on the severity of rheumatic heart disease[1] and risk of further exposure to high-risk Group A Streptococcus environment.

SEVERITY OF RHEUMATIC HEART DISEASE[1]	DURATION OF PROPHYLAXIS
None	At least 5 years after the most recent episode of probable ARF, or until age 21 years (whichever is longer)
Mild	Documented history of ARF: minimum of 10 years after most recent episode of ARF or until age 21 years (whichever is longer). Consider longer for women considering pregnancy and who live in high-risk Group A Streptococcus environment No documented history of ARF and aged < 35 years: minimum of 5 years following diagnosis of rheumatoid heart disease or until age 21 years (whichever is longer) No documented history of ARF and aged 35 years or over: secondary prophylaxis not required
Moderate	Documented history of ARF: minimum of 10 years after most recent episode of ARF or until age 35 years (whichever is longer). Consider longer for women considering pregnancy and who live in high-risk Group A Streptococcus environment No documented history of ARF and aged < 35 years: minimum of 5 years following diagnosis of rheumatoid heart disease or until age 35 years (whichever is longer). Consider continuation if ongoing exposure to high-risk Group A streptococcus environment No documented history of ARF and aged 35 years or over: secondary prophylaxis not required
Severe	Documented history of ARF: minimum of 10 years after most recent episode of ARF or until age 40 years (whichever is longer) No documented history of ARF: minimum of 5 years following diagnosis of rheumatoid heart disease or until age 40 years (whichever is longer). Then specialist review for consideration of the need for continuation of prophylaxis. Although risk of ARF recurrence is low in people over 40 years, lifelong secondary prophylaxis is usually recommended for patients who have had, or are likely to need, heart valve surgery

1. The 2022 definitions of severity of rheumatic heart disease can be found in the Rheumatic Heart Disease Australia guidelines (https://www.rhdaustralia.org.au/arf-rhd-guideline).

ARF: acute rheumatic fever

SPLENECTOMY PROPHYLAXIS, VACCINATION AND TREATMENT OF ACUTE FEVER

Based on the Australian Therapeutic Guidelines 2022

Patients with asplenia or impaired spleen function are at higher risk of severe sepsis, most often caused by *Streptococcus pneumoniae*, as well as other bacteria (including those from animal bites) and malaria.

Duration of prophylaxis

Take prophylactic antibiotics for at least 3 years after splenectomy or until at least 5 years of age, whichever is longer; thereafter stop if fully vaccinated, not suffering repeated infections, and has antibiotics on hand for self-treatment if fever (*see below*). Consider prophylaxis for longer if ongoing immune-compromise (e.g., haematological malignancy, primary immunodeficiency disorder) or incomplete vaccination against pneumococcal disease, or for 6 months after an episode of invasive pneumococcal disease.

Choice of antibiotic for prophylaxis

- Amoxicillin 250 mg (child: 20 mg/kg up to 250 mg) orally, daily, or
- Penicillin V 250 mg (child < 1 year: 62.5 mg; 1 to 5 years: 125 mg) orally, 2 times a day
- If amoxicillin allergy, consider desensitisation to amoxicillin (*see page 100*). Alternatively, consider trimethoprim+sulfamethoxazole (P) 80+400 mg (child: infant or toddler 10+50 to 20+100 mg, up to 40 kg 40+200 mg) orally, daily, erythromycin (see rheumatic fever prophylaxis guidelines for dosing suggestions), or roxithromycin 150 mg (child: 4 mg/kg up to 150 mg) orally daily.

Vaccination after splenectomy

Recommended vaccinations include those for pneumococcus, meningococcus, *Haemophilus influenzae* type B (Hib) and influenza. Details on timing and choice of vaccines can be found in the latest edition of the New Zealand Immunisation Handbook (www.health.govt.nz/immunisation). In many cases, these vaccines will be administered in New Zealand before or after splenectomy. If the vaccines available in the Cook Islands are different from those recommended in the New Zealand Immunisation Handbook, use similar vaccines.

Self-treatment of acute fever

Patients after splenectomy should have antibiotics on hand in case of acute fever, rigors or any other symptom of acute severe infection. Appropriate choices include amoxicillin+clavulanate, doxycycline (P), or trimethoprim+sulfamethoxazole (P) in moderately high doses. For example, the first dose could be amoxicillin+clavulanate 1000+250 mg (child: 30 mg/kg of amoxicillin, up to 1000 mg) orally, doxycycline (P) 200 mg (child: 4 mg/kg up to 200 mg) orally, or trimethoprim+sulfamethoxazole (P) 320+1600 mg (child: 6 mg/kg of trimethoprim). After taking these antibiotics immediately, the patient should seek prompt medical help for investigation and ongoing treatment. *See Immune-compromise and sepsis*.

(P) *Contra-indicated or caution in pregnancy; see pages 101 – 102*

TRAUMATIC WOUND INFECTION PROPHYLAXIS

Based on the Australian Therapeutic Guidelines 2022

Traumatic wounds often become infected. All wounds should be managed by washing with tap water or saline (both are OK), removal of dirt, debridement of dead tissue, application of a topical antiseptic (e.g., dilute bleach, povidone iodine 10% – at least on the first day and ideally also until healed) and covering with a dressing. Ensure that tetanus vaccination is up to date. In addition, wounds with the highest risk of infection should be managed with prophylactic antibiotics:

Relative indications for prophylactic antibiotic:

- Lots of soil or dirt in the wound
- Bites and clenched-fist injuries (*see page 61, Bite prophylaxis*)
- Leg or arm wound PLUS either diabetic, weight over 100 kg, oedema or past skin infections in that location
- Severe crush injury
- Deep (e.g., muscle, joint, open fracture (compound fracture)) or penetrating (e.g., stab, through footwear) wound.

Administer prophylactic antibiotics as soon as possible after the injury and continue for up to 3 days. If established post-traumatic wound infection, *see page 56*.

Prophylactic antibiotic options

Cover any recent *Staphylococcus aureus* isolates, such as MRSA.

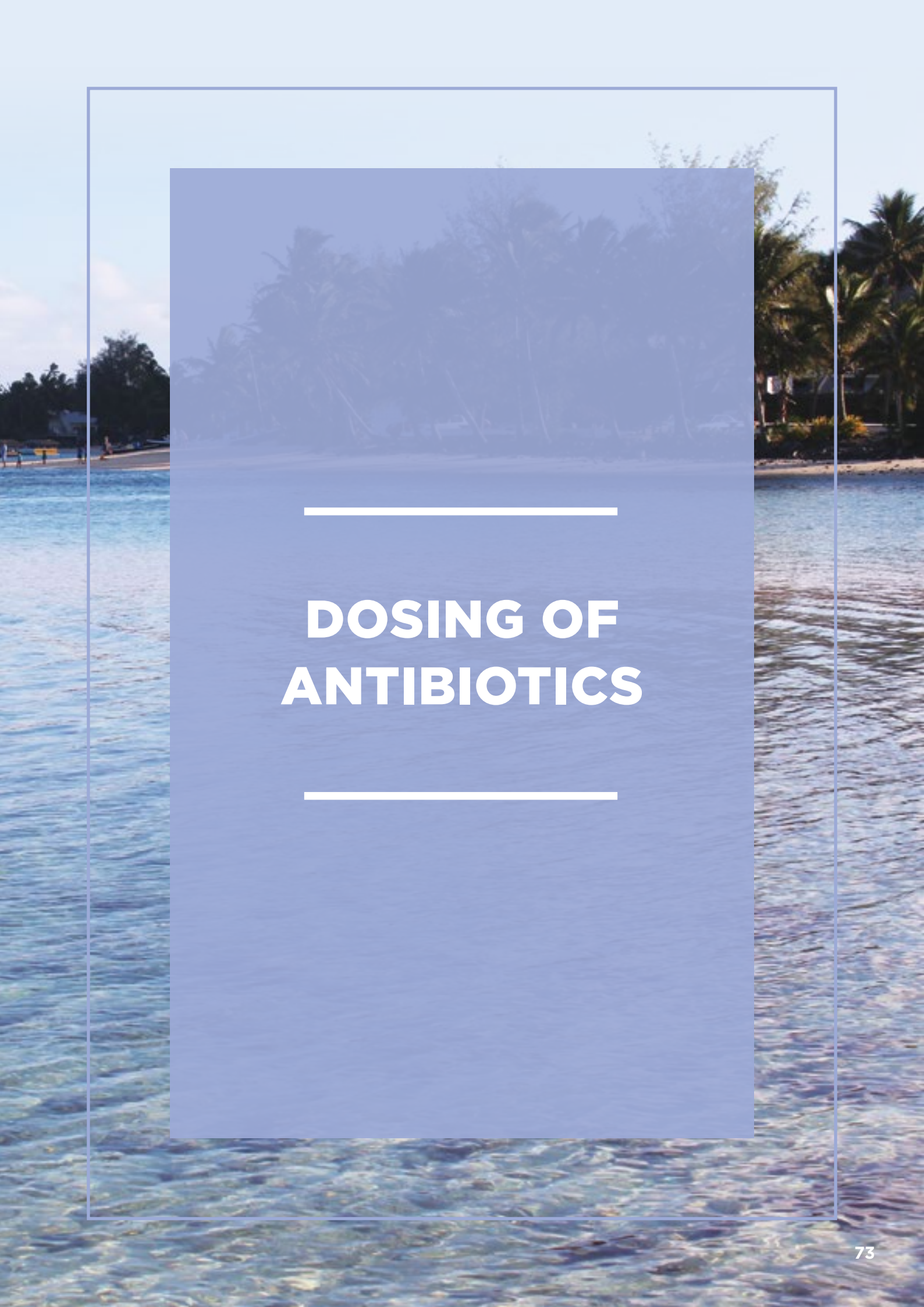
For wounds requiring surgical management:

