ANTIBIOTIC GUIDELINES

COOK ISLANDS 2018

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

TE MARAE ORA
COOK ISLANDS Ministry of Health

1 March 2018

CONTENTS

FOREWORD

Appropriate use of antibiotics is important for best health outcomes! Clinicians need to make the right choice of antibiotic and right dosage for individual patients. Overuse and misuse of antibiotics means they will no longer work in the future!

This document will add significant value to the services provided by the MOH 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 pleasure to endorse this handbook as another great initiative of the Cook Islands Ministry of Health which will help guide and support our clinicians in their treatment of their patients.

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

I acknowledge the contribution from our own Ministry of Health 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 the development of this handbook and who has worked with our clinical staff (laboratory and hospital) to improve the standard of services in the Cook Islands.

Kia manuia,

Elizabeth Iro
Secretary 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 April 2017 (see Isolates and Antibiogram section)
- Recent international guidelines, including the Australian Therapeutic Guidelines, US Sanford Guide, and Auckland Starship, Counties Manukau DHB, the Red Book and New Zealand BPAC antibiotic guidelines
- The availability and cost of antibiotics in the Cook Islands
- Convenience, safety and a low risk of antibiotic resistance in the future.

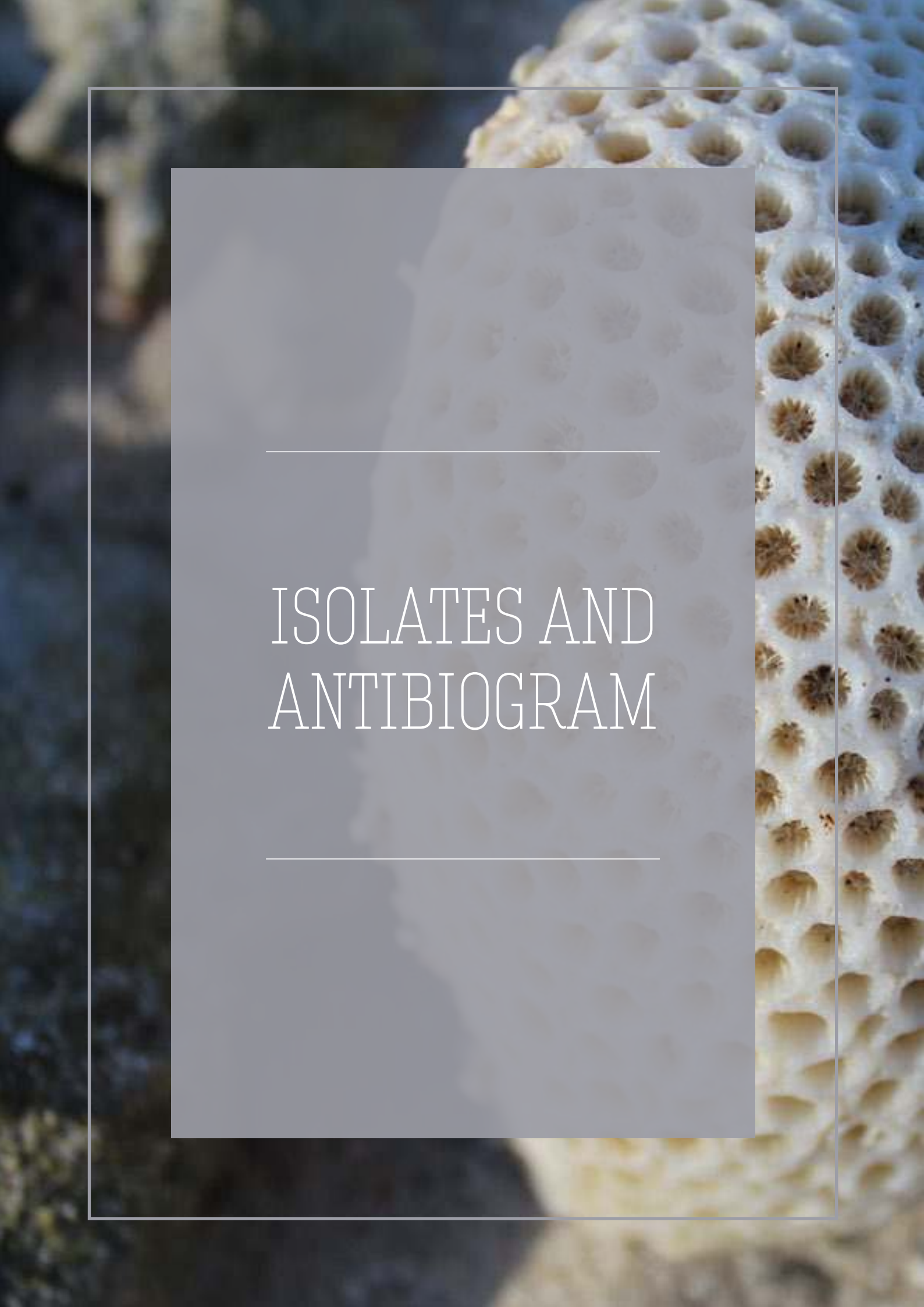
These guidelines are intended for use in the hospital and the community, by doctors, pharmacists and nurses, on all of the Cook Islands. In individual patient circumstances, recommendations in these guidelines may be over-ruled by the prescriber's judgement or the prescriber may seek advice from an Infectious Diseases or Microbiology Specialist. 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). 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 all 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.



ISOLATES AND ANTIBIOGRAM

The laboratory at Rarotonga Hospital in Avarua is the only microbiology laboratory for the Cook Islands (est. population 11,600 in mid-2016). 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 May 2017. Susceptibility testing from 2015 onwards was performed by disk diffusion on Mueller-Hinton agar (or when appropriate Mueller-Hinton agar + 5% defibrinated horse blood and 20 mg/L β-NAD) and according to EUCAST methods and interpretative criteria. Because clinical samples are collected on the minority of patients with infections (especially those patients who are failing antibiotic treatment), unselected patients presenting with acute infection will generally have more common and antibiotic-susceptible bacterial causes for their infections than is presented in this antibiogram.

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

Thanks to Geoffrey Wuatai and Peia Ben, Microbiology Laboratory scientists, for their assistance.

ISOLATES

Bloodstream infections – all ages

Isolates from blood, 8 July 1996 to 31 December 2014. There were 153 likely true isolates from 1846 sets (= 8.3% positive)). 18 (0.98%) blood cultures were probably contaminated.

Likely 'true' isolates identified as: *Staphylococcus aureus* 68, *E. coli* 18, *Klebsiella* spp. 18, Group A streptococci 16, *Streptococcus pneumoniae* 12, *Pseudomonas aeruginosa* 6, other beta-haemolytic streptococci 4, 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 2014. 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	4	1	5	0	8	4
Streptococcus pneumoniae	0	0	1	0	0	0	0
E. coli	2	1	0	0	0	1	2
Neisseria meningitidis	0	0	0	0	0	0	2

Chest infections

Isolates from sputum, 9 July 2007 to 31 December 2014 (n= 429). Micro-organisms identified as: *Klebsiella* spp. 132, *Streptococcus pneumoniae* 82, Group A streptococci 77, *Haemophilus influenzae* 45, *Pseudomonas aeruginosa* 44, *Staphylococcus aureus* 18, other enteric gram-negative bacilli 11, and other non-fermentative gram-negative bacilli 10.

Meningitis

Isolates from cerebrospinal fluid, 1996 to April 2017 (10 isolates): *Streptococcus pneumoniae* 6, *Haemophilus influenzae* type B 4.

Urinary organisms

The most common isolates from urine from 1 September 2015 to 1 April 2017: *E. coli* 245, *Klebsiella* spp. 20, *Proteus* spp. 15, *Staphylococcus saprophyticus* 8, *Enterococcus faecalis* 7, *Staphylococcus aureus* 6, and *Pseudomonas aeruginosa* 2.

ANTIBIOGRAM

Staphylococcus aureus

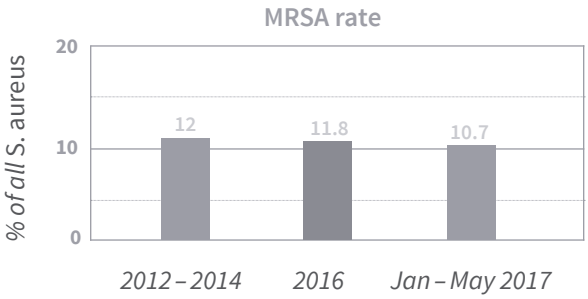
Isolates from all sources, October 2015 to May 2017.