- First choice: cefazolin 2 g (child: 50 mg/kg up to 2 g) IV, 8-hourly
  - » If heavily contaminated injury, add metronidazole B, orally (preferred) or IV
- Alternatives: oral trimethoprim+sulfamethoxazole P plus metronidazole B (*see doses below*), amoxicillin+clavulanate IV

For wounds not requiring surgical management:

- Trimethoprim+sulfamethoxazole P 160+800 mg (child > 1 month: 4+20 mg/kg up to 160+800) orally 2 times daily plus metronidazole B 400 mg (child: 10 mg/kg up to 400 mg) orally 2 times daily, or
- Amoxicillin+clavulanate 500+125 mg (child: 15 to 30 mg/kg up to 500+125 mg) orally 3 times daily, or
- Doxycycline P 100 mg (child over 8 years: 4 mg/kg up to 100 mg) orally daily plus metronidazole B, or
- Clindamycin 300 mg (child: 10 mg/kg up to 300 mg) orally 3 times daily

For seawater injuries (e.g., coral cuts) with indications for prophylactic antibiotics, give trimethoprim+sulfamethoxazole P, or the same antibiotics as are recommended for treatment of mild seawater injury infections (*see page 56 – Wound Infection – water injuries*), for 3 days.



DOSING OF ANTIBIOTICS

DOSING FOR NEWBORNS (CHILDREN < 28 DAYS OLD)

Based on the NZ Formulary for Children 2022 and Sanford Guide to Antimicrobial Therapy 2022.

For antibiotic dosing in pre-term infants, see the Starship Child Health guidelines for neonatal sepsis (starship.org.nz/guidelines/antibiotics-for-neonatal-sepsis) or seek expert paediatric infectious diseases advice.

ANTIBIOTIC	DOSE (MG/KG PER DOSE AT FREQUENCY INDICATED)	
	TERM BABY (> 37 WEEKS GESTATION) – DAYS AFTER BIRTH	
	0 TO 7 DAYS	8 TO 28 DAYS
Amoxicillin – IV	50 q12h	50 q6h or q8h
Amoxicillin – oral	–	15 to 30 TDS
Amoxicillin+clavulanate[1] – IV	30 q12h	30 q8h
Amoxicillin+clavulanate[1] – oral	15 to 30 TDS	15 to 30 TDS
Cefalexin	25 BD	8 to 21 days: 25 TDS. 22 to 28 days: 25 QID
Cefotaxime	50 q12h	50 q8h
Ceftazidime[RESTRICTED]	50 q12h	8 to 21 days: 50 q12h. 22 to 28 days: 50 q8h
Ceftriaxone[2]	50 q24h	50 q24h
Erythromycin – IV, oral	10 to 12.5 q6h	10 to 12.5 q6h
Flucloxacillin – IV	25 to 50 q12h	8 to 21 days: 25 to 50 q8h. 22 to 28 days: 25 to 50 q6h
Flucloxacillin – oral	25 BD	8 to 21 days: 25 TDS. 22 to 28 days: 25 QID
Gentamicin	*See Dosing of gentamicin in infants and children – page 88*	
Meropenem[RESTRICTED]	20 to 40 q12h	20 to 40 q8h
Metronidazole – IV, oral	7.5 q8h to q12h	7.5 q6h to q12h
Penicillin (Benzyl) – IV	30 to 50 q8h to q12h	30 to 50 q6h to q8h
Rifampicin	10 q12h	10 q12h
Vancomycin	*See Dosing of vancomycin – page 88*	

1. Dose expressed as the total dose of amoxicillin plus clavulanate

2. Cefotaxime is preferred for neonates. If cefotaxime not available, seek expert advice before using ceftriaxone

BD = 2 times daily; TDS = 3 times daily; QID = 4 times daily; q6h = 6-hourly; q8h = 8-hourly, q12h = 12-hourly, q24h = 24-hourly

DOSING FOR CHILDREN > 28 DAYS OLD

Based on the New Zealand Formulary for Children 2022.

These doses do not apply to newborns < 28 days. See specific dosing guidelines for certain infections, such as meningitis, endocarditis, pharyngitis, pneumonia, and otitis media. See individual drug tables on the following pages for amoxicillin, amoxicillin+clavulanate, azithromycin, cefalexin, doxycycline, flucloxacillin and trimethoprim+sulfamethoxazole. These doses are for children with normal renal function.

ANTIBIOTIC	DOSE (CHILD > 28 DAYS)	FREQUENCY OF DOSES
Amoxicillin – oral	15 to 30 mg/kg (max 1 g)	3 times daily[1]
Amoxicillin – IV	25 to 50 mg/kg (usual max 6 g/day; up to 8 to 12 g/day in severe infections)	6- to 8-hourly
Amoxicillin+clavulanate – oral	15 to 30 mg/kg total drug (both amoxicillin and clavulanate) (max 625 mg)	3 times daily
Amoxicillin+clavulanate – IV	30 mg/kg total drug (both amoxicillin and clavulanate) (usual max 1.2 g 8-hourly; up to 6-hourly in severe infections)	8-hourly
Azithromycin	10 mg/kg (max 500 mg) once daily on day 1, then 5 mg/kg (max 250 mg) once daily on days 2 to 5	Once daily
Cefaclor	10 mg/kg (max 500 mg)	3 times daily
Cefalexin	12.5 mg/kg (max 500 mg). Up to 25 mg/kg (max 1000 mg) may be used for step-down dosing from IV to oral for bone and joint infections	4 times daily
Cefazolin	25 to 50 mg/kg (max 2 g)	8-hourly
Ceftazidime[RESTRICTED]	50 mg/kg (usual max 6 g/day; up to 9 g/day in cystic fibrosis)	8-hourly
Ceftriaxone	50 mg/kg (meningitis 100 mg/kg) (max 4 g/day)	24-hourly (If dose > 2 g/day, split dose and give 12-hourly)
Ciprofloxacin – oral[2]	10 mg/kg (20 mg/kg in severe infections) (max 750 mg)	2 times daily
Clindamycin – oral	10 to 12.5 mg/kg (max 600 mg) 3 times daily or 10 mg/kg (max 600 mg) 4 times daily	3 or 4 times daily

1. Amoxicillin dosing different for pharyngitis, pneumonia and acute otitis media (see empiric and targeted guidelines).

2. Ciprofloxacin causes an adverse effect on cartilage development in animals, but this has not been proven in humans. Ciprofloxacin can be used in children when it is the drug of choice.

ANTIBIOTIC	DOSE (CHILD > 28 DAYS)	FREQUENCY OF DOSES
Doxycycline (not more than 21 days duration if < 8 yr)	1 to 2 mg/kg (max 100 mg)	2 times daily on day 1, then once daily for mild infections or 2 times daily for moderate-severe infections. Take with food, and remain sitting or standing for 30 min afterwards
Erythromycin – IV, oral	10 to 12.5 mg/kg (usual max 400 mg; severe infections max 1 g)	6-hourly, 4 times daily
Flucloxacillin – IV	25 to 50 mg/kg (max 2 g)	4- to 6-hourly (e.g., 4-hourly for severe infections)
Flucloxacillin – oral	12.5 to 25 mg/kg (max 1 g)	4 times daily
Gentamicin[3]	6 to 7.5 mg/kg (10 to 12 mg/kg if P. aeruginosa in cystic fibrosis), based on ideal body weight	24-hourly
Meropenem[RESTRICTED]	20 to 40 mg/kg (max 2 g)	8-hourly
Metronidazole – IV, oral[4]	7.5 mg/kg (max 400 mg PO, max 500 mg IV)	Age 1 to 2 months: 12-hourly, 2 times daily Age over 2 months: 3 times daily
Nitrofurantoin	1.5 mg/kg (max 50 mg)	4 times daily
Penicillin V – oral[5]	6.25 to 12.5 mg/kg (max 500 mg)	4 times daily
Penicillin G (Benzyl) – IV	30 to 50 mg/kg (max 2.4 g)	4- to 6-hourly
Roxithromycin	2.5 to 4 mg/kg (max 150 mg)	2 times daily
Trimethoprim+ sulfamethoxazole – oral	24 mg/kg total drug (both trimethoprim and sulfamethoxazole) (max 960 mg)	2 times daily
Vancomycin – IV[3]	30 mg/kg (max 1.5 g)	12-hourly

3. See guidelines for dosing in infants and children for gentamicin (page 88) or vancomycin (page 90).

4. Oral metronidazole is 95 – 100% absorbed, so is preferred over IV metronidazole unless vomiting or severe sepsis.

5. Oral amoxicillin is preferred because its pharmacokinetics are substantially better than penicillin V.

DOSING FOR CHILDREN – ORAL AMOXICILLIN BY WEIGHT

Based on dose of 15 to 30 mg/kg (max 1000 mg), usually taken 3 times daily.

It does not matter when you take amoxicillin in relation to food.

CHILD WEIGHT (KG)	AMOXICILLIN DOSE (USUALLY TAKEN 3 TIMES DAILY)		
	DOSE (MG)*	VOLUME OF 250 MG/5 ML LIQUID (ML)	CAPSULES (MG)
3	45 to 90	1 to 2	
4	60 to 120	1 to 2.5	
5	75 to 150	1.5 to 3	
6	90 to 180	2 to 4	
8	120 to 240	2.5 to 5	
10	150 to 300	3 to 6	
12	180 to 360	3.5 to 7	
15	225 to 450	4.5 to 9	
20	300 to 600	6 to 12	500
25	375 to 750	7.5 to 15	500 +/- 250
30	450 to 900	9 to 18	500 +/- 250
35	525 to 1000	10 to 20	500 +/- either 250 or 500
40	600 to 1000	12 to 20	500 +/- either 250 or 500
45	675 to 1000	14 to 20	500 + either 250 or 500
50	750 to 1000	15 to 20	500 + either 250 or 500
60	900 to 1000	18 to 20	2 x 500

**Choose higher dose if infection more severe*

DOSING FOR CHILDREN – ORAL AMOXICILLIN+CLAVULANATE BY WEIGHT

Based on dose of 15 to 30 mg/kg total drug (both amoxicillin and clavulanate, max 625 mg), usually taken 3 times daily.

Take amoxicillin+clavulanate with food to reduce stomach irritation.

CHILD WEIGHT (KG)	AMOXICILLIN+CLAVULANATE DOSE (USUALLY TAKEN 3 TIMES DAILY)		
	DOSE (MG)*	VOLUME OF 312.5 MG/5 ML LIQUID (ML)	TABLETS (MG)
3	45 to 90	1 to 1.5	
4	60 to 100	1 to 2	
5	75 to 150	1 to 2.5	
6	90 to 180	1.5 to 3	
8	120 to 240	2 to 4	
10	150 to 300	2.5 to 5	
12	180 to 360	3 to 6	
15	225 to 450	4 to 7	
20	300 to 600	5 to 10	½ x 625, or 625
25	375 to 625	6 to 10	½ x 625, or 625
30	450 to 625	7 to 10	625
35	525 to 625	8 to 10	625
40	600 to 625	10	625
45	625	10	625
50	625	10	625
60	625	10	625

**Choose higher dose if infection more severe*

DOSING FOR CHILDREN – ORAL AZITHROMYCIN BY WEIGHT

Based on dose of 10 mg/kg (max 500 mg), taken once daily on days 1 to 3.[1]

It does not matter when you take azithromycin in relation to food.

CHILD WEIGHT (KG)	AZITHROMYCIN DOSE (10 MG/KG, USUALLY TAKEN ONCE DAILY)		
	DOSE (MG)	VOLUME OF 200 MG/5 ML LIQUID (ML)	TABLETS (MG)
3	30	1	Discuss with pharmacy re crushing tablets
4	40	1	
5	50	1 to 1.5	
6	60	1.5	
8	80	2	
10	100	2.5	
12	120	3	
15	150	4	
20	200	5	½ x 500
25	250	6	½ x 500
30	300	7.5	½ x 500
35	350	9	½ x 500
40	400	10	500
45	450	11	500
50	500	12.5	500
60	500	12.5	500

1. Alternatively, use 10mg/kg on day 1, then 5mg/kg once daily on days 2, 3, 4 and 5

DOSING FOR CHILDREN – ORAL CEFALEXIN BY WEIGHT

Based on dose of 12.5 to 25 mg/kg (max 1000 mg), usually taken 4 times daily.

It does not matter when you take cefalexin in relation to food. Take flucloxacillin with a light meal or snack or on an empty stomach, not with a large meal.

CHILD WEIGHT (KG)	CEFALEXIN DOSE (USUALLY TAKEN 4 TIMES DAILY)		
	DOSE (MG)*	VOLUME OF 250 MG/5 ML LIQUID (ML)	CAPSULES (MG)
3	37.5 to 75	1 to 1.5	
4	50 to 100	1 to 2	
5	62.5 to 125	1.5 to 2.5	
6	75 to 150	1.5 to 3	
8	100 to 200	2 to 4	
10	125 to 250	2.5 to 5	
12	150 to 300	3 to 6	
15	187.5 to 375	4 to 7.5	
20	250 to 500	5 to 10	500
25	312.5 to 625	6.5 to 13	500
30	375 to 750	7.5 to 15	500
35	437.5 to 875	9 to 18	500
40	500 to 1000	10 to 20	1 or 2 x 500
45	562.5 to 1000	12 to 20	1 or 2 x 500
50	625 to 1000	13 to 20	1 or 2 x 500
60	750 to 1000	15 to 20	2 x 500

**Choose higher dose if infection more severe*

DOSING FOR CHILDREN – ORAL DOXYCYCLINE BY WEIGHT

Based on dose of 1 to 2 mg/kg (max 100 mg), taken 2 times daily on day 1, then either 1 or 2 times daily thereafter, depending on severity of infection.

Take with food, and remain sitting or standing for 30 min afterwards. Do not prescribe doxycycline for more than 21 days duration if child less than 8 years old.

CHILD WEIGHT (KG)	DOXYCYCLINE DOSE (1 TO 2 MG/KG, TAKEN 2 TIMES DAILY ON DAY 1, THEN 1 OR 2 TIMES DAILY, DEPENDING ON SEVERITY OF INFECTION)	
	DOSE (MG)*	TABLETS (MG)
3	3 to 6	Discuss with pharmacy re crushing tablets
4	4 to 8	
5	5 to 10	
6	6 to 12	
8	8 to 16	
10	10 to 20	
12	12 to 24	
15	15 to 30	
20	20 to 40	
25	25 to 50	½ x 100
30	30 to 60	½ x 100
35	35 to 70	½ x 100
40	40 to 80	½ x 100, or 100
45	45 to 90	½ x 100, or 100
50	50 to 100	½ x 100, or 100
60	60 to 100	½ x 100, or 100

**Choose higher dose if infection more severe*

DOSING FOR CHILDREN – ORAL FLUCLOXACILLIN BY WEIGHT

Based on dose of 12.5 to 25 mg/kg (max 1000 mg), usually taken 4 times daily.

Take flucloxacillin with a light meal or snack or on an empty stomach, not with a large meal.

CHILD WEIGHT (KG)	FLUCLOXACILLIN DOSE (USUALLY TAKEN 4 TIMES DAILY)		
	DOSE (MG)*	VOLUME OF 250 MG/5 ML LIQUID (ML)	CAPSULES (MG)
3	37.5 to 75	1 to 1.5	
4	50 to 100	1 to 2	
5	62.5 to 125	1.5 to 2.5	
6	75 to 150	1.5 to 3	
8	100 to 200	2 to 4	
10	125 to 250	2.5 to 5	
12	150 to 300	3 to 6	
15	187.5 to 375	4 to 7.5	
20	250 to 500	5 to 10	250 or 500
25	312.5 to 625	6.5 to 13	250 or 500
30	375 to 750	7.5 to 15	500 +/- 250
35	437.5 to 875	9 to 18	500 +/- 250
40	500 to 1000	10 to 20	500 +/- either 250 or 500
45	562.5 to 1000	12 to 20	500 +/- either 250 or 500
50	625 to 1000	13 to 20	500 +/- either 250 or 500
60	750 to 1000	15 to 20	2 x 500

**Choose higher dose if infection more severe*

DOSING FOR CHILDREN – ORAL TRIMETHOPRIM+SULFAMETHOXAZOLE BY WEIGHT

Based on dose of 24 mg/kg total drug (both trimethoprim and sulfamethoxazole, max 960 mg), taken 2 times daily.

Take trimethoprim+sulfamethoxazole (P) with food to reduce stomach irritation.

CHILD WEIGHT (KG)	TRIMETHOPRIM+SULFAMETHOXAZOLE (P) DOSE (USUALLY TAKEN 2 TIMES DAILY)		
	DOSE (MG)	VOLUME OF 240 MG/5 ML LIQUID (ML)	TABLETS (MG)
3	72	1.5	
4	96	2	
5	120	2.5	
6	144	3	
8	192	4	
10	240	5	
12	288	6	
15	360	7.5	
20	480	10	480
25	600	12.5	480
30	720	15	480 + ½ x 480
35	840	17.5	2 x 480
40	960	20	2 x 480
45	960	20	2 x 480
50	960	20	2 x 480
60	960	20	2 x 480

(P) *Contra-indicated or caution in pregnancy; see pages 101 – 102*

DOSING FOR ADULTS

Based on EUCAST Clinical Breakpoint Tables 2022 and other sources for standard dose, and the Australian Therapeutic Guidelines and NZ datasheets for dosing in renal impairment.

Dose at the higher end of the range if patient has severe infection, immune-compromise, or GFR over 150 mL/min, known causative organism is 'intermediate-susceptible', or in the first 1 to 2 days of treatment (especially if patient's weight is over 120 kg), For IV dosing in critically ill patients *see page 86*. For high-dose oral dosing *see page 94*.