ANTIBIOTIC	SUSCEPTIBLE RAROTONGA 2015 – 2017 (NO. TESTED)	SUSCEPTIBLE NEW ZEALAND 2015
Amoxicillin, ampicillin and penicillin	9% (550)	13%
Chloramphenicol	95% (259)	-
Clindamycin	90% (327)	92%
Doxycycline	97% (543)	98%
Erythromycin	83% (557)	88%
Flucloxacillin[1]	88% (588)	90%
Trimethoprim+sulfamethoxazole	94% (618)	99%

[1] Flucloxacillin susceptibility (based on cefoxitin disk result) predicts susceptibility to flucloxacillin, amoxicillin+clavulanate and all cephalosporins. Flucloxacillin resistance is described as 'methicillinresistantStaphylococcus aureus' (MRSA).

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) thereafter.



Group A streptococci *(Streptococcus pyogenes)*

Isolates from all sources, October 2015 to May 2017 (susceptibility testing only performed on request).

ANTIBIOTIC	SUSCEPTIBLE RAROTONGA 2015 - 2017 (NO. TESTED)	SUSCEPTIBLE NEW ZEALAND
Ampicillin, amoxicillin and penicillin	All	All
Doxycycline	100% (7)	88% (2001)
Erythromycin	100% (8)	96% (2015)
Trimethoprim+sulfamethoxazole	100% (8)	100% (2001)

Enteric gram-negative bacilli

Isolates from all sources, October 2015 to May 2017. Includes *E. coli*, *Klebsiella* spp., *Enterobacter* spp., *Proteus* spp., *Citrobacter* spp. and *Morganella* spp.

ANTIBIOTIC	SUSCEPTIBLE RAROTONGA 2015 - 2017 (NO. TESTED)
Amoxicillin	22% (250)
Amoxicillin+clavulanate	41% (494)
Ceftriaxone	96% (414)
Cefuroxime	91% (140)
Cephalexin (urine only)	70% (179)
Ciprofloxacin	100% (88)
Gentamicin	86% (396)
Nitrofurantoin (urine only)	68% (258)
Trimethoprim+sulfamethoxazole	85% (537)

Pseudomonas aeruginosa

Isolates from all sources, October 2015 to May 2017.

ANTIBIOTIC	SUSCEPTIBLE RAROTONGA 2015 - 2017 (NO. TESTED)	SUSCEPTIBLE NEW ZEALAND 2015
Meropenem	100% (29)	-
Ceftazidime	98% (117)	96%
Ciprofloxacin	98% (154)	93%
Gentamicin	97% (154)	93%

EMPIRIC AND TARGETED GUIDELINES

INFECTION	FIRST CHOICE	ALTERNATIVES	COMMENTS
Abdomen Infection associated with biliary or gut pathology, including cholecystitis, cholangitis, diverticulitis, liver abscess and peritonitis *See also Pelvic inflammatory disease*	Mild: amoxicillin+ clavulanate plus either doxycycline (8 years or older) or trimethoprim+ sulfamethoxazole. If failing, amoxicillin+ clavulanate plus ciprofloxacin Severe: ceftriaxone plus metronidazole IV	**Mild:** chloramphenicol alone, or trimethoprim+ sulfamethoxazole plus metronidazole. If failing, chloramphenicol plus ciprofloxacin **Severe:** amoxicillin+ clavulanate IV plus either doxycycline (8 years or older) or trimethoprim+ sulfamethoxazole. Or chloramphenicol IV plus either ciprofloxacin or gentamicin. If failing, amoxicillin+clavulanate IV plus ciprofloxacin, or meropenem[RESTRICTED] alone	Metronidazole not needed if biliary infection without obstruction or recent biliary surgery If use gentamicin, replace after 48 to 72 hours Often need surgery or drainage for source control Liver abscess treatment duration 4 to 6 weeks
Abscess	*See Abdomen, Boils, Breast, Diabetic foot sepsis, Wound infection etc*		Drain and culture pus
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 plus vancomycin. Mild penicillin allergy: vancomycin plus cefazolin. Severe penicillin allergy or any cephalosporin allergy: vancomycin alone Gram-positive cocci, like streptococci (in chains) – benzylpenicillin (penicillin G) 1.8 to 2.4 g (3 to 4 MU) IV 4-hourly (child: 150-200 mg/kg/day in 6-hourly doses). Alternatives include vancomycin (if likely urine or abdominal source, severe penicillin allergy, or any cephalosporin allergy) 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 – ceftriaxone 2 g IV 12-hourly (child: 50 mg/kg up to 2 g 12-hourly). Severe penicillin allergy or any cephalosporin allergy: chloramphenicol or ciprofloxacin Gram-negative bacilli – ceftriaxone 2 g IV 12-hourly (child: 50 mg/kg up to 2 g 12-hourly) plus gentamicin. Cover ceftriaxone-resistant gram-negative bacilli (e.g. with meropenem [RESTRICTED]) if major infection with ceftriaxone-resistant GNB in past or recent travel to Asia, Middle East or Southern Europe. If severe penicillin allergy or any cephalosporin allergy, use ciprofloxacin alone, gentamicin alone or both ciprofloxacin and gentamicin. If GFR < 20 mL/min, ceftriaxone plus ciprofloxacin. Gram-positive bacilli – usually a contaminant. Continue empiric antibiotics based on likely clinical source. Add ampicillin IV if suspect listeria (e.g. pregnancy, or immune-compromised with meningitis) Yeast – fluconazole 400 mg orally daily (child: 12 mg/kg up to 400 mg daily)		
Biliary tract infection	*See Abdomen*		

INFECTION	FIRST CHOICE	ALTERNATIVES	COMMENTS
Bites Animal or human, includes injury to fist from contact with teeth	Cover any recent *Staphylococcus aureus* isolates Amoxicillin+clavulanate. If failing or MRSA grown from any site in last 6 months add trimethoprim+ sulfamethoxazole or doxycycline (8 years or older) Severe: ceftriaxone plus metronidazole IV	Metronidazole plus either doxycycline (if over 8 years only) or trimethoprim+ sulfamethoxazole. Or chloramphenicol alone	Clean, irrigate and debride non-viable tissue; submit pus or tissue for culture. Assess need for tetanus toxoid *For infected insect bites see Cellulitis – Limb or face* *For prophylaxis of animal or human bites see Prophylaxis – Bites*
Blastocystis hominis Gastroenteritis	Nil	Metronidazole 2 g (child: 30 mg/kg up to 2 g) orally daily for 3 days or metronidazole 500 mg (child 10 mg/kg up to 500 mg) orally 3 times daily for 5 to 7 days Trimethoprim+ sulfamethoxazole 160 + 800 mg (child 1 month or older: 4 + 20 mg/kg up to 160 + 800 mg) orally 2 times daily for 7 days (10 days if immune-compromised)	Usually a non-pathogenic commensal. Give trial of antibiotic therapy only if persistent diarrhoea and no o ther cause found
Bloodstream infection	*See Bacteraemia,* Staphylococcus aureus *bloodstream infection, Sepsis – unknown cause, Immune compromise and sepsis*		
Boils	Cover any recent *Staphylococcus aureus* isolates Mild: doxycycline (8 years or older) or trimethoprim+ sulfamethoxazole. If failing, amoxicillin+clavulanate plus either doxycycline (8 years or older) or trimethoprim+ sulfamethoxazole Severe: either amoxicillin+ clavulanate IV or cefazolin, plus either doxycycline (8 years or older) or trimethoprim+ sulfamethoxazole	Mild: doxycycline (8 years or older) plus ciprofloxacin, or chloramphenicol alone Severe: chloramphenicol IV alone. If failing: vancomycin plus ciprofloxacin	Small, uncomplicated, non-facial boils can often be treated with incision and drainage alone
Bone – non-vertebral *See also Bone – vertebral*	Cover any recent *Staphylococcus aureus* isolates IV amoxicillin+clavulanate or cefazolin, plus oral trimethoprim+ sulfamethoxazole Oral step-down options: either amoxicillin+clavulanate or cephalexin, plus trimethoprim+ sulfamethoxazole	Chloramphenicol. If failing, vancomycin plus either ceftriaxone or ciprofloxacin Oral step-down options: chloramphenicol or trimethoprim+ sulfamethoxazole alone	Culture deep samples (e.g. bone, deep soft tissue) and blood, especially if failing treatment. If deep sample not available, test nasal swab for *Staphylococcus aureus* as often same as bone isolate Duration of treatment depends on severity and clinical response. In general, treat acute bone infection in adults with high-dose antibiotics (IV or high-dose oral, *see page 71*) for at least 2 weeks then switch to standard-dose oral antibiotics for total duration of 6 to 12 weeks. In children, treat for 2 to 3 weeks

INFECTION	FIRST CHOICE	ALTERNATIVES	COMMENTS
Bone – vertebral Vertebral osteomyelitis, discitis or epidural abscess	Cover any recent *Staphylococcus aureus* isolates Ceftriaxone plus either oral trimethoprim+ sulfamethoxazole or IV vancomycin Oral step-down options: either amoxicillin+ clavulanate or cephalexin, plus trimethoprim+ sulfamethoxazole	Chloramphenicol +/- ciprofloxacin. If failing, vancomycin plus ciprofloxacin Oral step-down options: chloramphenicol +/- ciprofloxacin	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	Chloramphenicol. If failing, ceftriaxone plus chloramphenicol	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
Brain abscess Post-traumatic	Cover any recent *Staphylococcus aureus* isolates Vancomycin plus ceftriaxone If penetrating trauma, substitute ceftazidime, ciprofloxacin or meropenem for ceftriaxone	Vancomycin plus ciprofloxacin Or chloramphenicol plus ciprofloxacin	Swab nose for MRSA
Breast Mastitis or abscess	Cover any recent *Staphylococcus aureus* isolates Mild: doxycycline (not more than 10 days if breastfeeding), amoxicillin+clavulanate or cephalexin alone. If failing, either amoxicillin+clavulanate or cephalexin plus either doxycycline or trimethoprim+ sulfamethoxazole Severe: amoxicillin+ clavulanate IV plus either doxycycline or trimethoprim+ sulfamethoxazole	Mild: Chloramphenicol alone, or metronidazole plus either doxycycline or trimethoprim+ sulfamethoxazole Severe: Cefazolin plus either doxycycline or trimethoprim+ sulfamethoxazole. Or chloramphenicol IV or vancomycin alone	Continue breastfeeding or expressing milk throughout infection If fail, swab and culture breast milk If *Candida* sp. grows, try topical imidazole (e.g. miconazole) or oral fluconazole 400 mg day 1 then 200 mg daily for 14 days

INFECTION	FIRST CHOICE	ALTERNATIVES	COMMENTS
Bronchiectasis Infective exacerbation (cystic fibrosis or other cause)	Base antibiotic choice on previous sputum culture results If cystic fibrosis, use higher-than-usual doses. Promote sputum clearance and nutrition	Cover any recent *Staphylococcus aureus* isolate Mild to moderate: ciprofloxacin plus either doxycycline (8 years or older), amoxicillin+clavulanate or chloramphenicol Severe: ceftriaxone plus either ciprofloxacin or gentamicin. If severe penicillin allergy or any cephalosporin allergy: chloramphenicol plus either ciprofloxacin or gentamicin Failing other treatment: meropenem[RESTRICTED] (plus cover MRSA if positive)	Get sputum for culture each exacerbation. Treat for 10 to 14 days (mild, good response) or 14 to 21 days (severe, slow response) Mild *Pseudomonas aeruginosa* infection: ciprofloxacin 750 mg orally 2 times daily +/- nebulised gentamicin Severe *P. aeruginosa* infection: meropenem[RESTRICTED] 1 g IV 8-hourly plus gentamicin IV then nebulised *See Dosing of gentamicin, pages 66 and 67*
Bronchiolitis Under 1 year or "wheezy bronchitis" in children	Nil	Consider antibiotics only if very ill or consolidation on x-ray *See Pneumonia*	RSV and other viruses are the cause. Exclude from pre-school/school until coryzal phase is over Inhaled hypertonic 3% saline may help
Bronchitis Acute in adults, no underlying lung disease	Nil		Most cases viral. Purulent sputum alone is not an indication for antibiotics. Give antibiotics if suspect pneumonia (fever, tachycardia, tachypnoea, chest signs or CRP > 30)
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 suspect pneumonia (fever, tachycardia, new chest signs or CRP > 30) or if severe COPD
Bursitis	*See Joint*		
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 If intolerant of azithromycin, give ciprofloxacin 500 mg (child: 10 mg/kg up to 500 mg) orally 2 times daily for 3 days	Treat only if severe 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)	If fail topical treatment, use fluconazole 150 mg orally single dose (for skin or vulvo-vaginitis) or 50-100 mg daily for 7 days (oro-pharyngeal infection) Consider anti-candida natural product *(see page 78)*	If severe vaginal infection, repeat fluconazole 150 mg every 72 hours for 2 or 3 doses Correct causative factors when possible (e.g. diabetes, antibiotics, inhaled steroids, poor denture hygiene). If resistant species (e.g. *Candida krusei*), consult specialist

INFECTION	FIRST CHOICE	ALTERNATIVES	COMMENTS
Cellulitis Limb or face *See also Wound infections – post-trauma, post-operative, Diabetic foot infection, Necrotising fasciitis, Ulcers, or Cellulitis – orbital*	Cover any recent *Staphylococcus aureus* isolates Mild: trimethoprim+ sulfamethoxazole, flucloxacillin or cephalexin Severe: flucloxacillin IV or cefazolin	Mild: roxithromycin Severe: vancomycin	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, cover enteric gram-negative bacilli (e.g. add ciprofloxacin or gentamicin)
Cellulitis Orbital	Cover any recent *Staphylococcus aureus* isolates Mild: amoxicillin+ clavulanate Severe: amoxicillin+ clavulanate IV or ceftriaxone	Mild: cephalexin plus doxycycline (8 years or older), or chloramphenicol alone Severe: chloramphenicol IV alone. If failing, either amoxicillin+clavulanate IV or ceftriaxone plus either doxycycline (8 years or older) or trimethoprim+ sulfamethoxazole	Cover MRSA if positive in recent past or if failing flucloxacillin or cephalosporin treatment Orbital cellulitis refers to post-septal (posterior) infections arising from sinuses or trauma. *If pre-septal, see Cellulitis – limb or face.*
Chickenpox	*See Shingles and chickenpox*		
Chlamydia And other non-gonococcal urethritis or cervicitis	Azithromycin 1 g (child: 10 mg/kg up to 1 g) orally single dose	Non-pregnant: Doxycycline 100 mg orally 2 times daily for 7 days	Treat partners, even if asymptomatic **Notifiable**
Cholecystitis, cholangitis	*See Abdomen*		
Choreo-amnionitis	*See Pelvic inflammatory disease (PID)*		
Clostridium difficile Toxin-positive, antibiotic-associated diarrhoea	Metronidazole 400 mg (child: 10 mg/kg up to 400 mg) orally 3 times daily for 10 days	Vancomycin 125 mg (child: 5 mg/kg up to 125 mg) orally 4 times daily for 10 days If severe (shock, ileus), give metronidazole IV plus vancomycin orally	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

INFECTION	FIRST CHOICE	ALTERNATIVES	COMMENTS
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
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*		*For prevention of secondary infection see Traumatic wound infection prophylaxis – page 51*
Croup	*See Laryngitis*		
Cystic fibrosis	*See Bronchiectasis*		
Cystitis	*See UTI – Cystitis*		
Dental infection	*See Tooth abscess, gingivitis*		
Dermatophytoses 'Tinea' or 'ringworm' of scalp or body *See also Tinea versicolor*	Topical imidazole (e.g. miconazole 2% cream), topical terbinafine 1%	Terbinafine 250 mg orally daily until resolved (2 to 6 weeks for skin or scalp, 6 to 12 weeks for nail infection). For tinea capitis (scalp) infection caused by *Microsporum canis*, use griseofulvin 20 mg/kg up to 500 mg orally, once daily for 6 to 8 weeks	Oral treatment indicated if failing topical treatment, patient is very immune-compromised, or rash is widespread or involves scalp, palms, soles or nails

INFECTION	FIRST CHOICE	ALTERNATIVES	COMMENTS
Diabetic foot sepsis Applies also to ischaemic, venous, and pressure ulcer and wound infections	Very mild infection or heavily colonised ulcers or wounds: topical antiseptic (*see pages 76 – 77*) or natural product (*see page 78*) Cover any recent *Staphylococcus aureus* isolates Mild: amoxicillin+ clavulanate plus trimethoprim+ sulfamethoxazole Severe: amoxicillin+ clavulanate IV plus either trimethoprim+ sulfamethoxazole or ciprofloxacin orally. Or metronidazole plus cefazolin plus gentamicin	Mild: trimethoprim+ sulfamethoxazole plus metronidazole. Or chloramphenicol alone. If failing, ciprofloxacin plus either amoxicillin+clavulanate or chloramphenicol Severe: chloramphenicol IV plus either ciprofloxacin, ceftriaxone or gentamicin	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. If swab superficial site, first cleanse/ wipe with saline to remove exudate When culture results indicate no resistant bacteria are present, switch to simpler antibiotics Remember regular dressing changes, debridement, and management of venous or arterial insufficiency
Diarrhoea	*See Gastroenteritis or individual organism*		
Dientamoeba fragilis Gastroenteritis	If symptomatic, *(see comments)* doxycycline 100 mg (child > 8 years: 2 mg/kg up to 100 mg) orally 2 times daily for 10 days	Metronidazole 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
Discitis	*See Bone – vertebral*		
Diverticulitis	*See Abdomen*		
Ear	*See Otitis externa, Otitis media, Mastoiditis*		
Eczema Infected (honey-coloured crusting, folliculitis)	Dilute bleach 2 to 3 times a week *See page 76 for other topical antiseptic options*	If moderate-severe, prescribe short courses of oral antibiotics *(see Cellulitis – limb or face)*. Swab if usual antibiotics fail	For bleach dilution instructions *see Topical antiseptic agents, page 77*. Soak or wipe over skin for 5 to 10 min, rinse in fresh water, dry and apply emollient +/- other prescribed medication Mupirocin effective for localised infection but resistance develops rapidly
Empyema	*See Pleural space infection*		