ANTIBIOTIC	DOSE BY GLOMERULAR FILTRATION RATE (ML/MIN)[1]			
	> 50 (NORMAL)	30–50	10–30	< 10
Amoxicillin	500 mg to 1 g orally 3 times daily, 1 to 2 g IV 6- to 8-hourly	Normal	100% 3 times daily or 8-hourly	100% 2 times daily
Amoxicillin+ clavulanate	500+125 mg orally 3 times daily (to increase dose add extra amox 500 mg), 1000+200 mg IV 6-hourly	Normal	100% 12-hourly	100% 12-hourly
Azithromycin	500 mg orally daily	No dose adjustment required in renal impairment		
Cefaclor	500 mg to 1 g orally 3 times daily	Normal	Normal	12-hourly
Cefazolin	1 to 2 g IV or IM 8-hourly	Normal	100% 12-hourly	50% 24-hourly
Ceftazidime RESTRICTED	1 to 2 g IV 8-hourly	50% 8-hourly	50% 12-hourly	25 – 50% 24-hourly
Ceftriaxone	2 g IV (or IM with 1% or 2% lidocaine*) daily	No dose adjustment required in renal impairment		
Cefalexin	500 mg to 1 g orally 3 or 4 times daily	Normal	Normal	50 – 100% 2 or 3 times daily
Ciprofloxacin	500 to 750 mg orally 2 times daily	Normal	100% 24-hourly	100% 24-hourly
Clindamycin	300 mg orally 3 or 4 times daily	No dose adjustment required in renal impairment		
Doxycycline	100 to 200 mg once daily, or 100 mg 2 times daily	No dose adjustment required in renal impairment		
Erythromycin	Erythromycin ethylsuccinate 400 mg 4 times daily or 800 mg 2 times daily orally. Erythromycin lactobionate 12.5 mg/kg (up to 1 g) every 6 hours IV	Normal	Normal	50 to 75% at normal interval

1. For calculation of GFR see page 87 Calculation of Glomerular Filtration Rate.

** If using ceftriaxone for IM injection, dilute 1.75 mL of lidocaine 2% with 1.75 mL of water for injection, then use this 3.5 mL solution to reconstitute a ceftriaxone 1g vial for IM use. Administer 2 mL of the reconstituted solution for 0.5 g dose and 4 mL for a 1 g dose.*

ANTIBIOTIC	DOSE BY GLOMERULAR FILTRATION RATE (ML/MIN)[1]			
	> 50 (NORMAL)	30–50	10–30	< 10
Flucloxacillin	1 g orally 3 or 4 times daily, 2 g IV 4- to 6-hourly	Normal	Normal	Orally: 100% 8-hourly. IV: 100% 8- to 12-hourly
Gentamicin	*See pages 88 and 89*			
Meropenem RESTRICTED	1 to 2 g IV 8-hourly	100% 8- to 12-hourly	50% 8 to 12-hourly	50 to 100% 24-hourly
Metronidazole	7.5 mg/kg (mild- moderate infection) or 15 mg/kg (severe infection) orally or IV 12-hourly (up to 4 g/day)	No dose adjustment required in renal impairment Note: oral metronidazole is 95 to 100% absorbed from the gastrointestinal tract, so is preferred over IV metronidazole unless vomiting or severe sepsis		
Nitrofurantoin	50 mg 4 times daily or 100 mg orally 3 times daily	Avoid if GFR < 40 mL/min	Avoid	Avoid
Penicillin G (benzylpenicillin)	600 mg to 1.8 g (1 to 3 MU) IV 4- to 6-hourly	75% at normal interval	75% at normal interval	25 to 50% at normal interval
Rifampicin	300 to 600 mg orally 2 times daily	Normal	Normal	50 to 100% at normal interval
Roxithromycin	300 mg orally daily	No dose adjustment required in renal impairment		
Trimethoprim	300 mg orally daily	Normal	GFR >15: normal, monitor CBC and potassium closely GFR < 15: as per < 10	Avoid or 150 mg daily and monitor CBC and potassium closely
Trimethoprim+ sulfamethoxazole	160+800 mg to 240+1200 mg orally 2 times daily	Normal	GFR 25 to 50: 160+800 mg 2 times daily for up to 14 days then 80+400 mg 2 times daily and monitor CBC and potassium closely. GFR 15 to 25: Avoid, or 160+800 mg 2 times daily for up to3 days then 160+800 mg daily and monitor CBC and potassium closely	GFR < 15: Avoid; if essential, 160+800 mg daily and monitor CBC and potassium closely
Vancomycin	*See pages 90 and 91*			

1. For calculation of GFR see page 87 Calculation of Glomerular Filtration Rate.

DOSING FOR CRITICALLY ILL ADULT PATIENTS

Infections in severely ill hospital inpatients are more likely to be caused by resistant organisms and at high microbial loads. Treatment of severely ill patients with infections is also difficult because of changes in antibiotic pharmacokinetics due to abnormal blood flow, renal failure, liver dysfunction, oedema and variable protein binding; as a result, underdosing of antibiotics is common.

The table below includes recommended loading and maintenance doses for critically ill adult patients. *See Dosing for Adults, pages 84 – 85*, for advice on reducing antibiotic doses in renal impairment. The converse also applies: increase the maintenance dose of cefazolin, flucloxacillin, meropenem and penicillin G by 10 to 25% in patients with extra-ordinary renal clearance (GFR > 150 mL/min).

ANTIBIOTIC	DOSE IN CRITICAL ILLNESS
Cefazolin	Loading dose: 2 g IV if not oedematous; 3 g if oedematous or weight > 120 kg Maintenance dose: 2 g IV 6-hourly
Ceftriaxone	Loading dose: 2 g IV if not oedematous; 3 g if oedematous or weight > 120 kg Maintenance dose: 2 g IV 12-hourly
Ciprofloxacin	750 mg PO 12-hourly
Flucloxacillin	Loading dose: 2 g IV if not oedematous; 3 g if oedematous or weight > 120 kg Maintenance dose: 2 g IV 4-hourly
Gentamicin	7 mg/kg 24-hourly for 48 hours (based on ideal body weight not actual body weight. *See page 87*). *See also pages 88 and 89.*
Meropenem RESTRICTED	Loading dose: 2 g IV Maintenance dose: 2 g IV 8-hourly
Metronidazole B	Loading dose: 15 mg/kg IV Maintenance dose: 15 mg/kg IV 12-hourly (not more than 4 g/24h)
Penicillin G (benzylpenicillin)	Loading dose: 2.4 g (4 MU) IV Maintenance dose: 2.4 g (4 MU) IV 4-hourly
Vancomycin *See also pages 90 and 91*	Loading dose: 25 mg/kg* IV if not oedematous; increase to approximately 30 mg/kg* if oedematous Maintenance dose: 15 to 20 mg/kg IV 8 to 12-hourly (max single dose 2 g). For individual doses over 1 g, infuse over 1.5 to 2 hours **Use actual body weight, even if obese*

B *Contra-indicated or caution when breastfeeding; see pages 101 – 102*

CALCULATION OF GLOMERULAR FILTRATION RATE

In patients with renal impairment, antibiotics or their metabolites that are excreted entirely or in part by the kidneys can accumulate, and dosage adjustment might be required. Glomerular filtration rate (GFR) is usually proportional to renal drug clearance and the Cockcroft-Gault formula is a reasonably accurate way to estimate this (except in patients with very low muscle mass (cachexia)). GFR can be calculated quickly and easily using a free smartphone app, like ClinCalc, or other online calculator. Enter your patient's age, gender, height, weight and creatinine. Alternatively, GFR can be calculated from the formulate and table below.

Cockcroft-Gault formula (adults)

$$\text{CrCl (mL/min)} = \frac{\text{(140-age) x ideal weight (kg)}}{\text{0.814 x serum creatinine (micromol/L)}}$$

Multiply above formula by 0.85

Ideal body weight formula (adults)

50 kg + 0.9 kg for each cm over 152 cm

45.5 kg + 0.9 kg for each cm over 152 cm

Ideal body weight table (adults)

HEIGHT		IDEAL BODY WEIGHT (KG)	
CM	INCHES	WOMEN	MEN
155	61	48	53
160	63	53	57
165	65	57	62
170	67	62	66
175	69	66	71
180	71	71	75
185	73	75	80
190	75	80	84
195	77	84	89
200	79	89	93
205	81	93	98
210	83	98	102
215	85	102	107
220	87	107	111

Modified Schwartz formula (children over 1 year)

$$\text{GFR (mL/min/1.73 m}^2\text{)} = \frac{\text{36.5 x height (cm)}}{\text{serum creatinine (micromol/L)}}$$

DOSING OF GENTAMICIN

Based on the Australian Therapeutic Guidelines 2022

Gentamicin is most often used as empirical therapy for suspected acute gram-negative bacillus infections for the first 48 hours, after which it is replaced by other antibiotics, to avoid toxicity. Gentamicin may be used for 2 to 6 weeks in combination with other antibiotics, either in high-dose IV or nebulised, for serious *Pseudomonas aeruginosa* lung infections (typically cystic fibrosis or other causes of bronchiectasis) or low-dose IV for streptococcal and enterococcal endocarditis.

Contraindications and precautions

Always avoid if vestibular or auditory toxicity caused by an aminoglycoside in the past, or myasthenia gravis. Also preferably avoid if pre-existing significant hearing loss or tinnitus, pre-existing dizziness, vertigo or balance problems, renal impairment (GFR less than 40 mL/min), advanced age (e.g., over 80 years), chronic liver disease or severe cholestasis (serum bilirubin > 90).

Dosing of gentamicin in infants and children

Base doses on ideal body weight unless actual body weight is lower. Ideal body weight can be estimated by using the corresponding weight for the height or length percentile on a growth chart.

AGE	DOSE OF GENTAMICIN	DOSING FREQUENCY	MAXIMUM NUMBER OF EMPIRICAL DOSES
Neonates 30 to 34 weeks post-menstrual age [1]	5 mg/kg [2]	36-hourly [2]	2 doses (at 0 and 36 hours) [2]
Neonates 35 weeks post-menstrual age [1] or older	5 mg/kg	24-hourly	3 doses (at 0, 24 and 48 hours)
Infants 1 month and older, and children up to 10 years	7.5 mg/kg up to 320 mg [3]	24-hourly	3 doses (at 0, 24 and 48 hours)
Children 10 years and older	6 mg/kg up to 560 mg (septic shock or in ICU 7 mg/kg) [3]	24-hourly	3 doses (at 0, 24 and 48 hours)

1. Post-menstrual age is the time elapsed between the first day of the last menstrual period and birth (gestational age) plus the time elapsed after birth (post-natal age).

2. For ease of nursing administration, 5 mg/kg given 48-hourly for 1 or 2 doses is an option.

3. Use up to 10 – 12 mg/kg IV 24-hourly for Pseudomonas aeruginosa infections in cystic fibrosis.

Gentamicin dosing by nebuliser for *Pseudomonas aeruginosa* infections in bronchiectasis

Use 160 mg (4 mL) nebulised once or 2 times daily after bronchodilation for 2 to 3 weeks in combination with intravenous or oral antibiotics for *P. aeruginosa* infective flares of bronchiectasis.

Gentamicin dosing in adults with streptococcal or enterococcal endocarditis

Discuss with Infectious Disease Physician as there usually are alternatives to using gentamicin. If CrCL is less than 20 mL/min, do not use gentamicin; if more than 20 mL/min, consider using gentamicin 3 mg/kg IV once daily and doing gentamicin level testing. When testing gentamicin levels, measure the first level 30 minutes after the end of the infusion (1 hour after the start of the infusion) and the second level 6 to 14 hours later. Measure patient weight and serum creatinine the same day. Request expert advice from Clinical Pharmacy staff on optimal dosing based on computerised AUC (area under the curve) modelling (target AUC24h of 30 to 50 mg/L.hr for endocarditis). Measure creatinine at least 2 times weekly.

Gentamicin dosing in adults with acute systemic infection

If possible, use a smartphone app to calculate the initial and subsequent gentamicin doses.
Alternatively, follow the quick guide or the detailed steps below.

Quick guide for 3-day empiric gentamicin dosing in adults

Actual body weight	50 kg	60 kg	70 kg	80 kg	90 kg	100 kg	110 kg or more
Gentamicin dose for normal renal function	200 to 360 mg q24h	240 to 420 mg q24h	280 to 480 mg q24h	320 to 560 mg q24h	360 to 600 mg q24h	360 to 640 mg q24h	400 to 680 mg q24h
Gentamicin dose for GFR 40 – 60 mL/min	200 to 240 mg q36h	240 to 320 mg q36h	280 to 360 mg q36h	320 to 400 mg q36h	360 to 440 mg q36h	360 to 440 mg q36h	400 to 480 mg q36h

STEP 1. Ensure patient is hydrated

STEP 2. Determine dosing weight
Weigh patient (= Total Body Weight, TBW), measure patient height, and calculate ideal body weight (IBW, *see page 87*). If TBW is less than IBW, use TBW. If TBW is 1 to 1.25 x IBW, use IBW. If TBW is more than 1.25 x IBW, use adjusted body weight (AdjBW). AdjBW = IBW + 0.4 (TBW – IBW). If AdjBW is over 100 kg, use a value of 100 to calculate the dose.

STEP 3. Estimate creatinine clearance by Cockcroft-Gault formula
See page 87 for Cockcroft-Gault formula. If serum creatinine < 60 micromol/L, use a value of 60 in the Cockcroft-Gault formula.

STEP 4. Choose dose (for 3-day empiric treatment)

CRCL (ML/MIN)	DOSE*	FREQUENCY
Greater than 60	Severe sepsis 7 mg/kg Most other infections 4 – 5 mg/kg	3 doses (0, 24 and 48 hours) then stop
40 – 60	Severe sepsis 5 mg/kg Most other infections 4 – 5 mg/kg	2 doses (0 and 36 hours) then stop
Less than 40	Severe sepsis 4 mg/kg Most other infections 4 mg/kg	1 dose (0 hours) then stop

**Based on dosing weight (STEP 2). Round dose to the nearest multiple of 40 mg. Give by IV infusion over 30 min in 100 mL sodium chloride 0.9%. Chart only as STAT dose, not regular daily dose.*

STEP 5. Monitoring
Monitor creatinine daily while giving gentamicin. Stop gentamicin if any signs of vestibular toxicity (e.g., loss of balance or unsteadiness (especially when sitting up, standing up or walking) or oscillopsia (a sensation of the vision jumping up and down when walking), or hearing loss.

DOSING OF VANCOMYCIN

Based on the Australian Therapeutic Guidelines 2022

If possible, use a smartphone app to calculate the initial and subsequent vancomycin doses. Alternatively, follow the quick guide or the detailed instructions below.

Quick guide for 3-day empiric gentamicin dosing in adults

In general, dose higher for severe illness, or suspected meningitis or brain abscess.

Actual body weight	40 to 49 kg	50 to 64 kg	65 to 78 kg	79 to 92 kg	93 to 107 kg	108 kg or more	110 kg or more
Vancomycin dose for normal renal function	750 mg q12h	1 g q12h	1.25 g q12h	1.5 g q12h	1.75 g q12h	2 g q12h	400 to 680 mg q24h
Vancomycin dose for GFR 20 to 60 mL/min	750 mg q24h	1 g q24h	1.25 g q24h	1.5 g q24h	1.75 g q24h	2 g q24h	400 to 480 mg q36h

Loading dose

For adults with severe infection give a loading dose of 25 to 30 mg/kg of actual body weight. The role of a loading dose in children is unclear, but for neonates with severe infection give a loading dose of 20 mg/kg of actual body weight and for older children with severe infection give a loading dose of 25 to 30 mg/kg of actual body weight.

Initial dose and timing of trough concentration measurement for infants and children

For children with impaired renal function (GFR < 50 mL/min/1.73 m^2) seek expert advice. Use the modified Schwartz formula (*see page 87*) to estimate GFR.

AGE		STARTING DOSE (USE ACTUAL BODY WEIGHT)	DOSING FREQUENCY	TIMING OF TROUGH (PRE-DOSE) PLASMA CONCENTRATION MEASUREMENT
Neonates younger than 30 weeks post-menstrual age[1]	Post-natal age 0 to 2 days	15 mg/kg	18-hourly	Before the second dose
	Post-natal age 3 days or older	15 mg/kg	12-hourly	Before the third dose
Neonates 30 to 36 weeks post-menstrual age[1]	Post-natal age 0 to 14 days	15 mg/kg	12-hourly	Before the third dose
	Post-natal age 15 days or older	15 mg/kg	8-hourly	Before the fourth dose
Neonates 37 to 44 weeks post-menstrual age[1]	Post-natal age 0 to 7 days	15 mg/kg	12-hourly	Before the third dose
	Post-natal age 8 days or older	15 mg/kg	8-hourly	Before the fourth dose
Neonates 45 weeks post-menstrual age or older		15 mg/kg	6-hourly	Before the fifth dose
Infants and children		30 mg/kg up to 1.5 g	12-hourly	Before the third dose

1. Post-menstrual age is the time elapsed between the first day of the last menstrual period and birth (gestational age) plus the time elapsed after birth (post-natal age)

Initial dose and timing of trough concentration measurement for adults

CREATININE CLEARANCE [1] (ML/MIN) SEE PAGE 87	STARTING MAINTENANCE DOSE	TIMING OF TROUGH (PRE-DOSE) PLASMA CONCENTRATION MEASUREMENT[2]	TARGET TROUGH CONCENTRATION (MG/L)
Greater than 60	15 to 20 mg/kg actual body weight[3] 12-hourly[4]	Before the fourth dose	15 to 20
20 to 60	15 to 20 mg/kg actual body weight[3] 24-hourly[4]	Before the third dose	15 to 20
Less than 20	15 to 20 mg/kg actual body weight[3] 48- to 72-hourly[4]	48 hours after the first dose	15 to 20

1. Monitor creatinine regularly (e.g., 2 to 3 times weekly).
2. If a loading dose is given, it is considered the first dose.
3. If actual body weight is over 120 kg, ask Pharmacist for advice.
4. Prescribe at higher end of dose range if brain abscess or meningitis.

Special circumstances

- For CAPD (does not remove vancomycin from serum), dose as per ClCr less than 20 mL/min.
- For critically ill patients – *see page 86.*

Administration

Infuse each vancomycin dose in 100 to 250 mL 0.9% sodium chloride or 5% dextrose (not more than 5 mg/mL) not faster than 10 mg/minute (e.g., 1.5 g given in at least 300 mL and infused over at least 2 ½ hours). If given more rapidly, non-specific histamine release may be triggered leading to angioneurotic oedema, flushed skin and/or hypotension ("red-man syndrome"). If a 10 mg/minute infusion rate is tolerated, shorter infusion times may be possible, but should not be less than 60 minutes for each 1 g.