INFECTION	FIRST CHOICE	ALTERNATIVES	COMMENTS
Endocarditis Unknown cause or awaiting culture results	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	Mild or non-IgE-mediated penicillin allergy: cefazolin 2 g (child: 50 mg/kg up to 2 g) IV 8-hourly plus gentamicin plus vancomycin Severe, eosinophilic or IgE-mediated penicillin allergy or any cephalosporin allergy: vancomycin plus gentamicin	If MRSA positive in recent past, hospital-acquired endocarditis, suspect intravenous drug abuse or fulminant endocarditis, replace benzylpenicillin with vancomycin If prosthetic valve or pacemaker-associated endocarditis, first choice is (vancomycin plus flucloxacillin plus gentamicin); alternatives (vancomycin plus cefazolin plus gentamicin) or (vancomycin plus gentamicin)
Endocarditis Cause known	If alpha-haemolytic ('viridans') streptococcus, ask laboratory to test penicillin MIC Consult Infectious Diseases Specialist, Cardiologist and/or on-line reference such as UpToDate or Australian Therapeutic Guidelines for guidance 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
Endophthalmitis Post-trauma or postcatarract surgery	Intra-vitreal vancomycin 1 mg every 2 to 3 days		If suspect haematogenous infection, treat systemically plus give intra-vitreal vancomycin
***Enterococcus* spp. infection**	Ampicillin IV or amoxicillin orally	Vancomycin If urine infection and can't use ampicillin or amoxicillin then nitrofurantoin or ciprofloxacin. If wound infection (uncommon) and can't use ampicillin or amoxicillin then may try doxycycline, azithromycin or ciprofloxacin (+/- rifampicin)	If endocarditis, add low-dose gentamicin or ceftriaxone according to protocol and advice

INFECTION	FIRST CHOICE	ALTERNATIVES	COMMENTS
Epididymo-orchitis	Age < 35 years – more likely venereal – give ceftriaxone 250 mg IV (or IM in 1% lignocaine) as a single dose plus azithromycin 1 g orally as a single dose; repeat azithromycin 1 g orally 7 days later	> 35 years or after insertive anal intercourse more likely enteric gram-negative rod – treat as for cystitis in men (if mild or moderate) or pyelonephritis (if severe). Treat for 14 days	Culture mid-stream urine in all. Test for chlamydia and gonorrhoea if at risk. Sexually transmitted diseases are **notifiable** Giving IM ceftriaxone without lignocaine is painful. Dissolve 1 g ceftriaxone in 2 mL of 1% lignocaine
Epidural abscess	*See Bone – vertebral*		
Epiglottitis	Cover any recent *Staphylococcus aureus* isolates Ceftriaxone Amoxicillin+clavulanate for oral step-down phase	Chloramphenicol alone. Or cephalexin plus doxycycline (8 years or older)	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 single dose and repeat at 24 hours if required)
Eye	*See Cellulitis – orbital, Conjunctivitis, Endophthalmitis, or Keratitis*		
Foot	*See Diabetic foot infection*		
Fungal infection	*See Candida, Dermatophytoses*		
Gallbladder	*See Abdomen*		
Gastroenteritis Acute, cause unknown	Antibiotics rarely indicated. Stool testing seldom indicated: consider if severe or persistent diarrhoea, blood in stool, typical of giardiasis or typhoid, following antibiotics or hospitalization (*Clostridium difficile)* *If bacterial cause found, see individual organism guideline*	If particularly severe (*see comments*) or immune-compromised, while awaiting stool results: azithromycin 500 mg daily for 3 days or ciprofloxacin 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 IV If recent antibiotics or hospitalization add metronidazole 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**

INFECTION	FIRST CHOICE	ALTERNATIVES	COMMENTS
Giardiasis	Metronidazole 400 mg (child: 10 mg/kg up to 400 mg) orally 3 times daily for 5 to 7 days	Metronidazole 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 Acute, painful, ulcerative ('trench mouth')	Mild: chlorhexidine (0.12-0.2%) or hydrogen peroxide mouthwash (do not swallow)	Moderate or severe: metronidazole	Debride plaque and necrotic tissue Prevent recurrence with good oral hygiene and dental care, good nutrition and stopping smoking
Gonorrhoea	Ceftriaxone 250 mg IV (or IM in 1% lignocaine) as a single dose plus azithromycin 1 g orally as a single dose	If amoxycillin-susceptible and no pharyngeal or ano-rectal infection, you may use amoxycillin 3 g orally plus probenecid 1 g orally plus azithromycin 1 g orally, all as single doses Ciprofloxacin and oral cephalosporins are no longer recommended	Giving IM ceftriaxone without lignocaine is painful. Dissolve 1 g ceftriaxone in 2 mL of 1% lignocaine 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*		
Heart	*See Endocarditis*		
Helicobacter pylori Eradication	Omeprazole 20 mg orally 2 times daily plus amoxycillin 1 g orally 2 times daily plus metronidazole 400 mg orally 2 times daily, all for 14 days	If penicillin allergic or failed first choice, discuss with Pharmacy. Option: omeprazole 20 mg 2 times daily plus bismuth subsalicylate 524 mg 4 times daily plus tetracycline 500 mg 4 times daily plus metronidazole 400 mg 3 times daily for 14 days	Test of cure by stool antigen at 8 weeks post-treatment
Herpes simplex Severe first or recurrent episode	Aciclovir 400 mg (child: 10 mg/kg up to 400 mg) orally 5 times a day (oro-labial) or 3 times a day (genital) for 5 to 7 days	For minor recurrence use acyclovir 5% cream topically, 5 times daily for 5 days at the first sign of recurrence (adults and children)	Start as soon as possible, ideally within 3 days of onset; can start later if new lesions are developing or pain is severe Lignocaine 2% gel, chlorhexidine ointment and paracetamol may help

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 prednisolone, transplant, TNF-alpha inhibitor)	Ceftriaxone. Add gentamicin if neutropenia or cell-mediated immune compromise Add vancomycin if known MRSA-positive or high-risk for staphylococcal infection Use meropenem RESTRICTED (+/- vancomycin) if severe and unresponsive, recent travel to Asia, Middle East or Southern Europe or infection with ceftriaxone-resistant gram-negative bacilli in recent past	Severe penicillin allergy or any cephalosporin allergy: vancomycin plus ciprofloxacin Oral step-down option: amoxicillin+clavulanate plus either ciprofloxacin or doxycycline	Take two sets of blood cultures and give antibiotics immediately If use gentamicin, replace after 48 to 72 hours 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 77 for dilution instructions*) is probably effective, non-toxic and very cheap	Microdacyn hydrogel or wound solution (soaked in gauze) 1 to 3 times daily, hydrogen peroxide 1% to 3%, and chlorhexidine+ cetrimide probably work. 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 18 for bleach application instructions*
Influenza High suspicion (e.g. pandemic) and severe or high-risk *(see comments)*	Nil In exceptional circumstances (*see comments*), Tamiflu® (oseltamivir) 75 mg 2 times daily for 5 days (double dose in critically ill; GFR 30 to 60 use 30 mg 2 times daily; GFR 10 to 30 use 30 mg daily, GFR < 10 mL/min use 30 mg single dose)	Add antibiotics if suspect secondary bacterial infection. See guidelines for pneumonia. Cover any recent *Staphylococcus aureus* isolates	Tamiflu is of little if any benefit and only recommended if severely ill (e.g. respiratory failure) or at risk of severe illness (immune-compromised, pregnant, other medical co-morbidity, pandemic strain) **Notifiable**

INFECTION	FIRST CHOICE	ALTERNATIVES	COMMENTS
Joint Septic arthritis, bursitis	Cover any recent *Staphylococcus aureus* isolates IV amoxicillin+clavulanate or cefazolin, plus oral trimethoprim+ sulfamethoxazole Oral step-down options: either amoxicillin+clavulanate or cephalexin, plus trimethoprim+ sulfamethoxazole	Chloramphenicol. If failing, vancomycin plus either ceftriaxone or ciprofloxacin Oral step-down options: chloramphenicol or trimethoprim+ sulfamethoxazole alone	Aspirate joint. *S. aureus* is most common (including MRSA) but may be caused by gout, *Neisseria gonorrhoea* (may have rash and tenosinovitis), enteric gram-negative rod 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 71*) for at least 2 weeks then switch to standard-dose oral antibiotics for total duration of 4 to 6 weeks. In children, treat for 2 to 3 weeks Liaise with ID Physician and Orthopaedics for management of infected prosthetic joint
Keratitis Bacterial	Chloramphenicol 0.5% eye drops. No subconjunctival or systemic antibiotics are needed	If *Pseudomonas aeruginosa* grows, use framycetin (Soframycin)	Swab to detect cause. If fungal, seek expert help
Keratitis Viral	HSV – topical acyclovir		VZV ophthalmicus – *see Shingles*
Kidney infection	*See UTI – Pyelonephritis*		
Laryngitis / Croup	For croup, prednisone 1 mg/kg orally, as a single dose	If severe and suspect bacterial infection, *see Pneumonia*	Almost always viral
Leptospirosis	Doxycycline 100 mg orally (child 8 years or older: 2 mg/kg up to 100 mg) orally, 2 times daily for 7 days	Benzylpenicillin, ampicillin, amoxicillin or ceftriaxone. Total duration of treatment is 7 days	Start within 1 week of onset **Notifiable**
Liver abscess	*See Abdomen*		