Dose adjustment

Reduce dose of vancomycin or change to another antibiotic if creatinine clearance deteriorates.
The recommended target trough concentrations are:

- Adults – intermittent infusion: 15 to 20 mg/L.
- Children – 6-hourly regimen: 10 to 20 mg/L
- Children – 12-hourly regimen: 7 to 10 mg/L

Aim for a slightly higher trough concentration in very sick patients or those with central nervous system or meningeal infections (e.g., 25 mg/L) and a slightly lower trough concentration (e.g., 10-14 mg/L) in patients with mild infections, renal impairment or concomitant nephrotoxins such as gentamicin or loop diuretics. Dose adjustments should be done in a simple linear way – for example if the trough concentration is half the target, double the dose. In patients receiving prolonged vancomycin treatment, vancomycin concentration and creatinine levels should be monitored weekly, or more frequently in patients with impaired or rapidly changing renal function or those receiving concomitant nephrotoxins.

INTRAVENOUS TO ORAL SWITCHING

Oral antibiotics may not be reliably absorbed in patients who are severely ill, but it makes sense to switch the patient to oral antibiotics when he/she is recovering. This is because IV antibiotics are approximately 10 times more expensive than oral antibiotics, IV antibiotics take longer for nurses to prepare and administer than oral antibiotics, and IV antibiotics require venous-access catheters, which can clot, cause pain or become infected. Patients usually prefer oral antibiotics.

When can a patient be switched from IV to oral antibiotics?

Most patients who are clinically improved and are likely to absorb oral antibiotics can be switched at 48 hours.

Uncontrolled infection? (e.g. fever > 38°C, pulse > 90, respiratory rate > 20, hypoperfusion or hypotension, organ dysfunction, toxic neutrophils)

YES > CONTINUE IV ANTIBIOTICS

NO ⌄

Guideline specifically recommends prolonged high-dose antibiotic? (e.g. intra-cranial infection, endocarditis, cystic fibrosis or bronchiectasis flare)

YES > CONTINUE IV ANTIBIOTICS

NO ⌄

Oral route compromised? (Vomiting, bowel obstruction, swallowing disorder, active GI bleeding, unconscious, nil by mouth)

YES > CONTINUE IV ANTIBIOTICS

NO ⌄

Oral medication available?

NO > CONTINUE IV ANTIBIOTICS

YES ⌄

SWITCH TO ORAL ANTIBIOTICS

Empiric IV to oral switch choices

If the causative bacteria are known, switch to an oral antibiotic based on tested or predicted susceptibility results. If the causative bacteria are not known, either switch to an oral antibiotic from the list of options in the empiric guidelines for that infection, or from the list below.

IV ANTIBIOTIC(S)	ORAL ANTIBIOTIC(S) WITH SIMILAR COVER
Amoxicillin, benzylpenicillin	Amoxicillin
Amoxicillin + clavulanate	Amoxicillin+clavulanate
Cefazolin	Cefalexin, flucloxacillin
Ceftazidime	Ciprofloxacin P B
Ceftriaxone	Amoxicillin+clavulanate, cefalexin, trimethoprim+sulfamethoxazole P
Clindamycin	Clindamycin
Erythromycin	Erythromycin, roxithromycin, or azithromycin
Flucloxacillin	Flucloxacillin, cefalexin
Gentamicin	Ciprofloxacin P B
Meropenem	Amoxicillin+clavulanate plus ciprofloxacin P B
Metronidazole	Metronidazole B
Vancomycin	Skin/soft tissue: trimethoprim+sulfamethoxazole P, doxycycline P or clindamycin Lung, abdomen or urine: amoxicillin

P *Contra-indicated or caution in pregnancy; see pages 101 – 102*

B *Contra-indicated or caution when breastfeeding; see pages 101 – 102*

HIGH-DOSE ORAL ANTIBIOTICS IN ADULTS

High-dose oral antibiotics are used when the patient has a severe, deep infection (e.g., acute cellulitis or soft tissue abscess, osteomyelitis, septic arthritis) but does not need to be in hospital or to take IV antibiotics (*see IV to oral switching above*). Administration by the oral route can often achieve similar blood and tissue concentrations to the IV route. In all situations of high-dose oral antibiotics below, take with food to reduce nausea and in to generally improve serum concentration profile.

BACTERIAL CAUSE OF INFECTION	HIGH-DOSE ORAL OPTIONS (IF SUSCEPTIBLE) IN APPROXIMATE ORDER OF PREFERENCE
Streptococci	• Amoxicillin 1 g 3 times daily • Cefalexin 1 g 4 times daily +/- probenecid 500 mg 4 times daily (depending on species) » GFR 30 to 60 mL/min: reduce probenecid to 2 times daily, or no probenecid » GFR < 30 mL/min: no probenecid • Clindamycin 300 mg 4 times daily or 450 mg 3 times daily • Trimethoprim+sulfamethoxazole (P) 160+800 mg 2 or 3 times daily » *See Dosing for adults (page 85) if renal impairment* • Doxycycline (P) 200 mg daily
Staphylococci	• Amoxicillin 1 g 3 or 4 times daily » GFR 45 to 60 mL/min: 1 g 3 times daily • Cefalexin 1 g + probenecid 500 mg 4 times daily » GFR 30 to 60 mL/min: reduce probenecid to 2 times daily, or no probenecid » GFR < 30 mL/min: no probenecid • Flucloxacillin 1 g + probenecid 500 mg 4 times daily » GFR 30 to 60 mL/min: reduce probenecid to 2 times daily » GFR < 30 mL/min: insufficient data • Trimethoprim+sulfamethoxazole (P) 160+800 mg 2 or 3 times daily » *See Dosing for adults (page 85) if renal impairment* • Clindamycin 300 mg 4 times daily or 450 mg 3 times daily • Doxycycline (P) 200 mg daily
Enterococci	• Amoxicillin 1 g + probenecid 500 mg both 4 times daily (depending on MIC) » GFR 30 to 60 mL/min: reduce probenecid to 2 times daily » GFR < 30: no probenecid
Enterobacterales (e.g., *E. coli*, *Klebsiella* spp.)	• Trimethoprim+sulfamethoxazole (P) 160+800 mg 2 or 3 times daily » *See Dosing for adults (page 85) if renal impairment* • Ciprofloxacin (P) (B) 500 mg 2 times daily » GFR < 30 mL/min: 500 mg daily • Amoxicillin+clavulanate 500+125 mg 3 times daily plus amoxicillin 500 mg 3 times daily (+/- probenecid)
Pseudomonas aeruginosa	• Ciprofloxacin (P) (B) 750 mg 2 times daily » GFR < 30 mL/min: 750 mg daily

(P) *Contra-indicated or caution in pregnancy; see pages 101 – 102*

(B) *Contra-indicated or caution when breastfeeding; see pages 101 – 102*

PROBENECID

Probenecid inhibits renal tubular secretion and probably hepatic metabolism of some penicillin and cephalosporin antibiotics. For example, probenecid reduces the clearance of flucloxacillin by 72%, and doubles the time that the plasma flucloxacillin concentration is above what is needed to inhibit *Staphylococcus aureus*. This interaction has been used since 1950 to 'boost' the exposure of some penicillin and cephalosporin antibiotics in the blood, thereby making the antibiotic more effective or need to be taken less often.

Probenecid contraindications

Do not use probenecid if the patient has a previous allergy or adverse reaction to probenecid, is taking high-dose aspirin therapy (e.g., for acute rheumatic fever), has moderate to severe kidney disease (GFR < 35 mL/min), has a past history of uric acid kidney stones, or is currently suffering from an attack of gout. If the patient has a past history of attacks of gout, then probenecid could trigger another attack. In this situation, you should either avoid probenecid or give gout prophylaxis (e.g., colchicine).

Caution: limited data in breastfeeding.

Probenecid side effects

Probenecid can cause nausea and headache – this risk is reduced if probenecid is taken with food. When patients are taking an antibiotic with probenecid, please advise the patients to take their antibiotic and probenecid together at the same time, with food. Probenecid allergy (rash) is uncommon.

Probenecid interactions

Probenecid affects the clearance of some other medications. Please check what other medications the patient is taking. Important and common interactions include:

- **Paracetamol**. Probenecid reduces the clearance of paracetamol to about 50% of normal. Do not prescribe more paracetamol than 500 mg 4 times daily or 1000 mg 2 times daily while the patient is taking probenecid.
- **Non-steroidal anti-inflammatory drugs (NSAIDs).** Probenecid reduces the clearance of many NSAID medicines (e.g., diclofenac, ibuprofen, naproxen) from the body but it is not certain how strong this effect is. This is not important for people taking low-dose aspirin (100 mg daily) but may be important for people taking full-dose NSAID medicines. Please reduce the dose of the NSAID by 25% to 30% while the patient is taking probenecid.

SAFETY AND SUBSTITUTIONS

ANTIBIOTIC ALLERGY AND CROSS-REACTIVITY

Based on Australian Therapeutic Guidelines 2022 and several recent journal publications, including J Allergy Clin Immunol Pract 2019; 7(8): 2722-38, JAMA Intern Med 2020; 180(5): 745-52, J Allergy Clin Immunol 2015; 136: 685-91, Pharmacy 2019; 7: 103, and Lancet 2019; 393(10167): 183-98)

When is an allergy, not an allergy?

Most patient-reported antibiotic allergies are not true. If the allergic reaction occurred more than 5 years ago, was not severe, did not require treatment or hospitalisation, and the same or similar antibiotics have subsequently been tolerated, the likelihood of a true allergy is less than 1%. If uncertain, give antibiotic by graded challenge (*see below*).

Cross-reactions

Diarrhoea, vomiting, nausea, headache and thrush are not allergies. They are intolerances and do not prevent use of other antibiotics from the same group.

Penicillins, cephalosporins and carbapenem (e.g., meropenem) cross-reactions

Cross-reactions between these beta-lactam antibiotics is now known to occur mainly within groups of drugs with the same or similar side chains. The risk of cross-reaction is mainly within the following groups:

- Penicillin V and benzylpenicillin (penicillin G)
- Ampicillin, amoxicillin, cefaclor and cefalexin
- Ceftriaxone, cefotaxime, cefepime and cefuroxime.

To determine the risk of a cross-reaction between beta-lactams and appropriate prescriber response, use tables below.

Cross-reaction risk

- < 2%
- 2 to 10%
- > 10%

	Amoxicillin, ampicillin, or amox+ clavulanate	Penicillin	Flucloxacillin	Piperacillin+tazobactam	Cefalexin or cefaclor	Cefazolin	Cefuroxime, ceftriaxone or cefotaxime	Ceftazidime	Meropenem
Amoxicillin, ampicillin, or amox+ clavulanate	> 10%	2 to 10%	2 to 10%	2 to 10%	> 10%	< 2%	< 2%	< 2%	< 2%
Penicillin		> 10%	2 to 10%	2 to 10%	< 2%	< 2%	< 2%	< 2%	< 2%
Flucloxacillin			> 10%	2 to 10%	< 2%	< 2%	< 2%	< 2%	< 2%
Piperacillin+tazobactam				> 10%	< 2%	< 2%	< 2%	< 2%	< 2%
Cefalexin or cefaclor					> 10%	< 2%	< 2%	< 2%	< 2%
Cefazolin						> 10%	< 2%	< 2%	< 2%
Cefuroxime, ceftriaxone or cefotaxime							> 10%	2 to 10%	< 2%
Ceftazidime								> 10%	< 2%
Meropenem									> 10%

Appropriate prescribing according to cross-reaction risk, and type and severity of previous reaction

See page 100 for how to undertake graded challenges and desensitisation.

	TYPE AND SEVERITY OF PREVIOUS REACTION				
	IMMEDIATE, POTENTIAL IGE-MEDIATED		DELAYED, POTENTIAL T CELL-MEDIATED		NON-ALLERGIC
Cross-reaction risk (from table on previous page)	**Severe** Bronchospasm, anaphylaxis, angioedema (swelling of the face or throat), extensive urticaria ('hives'), arrhythmia, cardiovascular collapse, hypotension	**Mild** Isolated urticaria ('hives')	**Severe** Severe cutaneous adverse reactions*, mouth or eye lesions, serum sickness-like reaction, cytopenia, organ toxicity (e.g., acute interstitial nephritis, liver injury)	**Mild** Itching, isolated exanthem (maculo-papular eruption, unknown childhood history)	Intolerances (e.g., nausea, diarrhoea, headache) Family history of allergy only
🟢 < 2%	If wish to use, do graded challenge first	Safe, but caution	Avoid. If necessary to use, there is no value in doing drug challenge or desensitisation first. Risk of meropenem cross-reaction is relatively low	Safe	Safe
🟡 2 to 10%	Avoid. If necessary to use, desensitise first	If wish to use, do graded challenge first		Avoid. If necessary to use, there is little value in doing drug challenge or desensitisation first	
🔴 > 10%					Avoid same drug

** Severe skin adverse reactions include DRESS = drug reaction with eosinophilia and systemic symptoms, SJS/TEN = Stevens-Johnson syndrome and toxic epidermal necrolysis, AGEP = acute generalised exanthematous pustulosis, or extensive skin desquamation.*

If a patient has a history of allergic reaction to both a penicillin and a cephalosporin antibiotic, it's best to avoid all penicillins and cephalosporins.

Macrolide (e.g., erythromycin, roxithromycin, azithromycin) cross-reactions

If there is an allergic reaction to any one macrolide, do not prescribe any other macrolide.

Aminoglycoside (e.g., gentamicin, tobramycin, amikacin, streptomycin) cross-reactions

If there is an allergic reaction to any one aminoglycoside, do not prescribe any other aminoglycoside.

Fluoroquinolone (e.g., ciprofloxacin, norfloxacin, moxifloxacin) cross-reactions

The evidence on fluoroquinolone cross-reactions is very limited. Until there is more evidence, it's best to be safe and if the patient has an allergic reaction to any one fluoroquinolone, do not prescribe any other fluoroquinolone.

GRADED CHALLENGES

There is no consensus on the best protocol for these, but common and pragmatic protocols are:

- **Mild** previous reaction/low risk: give 1/10th dose and observe for 1 hour, then give full dose and observe for one hour (e.g., for cefalexin give 50 mg PO, then 500 mg PO). If very low risk, consider just giving ½ or full dose and observing for one hour.
- **Severe** previous reaction/high risk: give 1/100th dose and observe for 1 hour, then 1/10th dose and observe for one hour, then full dose and observe for one hour (e.g., for ceftriaxone give 10 mg IV, then 100 mg IV then the remainder of the dose IV).

If giving drug intravenously, do not dilute more than normal. Give as slow push. Do not give antihistamines or other allergy medications before a challenge – but have available an antihistamine (e.g., loratadine, promethazine), adrenaline and resuscitation equipment in case of a reaction during or shortly after the challenge. Some allergic reactions are also treated with topical or systemic corticosteroids.

If graded challenge is successful, delabel the patient's allergy to that medication.

DESENSITISATION

Drug desensitisation is predominantly used in patients with a history of IgE-mediated immediate hypersensitivity and for whom there are no appropriate alternative antimicrobials or when a particular antimicrobial is the preferred drug (e.g., benzylpenicillin for streptococcal endocarditis). Do not attempt desensitisation for delayed, severe hypersensitivity such as drug rash with eosinophilia and systemic symptoms (DRESS), Stevens-Johnson syndrome/toxic epidermal necrolysis (SJS/TEN), acute generalised exanthematous pustulosis (AGEP), acute interstitial nephritis, drug-induced liver injury, or haemolytic anaemia.

Perform desensitisation in hospital, where close monitoring can occur. Consider pre-medication with prednisone 0.25 to 0.5 mg/kg orally in high-risk cases. See on-line protocols for penicillin, amoxicillin, trimethoprim+sulfamethoxazole and other beta-lactams.

Desensitisation remains effective while the patient is continuously exposed to the drug; hypersensitivity returns after the drug has been cleared from the body (about 5 drug half-lives). Warn patients that desensitisation is only temporary – they are still allergic to the drug.

ANTIMICROBIAL AGENTS IN PREGNANCY / BREASTFEEDING

From the NZ Formulary in 2022, who in turn referenced Drugs in Pregnancy and Lactation 2017 (with permission from Wolters Kluwer Health). More detailed, up-to-date advice may be available from your local pharmacist.

ANTIMICROBIAL	SAFETY IN PREGNANCY	SAFETY WHEN BREASTFEEDING
Aciclovir	Compatible	Compatible
Amoxicillin	Very low risk. Possible toxicity in 1st and 3rd trimesters, not 2nd	Compatible
Amoxicillin+clavulanate	As for amoxicillin. In addition, one study reported an association with necrotising enterocolitis when the antibiotic was used near preterm birth	Probably compatible
Azithromycin	Compatible	Compatible
Cefaclor	Compatible	Compatible
Cefazolin	Compatible	Compatible
Cefotaxime	Compatible	Compatible
Ceftazidime[RESTRICTED]	Compatible	Compatible
Ceftriaxone	Compatible	Compatible
Cefuroxime	Compatible	Compatible
Cefalexin	Compatible	Compatible
Ciprofloxacin	Contra-indicated. Use only if no alternative. May cause developmental toxicity	Limited data. Potential toxicity. Not recommended
Clindamycin	Compatible	Compatible
Doxycycline	Contraindicated in the 2nd and 3rd trimesters due to risk of developmental toxicity	OK for short courses (e.g., up to 10 days)
Erythromycin	Compatible	Compatible
Flucloxacillin	Not known to be harmful	Compatible

ANTIMICROBIAL	SAFETY IN PREGNANCY	SAFETY WHEN BREASTFEEDING
Fluconazole	Possible developmental toxicity, throughout pregnancy. Contraindicated	Compatible
Gentamicin	Compatible	Compatible
Itraconazole	Low or no risk of toxicity, but concern as fluconazole, a similar drug, may cause toxicity. If possible, avoid	Potential toxicity. Not recommended
Meropenem[RESTRICTED]	Limited data. No detectable toxicity	Limited data but very low risk
Metronidazole	Limited data, but no concern	Limited human data. Potential toxicity. Not recommended
Nitrofurantoin	Possible developmental toxicity in the 3rd trimester or close to delivery, but not in the 1st or 2nd trimesters. Avoid close to delivery	Probably compatible
Penicillin	Compatible	Compatible
Probenecid	Probably compatible	Probably compatible
Roxithromycin	No human data available	Present in milk. No other information
Terbinafine	Limited data, but probably compatible	Potential toxicity. Not recommended
Trimethoprim	There is a low risk of developmental toxicity throughout pregnancy. Folic acid supplementation may reduce this risk	Compatible
Trimethoprim+ sulfamethoxazole	See above for trimethoprim – risk of toxicity throughout pregnancy. Sulfamethoxazole may cause developmental toxicity in the 3rd trimester, but not the 1st or 2nd trimester	Sulfamethoxazole may cause toxicity. Avoid if the infant has or is at risk of jaundice or hyperbilirubinaemia (risk of kernicterus), or has G6PD deficiency (risk of haemolytic anaemia) Note: reviews have not found any evidence that treatment of neonates with trimethoprim+sulfamethoxazole causes jaundice or hyperbilirubinaemia so risk from breastfeeding is probably very low
Vancomycin	Compatible	Probably compatible

ANTIBIOTIC SUBSTITUTIONS WHEN OUT-OF-STOCK

If temporarily unable to obtain an antibiotic, choose another antibiotic from the 'alternatives' column in the empiric guideline, substitute an oral for an IV formulation of the same antibiotic, or choose a similar antibiotic from this table.