INFECTION	FIRST CHOICE	ALTERNATIVES	COMMENTS
Lung abscess	Cover any recent *Staphylococcus aureus* isolates Mild: amoxicillin+ clavulanate. If failing, amoxicillin+clavulanate plus either doxycycline (8 years or older) or trimethoprim+ sulfamethoxazole Severe: Ceftriaxone +/- either metronidazole IV or vancomycin. Or amoxicillin+clavulanate IV plus either doxycycline (8 years or older) or trimethoprim+ sulfamethoxazole	Mild: cephalexin plus either doxycycline (8 years or older), trimethoprim+ sulfamethoxazole or metronidazole. Or chloramphenicol alone Severe: chloramphenicol IV. Or vancomycin plus ciprofloxacin	Treat for at least 4 weeks Consider TB or malignancy
Mastitis	*See Breast Infections*		
Mastoiditis Acute	Cover any recent *Staphylococcus aureus* isolates Amoxicillin+clavulanate or ceftriaxone Oral step-down phase: amoxicillin+clavulanate	Chloramphenicol alone. If failing, either amoxicillin+clavulanate or ceftriaxone plus either doxycycline (8 years or older) or trimethoprim+ sulfamethoxazole Oral step-down phase: cephalexin plus doxycycline, or chloramphenicol alone	If chronic, get samples for culture. May need treatment for MRSA (e.g. vancomycin) or *Pseudomonas aeruginosa* (e.g. ciprofloxacin, meropenem[RESTRICTED]), in conjunction with debridement and drainage surgery
Meningitis Cause unknown, adult and child > 1 month *For child < 1 month,* see *Neonatal sepsis*	Dexamethasone (*see comments*) plus ceftriaxone 2 g IV 12-hourly (child: 50 mg/kg up to 2 g 12-hourly) Add vancomycin 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 ampicillin or amoxicillin 50 mg/kg 4- to 6-hourly if > 50 years old, < 3 months old, pregnant, or immune-compromised (poorly controlled diabetes, alcoholism, high-dose steroids) until listeriosis ruled out	Severe penicillin allergy or any cephalosporin allergy: vancomycin plus ciprofloxacin 400 mg (child; 10 mg/kg up to 400 mg) IV 8-hourly; or chloramphenicol 1 g (child: 25 mg/kg up to 1 g) IV 6-hourly alone If listeria risk factors *(see first choice column)* and penicillin or cephalosporin allergy, give high-dose oral trimethoprim+ sulfamethoxazole *(see page 71)* in place of vancomycin.	In all adults and children over 2 months 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 4 days. Stop dexamethasone if meningitis is not caused by *S. pneumoniae* Risk factors for penicillin-resistant *S. pneumoniae* include recent penicillin or cephalosporin use, otitis media or sinusitis **Notifiable**

INFECTION	FIRST CHOICE	ALTERNATIVES	COMMENTS
Meningitis *Haemophilus influenzae* type B	Ceftriaxone (dose above)	If susceptible to penicillin, use benzylpenicillin If severe, eosinophilic or IgE-mediated penicillin allergy or any cephalosporin allergy: ciprofloxacin or chloramphenicol (doses above)	Treat for 7 days **Notifiable**
Meningitis *Neisseria meningitidis*	Benzylpenicillin 1.8 g (child: 60 mg/kg up to 1.8 g) IV, 4-hourly for 5 days (child: 5 to 7 days)	If mild penicillin allergy': Ceftriaxone 2 g IV 12-hourly (child: 50 mg/kg up to 2 g 12-hourly) If severe, eosinophilic or IgE-mediated penicillin allergy or any cephalosporin allergy: ciprofloxacin or chloramphenicol (doses above)	When *Neisseria meningitidis* infection is confirmed, stop dexamethasone. Treat for 5 days (5 to 7 days for child) 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. If penicillin MIC ≥ 0.25 mcg/mL, do not use benzylpenicillin If ceftriaxone MIC < 1, use ceftriaxone alone. If ceftriaxone MIC 1 to 2 use ceftriaxone plus vancomycin. If ceftriaxone MIC > 2 use vancomycin alone and seek advice If severe, eosinophilic or IgE-mediated penicillin allergy or any cephalosporin allergy: vancomycin plus ciprofloxacin	*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-tonsilar abscess), floor of mouth cellulitis (Ludwig's angina), necrotizing pharyngitis (Vincent's angina), and Lemierre's syndrome *See also Gingivitis*	Mild: amoxicillin+ clavulanate. If failing, amoxicillin+clavulanate plus either doxycycline (8 years or older) or trimethoprim+ sulfamethoxazole Severe: Ceftriaxone +/- either metronidazole IV or vancomycin. Or amoxicillin+clavulanate IV plus either doxycycline or trimethoprim+ sulfamethoxazole	Mild: cephalexin plus either doxycycline (8 years or older), trimethoprim+ sulfamethoxazole or metronidazole. Or chloramphenicol alone Severe: chloramphenicol IV. Or vancomycin plus ciprofloxacin	Incise and drain if infected collection, especially if airway threatened. Refer to Dentist if infection started around tooth *If retro-pharyngeal infection starting in cervical spine, see Bone – vertebral*

INFECTION	FIRST CHOICE	ALTERNATIVES	COMMENTS
MRSA Methicillin-resistant *Staphylococcus aureus*	*See* Staphylococcus aureus *infection,* Staphylococcus aureus – *bloodstream infection*		
Necrotising fasciitis, cellulitis or 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) IV 8-hourly 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 not available, ceftriaxone plus vancomycin plus metronidazole If mild penicillin allergy', meropenem is OK but replace benzylpenicillin with cefazolin 2 g (child: 50 mg/kg up to 2 g) IV 8-hourly If severe, eosinophilic or IgE-mediated penicillin allergy or any cephalosporin allergy: vancomycin plus clindamycin plus gentamicin	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 use gentamicin, replace after 48 to 72 hours If IV clindamycin not available, try to administer orally
Neonatal sepsis Includes bacteraemia, meningitis and pneumonia in child < 1 month	Ampicillin 50 mg/kg 6- to 12-hourly plus either gentamicin (4 to 7 mg/kg IV 24- to 36-hourly) or 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 with calcium-containing products (e.g. TPN) 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 53*	If failing, consider meropenem[RESTRICTED] plus vancomycin. If penicillin or cephalosporin allergy, consider vancomycin plus ciprofloxacin	Consider adding aciclovir until herpes simplex encephalitis has been excluded Add a macrolide if *Chlamydia trachomatis* (co-existent conjunctivitis) or *Bordetella pertussis* (paroxysmal cough, apnoea) pneumonia is suspected If meningitis is suspected, add dexamethasone 0.15 mg/kg up to 10 mg IV, started before or with the first dose of antibiotic, then 6-hourly for 4 days until pneumococcal or haemophilus infection ruled out Meningitis, chlamydia and pertussis are **notifiable**
Neutropenia	*See Immune deficiency and Sepsis – Neutropenia*		
Orchitis	*See Epididymo-orchitis*		

INFECTION	FIRST CHOICE	ALTERNATIVES	COMMENTS
Osteomyelitis	*See Bone*		
Otitis externa Acute diffuse	Mild: acetic acid 2% (e.g. Vosol) Locorten-Vioform 2 to 3 drops 2 times daily	Sofradex® effective but more expensive. Use 2 to 3 drops in the ear(s) 3 to 4 times daily	Keep ear canal dry during and for 2 weeks after treatment (e.g. dry mop the ear with rolled tissue spears; do not syringe with water). If fever, spread to pinna, folliculitis or suspect necrotising infection then swab for culture and treat with antibiotics to cover *Staphylococcus aureus* (see Boils) and *Pseudomonas aeruginosa* (e.g. ciprofloxacin, gentamicin)
Otitis media Acute *See also Mastoiditis*	Antibiotic treatment is usually unnecessary 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) Consider alternative antibiotic if recent amoxicillin use or recurrent acute otitis media	Not improving at 2 to 3 days: amoxicillin+ clavulanate If penicillin or cephalosporin allergy: trimethoprim+ sulfamethoxazole or azithromycin. Chloramphenicol or doxycycline (only if > 8 years) likely to work but unproven	Spontaneous resolution is common. Antibiotics overall cause harm more often than benefit. Give antibiotics only if worsening symptoms or failure to resolve after 2 to 3 days, bilateral otitis media, age < 2 years, or systemic symptoms (high fever, vomiting, lethargy). For others, educate and give paracetamol and antibiotic prescription to redeem or start taking only if symptoms persist at 48 to 72 hours or worsen
Otitis media Chronic suppurative, with or without grommets	Locorten-Vioform 2 to 3 drops 2 times daily		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*		
Peritonitis	*See Abdomen*		
Pertussis	*See Whooping cough*		

INFECTION	FIRST CHOICE	ALTERNATIVES	COMMENTS
Pelvic inflammatory disease (PID) Includes endometritis, chorioamnionitis, salpingitis, tubo-ovarian abscess, and pelvic cellulitis and peritonitis	Likely sexually acquired, mild to moderate infection: Ceftriaxone 250 mg IV or IM (*see comments*) as a single dose, plus metronidazole 400 mg orally 2 times daily for 14 days, plus azithromycin 1 g orally as a single dose plus azithromycin 1 g orally as a single dose 1 week later Likely sexually acquired, severe infection: Ceftriaxone 2 g IV daily plus azithromycin 500 mg daily plus metronidazole 500 mg IV 12-hourly. When substantial improvement, switch to oral regimen above Likely non-sexually acquired: *see Abdominal infections* and consider adding treatment for *M. hominis* with doxycycline for 14 days	Likely sexually acquired, with severe penicillin allergy or any cephalosporin allergy: gentamicin plus azithromycin plus chloramphenicol Likely non-sexually acquired: *see Abdominal infections*	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 (enteric gram-negative bacilli, anaerobes or *Mycoplasma hominis*). Non-sexually transmitted PID occurs after pregnancy termination, pelvic surgery or IUCD insertion. Test for sexually transmitted pathogens and treat empirically until results available. Consider testing and treating sexual partner Giving IM ceftriaxone without lignocaine is painful. Dissolve 1 g ceftriaxone in 2 mL of 1% lignocaine Puerperal fever, chlamydia and gonorrhoea are **notifiable**

INFECTION	FIRST CHOICE	ALTERNATIVES	COMMENTS
Pharyngitis / Tonsillitis	Amoxicillin 50 mg/kg (up to 1000 mg) once daily orally for 10 days (not if suspect EBV infection) Penicillin V 500 mg (child: 15 mg/kg up to 500 mg) orally 2 times daily for 10 days Benzathine penicillin G IM single dose: child 6 to 10 kg 337.5 mg, 10 to 15 kg 450 mg (0.6 MU), 15 to 20 kg 675 mg, > 20 kg or adult 900 mg (1.2 MU). Consider mixing with 0.25 mL lignocaine 2%	Azithromycin 500 mg (child 12 mg/kg up to 500 mg) orally, daily for 5 days Roxithromycin (child 2.5 mg/kg up to 150 mg 2 times daily; adult 300 mg once daily) for 10 days	Group A streptococcal pharyngitis cannot reliably be clinically distinguished from viral pharyngitis but is more likely if there is rigors or fever, tender cervical adenitis, tonsillar exudates, no cough, and age 3 to 14 years. Give antibiotics if: • Pacific or Maori person aged 3 to 35 years • Past personal, close family or household history of rheumatic fever (treat at any age) • Scarlet fever. **Notifiable** Peritonsillar abscess (severe pain, trismus) – *see Mouth, para-pharyngeal and deep neck infections* Consider adding corticosteroids if symptoms very severe (e.g. restricted swallowing, drooling)
Pleural space infection / Empyema	Mild: amoxicillin+ clavulanate. If failing, amoxicillin+clavulanate plus either doxycycline (8 years or older) or trimethoprim+ sulfamethoxazole Severe: Ceftriaxone +/- either metronidazole IV or vancomycin. Or amoxicillin+clavulanate IV plus either doxycycline (8 years or older) or trimethoprim+ sulfamethoxazole	Mild: cephalexin plus either doxycycline (8 years or older), trimethoprim+ sulfamethoxazole or metronidazole. Or chloramphenicol alone Severe: chloramphenicol IV. Or vancomycin plus ciprofloxacin	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/mm^3, culture or Gram-stain positive) Consider TB

INFECTION	FIRST CHOICE	ALTERNATIVES	COMMENTS
Pneumonia Adult, community-acquired	Mild/outpatient: doxycycline 200 mg daily. If failing, amoxicillin 1 g orally 3 times daily plus doxycycline Moderate/inpatient: amoxicillin 1 g orally 3 times daily or penicillin 1.2 g IV 6-hourly, plus doxycycline 200 mg daily Severe: ceftriaxone plus azithromycin Substitute meropenem[RESTRICTED] for ceftriaxone if failing, immune-compromised, *Pseudomonas aeruginosa* in sputum, recent known multi-drug-resistant gram-negative rod (GNR), recent travel to India or South Asia, or recent admission to overseas facility with high prevalence of resistant GNR	Mild/outpatient: cephalexin plus doxycycline, amoxicillin plus roxithromycin, or chloramphenicol alone. If failing, chloramphenicol plus ciprofloxacin Moderate-severe/ inpatient: mild penicillin allergy: ceftriaxone plus either azithromycin or doxycycline. Severe penicillin allergy or any cephalosporin allergy: chloramphenicol IV plus ciprofloxacin	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, cavitatory 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)
Pneumonia Adult, suspect aspiration	Mild: Augmentin plus either doxycycline or trimethoprim+ sulfamethoxazole. If failing, amoxicillin+clavulanate plus ciprofloxacin Severe: ceftriaxone plus either doxycycline, trimethoprim+ sulfamethoxazole or azithromycin	Mild: cephalexin plus either doxycycline or trimethoprim+ sulfamethoxazole. If severe penicillin allergy or any cephalosporin allergy: doxycycline plus ciprofloxacin, or chloramphenicol alone. If failing, ciprofloxacin plus either cephalexin or chloramphenicol Severe: chloramphenicol IV plus either ciprofloxacin or gentamicin	
Pneumonia Adult, hospital-acquired	Cover any recent *Staphylococcus aureus* isolate Mild: doxycycline plus ciprofloxacin Severe: ceftriaxone or amoxicillin+clavulanate IV plus either gentamicin or ciprofloxacin. If failing, see alternatives	Mild: ciprofloxacin plus either amoxicillin+ clavulanate, cephalexin or chloramphenicol. Or amoxicillin+ clavulanate plus doxycycline Severe: ciprofloxacin plus either vancomycin or chloramphenicol IV	

INFECTION	FIRST CHOICE	ALTERNATIVES	COMMENTS
Pneumonia Child < 1 month	*See Neonatal sepsis*		
Pneumonia Child > 1 month	Mild: doxycycline (8 years or older), or amoxicillin+ clavulanate. If failing, amoxicillin+clavulanate plus either doxycycline or ciprofloxacin Severe: penicillin IV plus doxycycline (8 years or older). Or ceftriaxone plus either doxycycline or azithromycin	Mild: chloramphenicol. If failing, cephalexin plus either doxycycline (8 years or older) or ciprofloxacin. Or ciprofloxacin plus either doxycycline or chloramphenicol Severe: ciprofloxacin plus either chloramphenicol or vancomycin	In all age groups, 25% to 60% of pneumonia 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
Prostatitis Acute	Mild: trimethoprim+ sulfamethoxazole. If failing, ciprofloxacin Severe: ceftriaxone or ciprofloxacin	Mild: cephalexin plus doxycycline Severe: gentamicin plus trimethoprim+ sulfamethoxazole	Check and treat for sexually-acquired pathogens if < 35 years or sexually active Treat for 2 to 4 weeks depending on severity and response
Prostatitis Chronic bacterial	Ciprofloxacin 500 mg orally 2 times daily for 4 weeks	Trimethoprim 300 mg orally daily for 4 weeks Trimethoprim+ sulfamethoxazole 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 Moderate to severe: ceftazidime[RESTRICTED]	Ceftazidime[RESTRICTED] If ceftazidime-resistant, use meropenem[RESTRICTED] If bladder infection, doxycycline 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 *(see page 67)* or IV) to ciprofloxacin or ceftazidime
Puerperal fever	*See Pelvic inflammatory disease or* Streptococcus pyogenes *infection*		
Pyelonephritis	*See UTI – Pyelonephritis*		
Ringworm	*See Dermatophytoses*		