OUT-OF-STOCK ANTIBIOTIC	ANTIBIOTICS WITH A SIMILAR (OR BETTER) SPECTRUM OF ACTIVITY
Amoxicillin	Penicillin, amoxicillin+clavulanate
Amoxicillin+ clavulanate	Cefalexin plus metronidazole (B), cefazolin plus metronidazole (B), trimethoprim+sulfamethoxazole (P) + metronidazole (B)
Azithromycin	Roxithromycin, erythromycin (except azithromycin is the only macrolide that covers typhoid), or doxycycline (P)
Cefazolin	Amoxicillin+clavulanate
Cefotaxime	Ceftriaxone
Ceftazidime[RESTRICTED]	Ciprofloxacin (P) (B), meropenem[RESTRICTED]
Ceftriaxone	Cefotaxime
Cefalexin	For skin, bone and joint infections: flucloxacillin, amoxicillin+clavulanate. For urine infections: trimethoprim+sulfamethoxazole (P), ciprofloxacin (P) (B)
Clindamycin	For skin infections: trimethoprim+sulfamethoxazole (P) plus metronidazole (B), amoxicillin+clavulanate, cefalexin, flucloxacillin For respiratory or anaerobic infections: amoxicillin+clavulanate
Ciprofloxacin	No similar oral agent. IV meropenem[RESTRICTED], ceftriaxone (not if *Pseudomonas*), ceftazidime[RESTRICTED]
Doxycycline	For skin infections: flucloxacillin, cefalexin, amoxicillin+clavulanate, or if MRSA infected then trimethoprim+sulfamethoxazole (P), clindamycin For upper or lower respiratory tract infections: macrolides (azithromycin, roxithromycin, erythromycin).
Flucloxacillin	Cefalexin, cefazolin, amoxicillin+clavulanate, clindamycin, trimethoprim+sulfamethoxazole (P)
Gentamicin	Ceftriaxone, cefotaxime; if Pseudomonas suspected then ciprofloxacin (P) (B), meropenem[RESTRICTED], ceftazidime[RESTRICTED]
Meropenem	Amoxicillin+clavulanate plus ciprofloxacin (P) (B), amoxicillin+clavulanate plus gentamicin, ceftazidime[RESTRICTED]
Metronidazole	Amoxicillin+clavulanate
Nitrofurantoin	Cefalexin, ciprofloxacin (P) (B)
Penicillin	Amoxicillin
Roxithromycin	Azithromycin, erythromycin, doxycycline (P)
Trimethoprim+ sulfamethoxazole	For skin infections: flucloxacillin, cefalexin, or if MRSA suspected then doxycycline (P), clindamycin For urine infections: trimethoprim (P)
Vancomycin	If methicillin-resistant staphylococci: trimethoprim+sulfamethoxazole (P), doxycycline (P), clindamycin

(P) *Contra-indicated or caution in pregnancy; see pages 101 – 102*

(B) *Contra-indicated or caution when breastfeeding; see pages 101 – 102*

TOPICAL ANTISEPTICS

TOPICAL ANTISEPTIC AGENTS

Recommended topical antiseptic agents

PURPOSE	CHOICE OF TOPICAL ANTISEPTIC AGENT
Treatment of impetigo or other minor, superficial skin infection (*see page 30*)	Dilute bleach, povidone iodine 10% Alternatives: super-oxidised solutions (e.g., Microdacyn), hydrogen peroxide, chlorhexidine, cetrimide
Heavily colonised ulcers (e.g., diabetic, venous)	Dilute bleach Super-oxidised solutions (e.g., Microdacyn), polyhexanide with betaine (Prontosan), cadexamer iodine or slow-release silver dressings (Not povidone iodine – may prevent healing of vulnerable tissue around the ulcer)
Prevention of infection in burns (*see page 61*)	Super-oxidised solutions (e.g., Microdacyn), slow-release silver dressings, dilute bleach
Eczema with recurrent infection (*see page 71*)	Dilute bleach Super-oxidised solutions (e.g., Microdacyn)
Prevention of infection in acute post-operative or traumatic wounds (*see page 55*)	Dilute bleach, povidone iodine 10%, Savlon (chlorhexidine + cetrimide), Bepanthen (benzylkonium or chlorhexidine), Dettol (chloroxylenol), Crystaderm (hydrogen peroxide), super-oxidised solutions (e.g., Microdacyn)

Use topical antiseptics, not topical antibiotics

Topical antiseptic agents (see table above) are preferred over topical antibiotic agents (e.g., chloramphenicol, fusidic acid, mupirocin, neomycin, sulfadiazine) because topical antiseptic agents are generally broader in spectrum, rarely suffer from resistance and rarely cause allergic reactions. Most antiseptic agents are safe to put on a wound.

Dilute bleach

Dilute bleach (sodium hypochlorite) is proven effective, non-toxic (at a concentration of 0.05 to 0.125 g/L (0.005 to 0.0125%)), very cheap and readily available in the Pacific Islands. **Do not** apply to skin, wounds or ulcers the more concentrated (0.05 to 0.5%) bleach solutions intended for disinfection of hard objects and surfaces, because these will cause tissue damage.

BLEACH DILUTION INSTRUCTIONS FOR SKIN, WOUNDS AND ULCERS

Bleach (sodium hypochlorite) can be purchased from many shops in Pacific Islands and New Zealand. If you add bleach to a bottle of water, please LABEL THE BOTTLE and store it out of the reach of children so that no-one accidentally drinks it. This bottle of dilute bleach will be effective for up to 3 months if stored out of the direct light.

UNDILUTED ORIGINAL BLEACH PRODUCT[1]	VOLUME OF BLEACH TO ADD[2, 3, 4]			
	TO 500 ML WATER	TO 1 L WATER	TO 1.5 L WATER	TO 15 L BUCKET
Janola bathroom bleach spray (11 g/L, 1%)	2.25 to 5.6 mL (½ to 1 teaspoon)	4.5 to 11 mL (1 to 2 teaspoons)	7 to 17 mL (2 to 3 teaspoons)	67.5 to 170 mL (5 to 10 tablespoons)
Budget brand – Regular (21.5 g/L, 2.15%)	1.2 to 3 mL (¼ to ½ teaspoon)	2.5 to 6 mL (½ to 1 teaspoon)	3.5 to 9 mL (1 to 2 teaspoons)	35 to 90 mL (3 to 6 tablespoons)
Janola toilet bleach gel (25 g/L, 2.4%)	1 to 2.5 mL (¼ to ½ teaspoon)	2 to 5mL (½ to 1 teaspoon)	3 to 7.5 mL (1 teaspoon)	30 to 75 mL (2 to 5 tablespoons)
Clor-o-gene (31.5 g/L, 3.15%)	0.8 to 2 mL (¼ to ½ teaspoon)	1.6 to 4 mL (¼ to 1 teaspoon)	2.5 to 6 mL (½ to 1 teaspoon)	24 to 60 mL (2 to 4 tablespoons)
Budget brand – Extra strength (36.7 g/L, 3.67%)	0.7 to 1.7 mL (¼ teaspoon)	1.4 to 3.5 mL (¼ to ½ teaspoon)	2 to 5 mL (½ to 1 teaspoon)	20 to 50 mL (1½ to 3 tablespoons)
Homebrand – Regular, Janola – Premium and White King – Premium Regular (42 g/L, 4.2%)	0.6 to 1.5 mL (¼ teaspoon)	1.2 to 3 mL (¼ to ½ teaspoon)	1.8 to 4.5 mL (½ teaspoon)	18 to 45 mL (1 to 3 tablespoons)
Janola – Super strength (45 g/L, 4.5%)	0.55 to 1.4 mL (¼ teaspoon)	1.1 to 2.8 mL (¼ to ½ teaspoon)	1.7 to 4.2 mL (½ teaspoon)	17 to 42 mL (1 to 2 tablespoons)
Domestos – Thick original (46.2 g/L, 4.6%)	0.5 to 1.4 mL (¼ teaspoon)	1.1 to 2.7 mL (¼ to ½ teaspoon)	1.6 to 4 (½ teaspoon)	16 to 40 mL (1 to 2 tablespoons)
Clorox – Regular (82.5 g/L, 8.25%)	0.3 to 0.8 mL	0.6 to 1.5 mL (¼ teaspoon)	1 to 2.3 mL (¼ teaspoon)	9 to 23 mL (1 tablespoon)

1. Use regular, not perfumed bleach.

2. Based on a target concentration of 0.05 to 0.125 g/L (0.005 to 0.0125%).

3. Add double the volume of bleach to the water if the bleach product is near its expiry date, as the sodium hypochlorite weakens with time to approximately 50% of the original strength by the expiry date.

4. Based on the conventional volumes of a teaspoon (5 mL), tablespoon (15 mL) and cup (237 mL).

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