INFECTION	FIRST CHOICE	ALTERNATIVES	COMMENTS
Salivary gland infection Acute bacterial / suppurative	Cover any recent *Staphylococcus aureus* isolates Mild: amoxicillin+ clavulanate alone. If failing, add either doxycycline (8 years or older) or trimethoprim+ sulfamethoxazole Severe: amoxicillin +clavulanate plus either doxycycline (8 years or older) or trimethoprim+ sulfamethoxazole	Mild: cephalexin plus either doxycycline (8 years or older) or trimethoprim+ sulfamethoxazole. If severe penicillin allergy or any cephalosporin allergy: metronidazole plus either doxycycline or trimethoprim+ sulfamethoxazole. Or chloramphenicol alone Severe: cefazolin plus either doxycycline (8 years or older) or trimethoprim+ sulfamethoxazole, or chloramphenicol IV alone	Culture pus if draining from salivary gland duct Oral anaerobes and *Staphylococcus aureus* are most common bacterial causes
Salmonella gastroenteritis	Nil. Antibiotics are of no benefit in mild or moderate illness. Treat high-risk groups only (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 6 days Ciprofloxacin 500 mg (child 12.5 mg/kg up to 500 mg) orally 2 times daily for 5 to 7 days If oral therapy not feasible and for bacteraemia or child < 3 months: ceftriaxone IV or ciprofloxacin IV	Treat if neonate or child < 3 months, child 3 to 12 months who is febrile or toxic, adult > 65 years, or person of any age with severe illness, bacteraemia, prosthetic vascular graft or immune-compromise. Consider treatment if prosthetic joint **Notifiable**
Salpingitis	*Pelvic inflammatory disease*		
School sores	*See Impetigo*		
Sepsis Severe, unknown source in adult *See also Immune compromise and sepsis – page 22*	Cover any recent *Staphylococcus aureus* isolates Cefazolin plus gentamicin. If possible abdominal or pelvic infection, add metronidazole. If failing, meropenem +/- vancomycin	Amoxicillin+clavulanate, chloramphenicol or vancomycin, plus gentamicin Cover ceftriaxone resistant gram-negative bacilli (e.g. with meropenem[RESTRICTED]) if infection with those bacteria in past or recent travel to Asia, Middle East or Southern Europe	If unable to tolerate gentamicin (e.g. acute kidney injury), replace gentamicin with ciprofloxacin 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 Change gentamicin or vancomycin to alternatives after 2 to 3 days

INFECTION	FIRST CHOICE	ALTERNATIVES	COMMENTS
Sepsis Unknown source in child *If < 1 month see Neonatal sepsis*	Cover any recent *Staphylococcus aureus* isolates Flucloxacillin plus ceftriaxone If failing, add gentamicin. If failing and/or suspect MRSA, use vancomycin plus ceftriaxone	Ciprofloxacin plus vancomycin. Or chloramphenicol plus either cefazolin, ceftriaxone or gentamicin	If unable to tolerate gentamicin (e.g. acute kidney injury), replace gentamicin with ciprofloxacin 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 Change gentamicin or vancomycin to alternatives after 2 to 3 days
Shigella gastroenteritis	Trimethoprim+ sulfamethoxazole 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 500 mg (child: 12.5 mg/kg up to 500 mg) orally 2 times daily for 5 days 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 Treat shingles with aciclovir in all cases Treat chickenpox with aciclovir if child has pre-existing skin disease (e.g. eczema) of if adult has severe chickenpox or complications (e.g. pneumonitis), or is pregnant or immune-compromised	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: approx 20 mg/kg < 5 years; 15 mg/kg ≥ 5 years) IV 8-hourly)	In general, start aciclovir only if less than 72 hours after onset of rash, except if ophthalmic zoster or immune-compromised If bacterial super-infection of chickenpox or shingles, treat as for *Cellulitis* If acute shingles very painful or > 50 years old, consider prednisolone (60 mg daily for 7 days then taper over 14 days) in addition to acyclovir. Caution in diabetes **Chickenpox is notifiable**
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: amoxicillin+ clavulanate, cephalexin plus doxycycline (8 years or older), or chloramphenicol alone Severe: amoxicillin+ clavulanate IV, ceftriaxone, or chloramphenicol IV	Most cases are viral or resolve spontaneously within 2 weeks without antibiotics. Consider antibiotics if worsening or severe symptoms, or marked sinus tenderness, especially if unilateral

INFECTION	FIRST CHOICE	ALTERNATIVES	COMMENTS
Skin infections	*See Bites, Boils, Cellulitis, Dermatophytoses, Diabetic foot sepsis, Eczema, Impetigo, Necrotising fasciitis, Ulcers, Wounds*		
Sore throat	*See Pharyngitis*		
Spinal infection	*See Bone – vertebral*		
Splenectomy	*See Immune compromise and Sepsis*		
***Staphylococcus aureus* infection** Including MRSA	**Flucloxacillin-susceptible:** Flucloxacillin is most potent, followed by amoxicillin-clavulanate, cefazolin and cephalexin. Next best option is trimethoprim+ sulfamethoxazole, followed by doxycycline (8 years or older), macrolides (e.g. azithromycin, roxithromycin) and chloramphenicol	**Flucloxacillin-resistant (MRSA):** Vancomycin is most potent and should be used if severe sepsis, endocarditis, meningitis, brain abscess or neutropenia. Other options: trimethoprim+ sulfamethoxazole, doxycycline (8 years or older), macrolides, chloramphenicol. Gentamicin alone may or may not have an effect Severe MRSA sepsis: combine vancomycin with flucloxacillin (flucloxacillin is not active alone but boosts vancomycin efficacy in combination)	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) *For* Staphylococcus aureus *bloodstream infection, see below* *For high-dose oral regimens, see page 71*
Staphylococcus aureus Bloodstream infection	Vancomycin plus flucloxacillin until susceptibility known. Flucloxacillin if susceptible. Do not add gentamicin. Add rifampicin if prosthetic valve endocarditis if susceptible (ask lab to test)	If flucloxacillin-susceptible but patient has mild penicillin allergy: cefazolin. If MRSA or patient has severe penicillin allergy or any cephalosporin allergy: 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 72 hours after start IV antibiotics in all patients. Look for source and metastatic infection (30%), especially joint or bone Can stop high-dose antibiotic at 7 days if no evidence of endocarditis or metastatic infection, no IV drug abuse, not relapsed bloodstream infection, fever settled and 72-hour blood cultures negative
***Streptococcus anginosis* group**	Penicillin	Ceftriaxone, vancomycin	

INFECTION	FIRST CHOICE	ALTERNATIVES	COMMENTS
***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	Cefazolin, cephalexin, ceftriaxone. Macrolides (e.g. roxithromycin, azithromycin – if susceptible) and vancomycin (always susceptible) Trimethoprim+ sulfamethoxazole and doxycycline may be active but should not be used for strep throat	If severe infection (e.g. bacteraemia, sepsis, shock, non-resolving cellulitis) add clindamycin (to beta-lactam) for synergy, if available Puerperal fever, scarlet fever and rheumatic fever are **notifiable** *For strep throat, see Pharyngitis*
STI (Sexually Transmitted Infection)	*See Chlamydia, Gonorrhoea, Herpes Simplex, Syphilis or Trichomoniasis*		
Syphilis Primary, secondary or latent < 2 years duration	Benzathine penicillin G 1.8 g (2.4 MU) IM single dose	Non-pregnant: doxycycline 100 mg 2 times daily for 14 days Azithromycin 2 g orally single dose	Do not use procaine penicillin. **Notifiable**
Syphilis Latent > 2 years duration	Benzathine penicillin G 1.8 g (2.4 MU) IM, once weekly for 3 weeks	Procaine penicillin 1.5 g IM, daily for 15 days Doxycycline 100 mg orally 2 times daily for 28 days	Do lumbar puncture to test for neurosyphilis if neurologic symptoms, treatment failure, or eye or ear involvement. **Notifiable**
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		For cardiovascular syphilis or neurosyphilis, consider adding prednisolone 20 mg orally 2 times daily for 3 doses with penicillin to reduce the risk of a Jarisch–Herxheimer reaction **Notifiable**
Testes	*See Epididymo-orchitis*		
Throat	*See Pharyngitis*		
Thrush	*See Candida*		

INFECTION	FIRST CHOICE	ALTERNATIVES	COMMENTS
Tinea versicolor 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 Fluconazole 400 mg orally single dose	
Tonsillitis	*See Pharyngitis*		
Tooth abscess *If severe, spread to neck, or airways compromise, see Mouth, para-pharyngeal and deep neck infections*	Mild: amoxicillin. If failing, add metronidazole or switch to amoxicillin+ clavulanate Severe: amoxicillin+ clavulanate IV or penicillin plus metronidazole IV	Mild: cephalexin, chloramphenicol Severe: cefazolin +/- metronidazole IV, or chloramphenicol IV alone	Antibiotic treatment is only an adjunct to an appropriate dental procedure. Give antibiotics if face swelling, systemic symptoms or fever
Trichomoniasis	Metronidazole 2 g orally single dose	If relapse, metronidazole 400 mg orally 2 times daily for 5 days	Treat partners, even if asymptomatic **Notifiable**
Typhoid (Proven, highly likely or on the advice of the Public Health doctor)	Ciprofloxacin 500 mg to 1 g (child 20 mg/kg up to 750 mg) orally 2 times daily for 5 to 7 days. If unable to take ciprofloxacin orally, give 400 mg IV 2 to 3 times daily Azithromycin 1 g (child: 20 mg/kg up to 1 g) orally daily for 5 days	Ceftriaxone, IV ampicillin, oral amoxicillin for 14 days, oral trimethoprim+ sulfamethoxazole 4+20 mg/kg up to 160+800 mg orally 2 times daily for 10 to 14 days	Use higher dose of ciprofloxacin if severe infection (until improved) or weight > 100 kg (for first 2 days). Use lower dose of ciprofloxacin if renal impairment. Stop ciprofloxacin if peripheral nerve pain or tendon pain. If severe, dexamethasone 3 mg/kg IV just before first dose of antibiotic then 1 mg/kg 4 times daily for 2 days Perform CSF analysis in all neonates and children < 3 months to exclude neurological disease; in this age group, treat IV for 10 days **Notifiable**

INFECTION	FIRST CHOICE	ALTERNATIVES	COMMENTS
Ulcers Leg, foot, pressure, vascular, diabetic	*See Diabetic foot sepsis or see Ulcers* – Haemophilus ducreyi		
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% lignocaine) as a single dose, or ciprofloxacin 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 Chronic painful skin ulcers in children may be caused by *Haemophilus ducreyi*. This is difficult to identify in the laboratory
Upper respiratory tract viral infection	*See Common cold*		
Urinary tract infection *Candida* sp.	Fluconazole 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, use fluconazole 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 colonizer, 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. Seek expert advice
Urinary tract infection Cystitis in adult men	Trimethoprim 300 mg orally daily for 7 days or trimethoprim+ sulfamethoxazole 160+800 mg 2 times daily for 7 days Cephalexin 500 mg 2 times daily for 7 days Nitrofurantoin 100 mg 3 times daily for 7 days (not if GFR < 30 mL/min, fever or suspect prostatitis) If high risk of resistance (old age, diabetes, urinary tract abnormalities, recent resistant isolate) or failed first-line antibiotics, use ciprofloxacin (see alternatives)	If susceptible bacteria isolated, you may use amoxicillin+clavulanate 500+125 mg 2 times daily for 7 days Use ciprofloxacin 500 mg orally 2 times daily for 7 days if proven or suspected resistance to first-line antibiotics	Twice daily cephalexin and amoxicillin+clavulanate dosing is appropriate for cystitis, not other infections 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* *Staphylococcus aureus* in the urine often indicates non-urine source (e.g. bone, joint, skin and soft tissues)

INFECTION	FIRST CHOICE	ALTERNATIVES	COMMENTS
Urinary tract infection Cystitis in adult women	Trimethoprim 300 mg orally daily for 3 days or trimethoprim+ sulfamethoxazole 160+800 mg 2 times daily for 3 days (neither in the first trimester of pregnancy) Cephalexin 500 mg 2 times daily for 5 days Nitrofurantoin 100 mg 3 times daily for 5 days (not if GFR < 30 mL/min) If high risk of resistance (old age, diabetes, urinary tract abnormalities, recent resistant isolate) or failed first-line antibiotics, use ciprofloxacin (see alternatives)	If susceptible bacteria isolated, you may use amoxicillin+clavulanate 500+125 mg 2 times daily for 5 days Ciprofloxacin 500 mg orally 2 times daily for 3 days if proven or suspected resistance to first-line antibiotics	Twice daily cephalexin and amoxicillin+clavulanate dosing is appropriate for cystitis, not other infections Culture urine before starting treatment if pregnant, aged-care facility resident, 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 cephalexin, nitrofurantoin or amoxicillin+clavulanate. 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	Trimethoprim+ sulfamethoxazole 4+20 mg/kg up to 160+800 mg 2 times daily Cephalexin 12.5 mg/kg up to 500 mg orally 4 times daily If recent resistant isolate or failed first-line antibiotics, use ciprofloxacin (see alternatives)	If susceptible bacteria isolated, you may use amoxicillin+clavulanate 15 mg/kg up to 500+125 mg 3 times daily If bacteria resistant to all the above antibiotics or *Pseudomonas aeruginosa*, use ciprofloxacin 12.5 mg/kg up to 500 mg orally, 2 times daily	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 Duration of cystitis treatment: 5 days if age < 1 year, 3 days if > 1 year If recurrent UTI, consider prophylactic antibiotics and urinary tract imaging

INFECTION	FIRST CHOICE	ALTERNATIVES	COMMENTS
Urinary tract infection Indwelling catheter	Nil unless symptomatic Wait for culture results before prescribing	Cephalexin plus either trimethoprim+ sulfamethoxazole or doxycycline, or ciprofloxacin alone if can't wait for results of culture Doxycycline may cure *Pseudomonas aeruginosa* cystitis, despite in-vitro resistance	Asymptomatic bacteriuria and pyuria are common and should not be treated Culture urine (**not** from collection bag) and treat only if: • Symptoms (fever, rigors, mental status changes without other explanation, flank pain or tenderness – not just if smelly or cloudy urine) • Imminent surgery involving urinary tract
Urinary tract infection Pyelonephritis, adult	Mild (low fever and no nausea or vomiting): trimethoprim+ sulfamethoxazole 160+800 mg 2 times daily plus cephalexin 500 to 1000 mg orally 3 times daily for 10 to 14 days Moderate to severe: ciprofloxacin orally. If can't tolerate oral medication, ceftriaxone +/- gentamicin	Mild: if susceptible: amoxicillin+clavulanate 500+125 mg orally 3 times daily for 10 to 14 days Use ciprofloxacin 500 mg orally 2 times daily for 7 days if proven resistance to first-line antibiotics Moderate to severe: trimethoprim+ sulfamethoxazole plus gentamicin. If failing, ciprofloxacin plus either amoxicillin+clavulanate IV or cefazolin	Culture urine before starting treatment Cover ceftriaxone-resistant gram-negative bacilli (e.g. with meropenem[RESTRICTED]) if urine infection with those bacteria in past or recent travel to Asia, Africa, Middle East or Southern Europe 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 Repeat urine culture 1 to 2 weeks after treatment to confirm cure if pregnant then 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)
Urinary tract infection Pyelonephritis, child	If oral therapy appropriate, ciprofloxacin 12.5 mg/kg up to 500 mg orally, 2 times daily Use IV therapy initially if < 1 month,or any child who is septic, unable to maintain oral intake,or has risk factors for serious illness: ceftriaxone (child > 1 month) 50 mg/ kg up to 1 g IV daily. Add gentamicin if not responding	Ampicillin plus gentamicin 5 to 7.5 mg/ kg up to 320 mg IV daily	Critically ill children may need higher doses Cover ceftriaxone-resistant gram-negative bacilli if urine infection with those bacteria in past or recent travel to Asia, Middle East or Southern Europe: meropenem[RESTRICTED] 12.5 to 25 mg/kg up to 500 to 1000 mg IV 8-hourly 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 atypicall *Staphylococcus aureus* in the urine often indicates non-urine source (e.g. bone, joint, skin and soft tissues)

INFECTION	FIRST CHOICE	ALTERNATIVES	COMMENTS
Vaginosis Bacterial	Metronidazole 400 mg orally 2 times daily for 5 days	Metronidazole 2 g orally single dose	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
Varicella zoster virus	*See Shingles*		
Vertebral osteomyelitis	*See Bone – vertebral*		
Whooping cough *(Bordetella pertussis)*	Azithromycin 500 mg orally day 1 then 250 mg orally daily for 4 days (child 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)	Trimethoprim+sulfamethoxazole 160+800 mg (child > 1 month: 4+20 mg/kg up to 160+800) 2 times daily for 14 days	Admit if cyanotic spells; refer if < 6 months. Treatment after early paroxysmal cough phase (approx 21 days) has no effect on illness or infectivity **Notifiable**
Wound infection Post-trauma *See also Diabetic foot infection, Ulcers, Wound infection – post-operative (surgical site), Wound infection – water injuries*	Cover any recent *Staphylococcus aureus* isolates Mild: amoxicillin+clavulanate plus trimethoprim+sulfamethoxazole Severe: amoxicillin+clavulanate IV plus either trimethoprim+sulfamethoxazole or ciprofloxacin	Mild: trimethoprim+sulfamethoxazole plus metronidazole. Or chloramphenicol alone. If failing, ciprofloxacin plus either amoxicillin+clavulanate or chloramphenicol Severe: chloramphenicol IV plus either ciprofloxacin, ceftriaxone or gentamicin	Drain pus – this may be all that is needed for small, mild infected wounds Culture pus to guide antibiotic choice 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: doxycycline (8 years or older) or trimethoprim+sulfamethoxazole. If failing, amoxicillin+clavulanate plus either doxycycline (8 years or older) or trimethoprim+sulfamethoxazole Severe: amoxicillin+clavulanate IV or cefazolin plus either doxycycline (8 years or older) or trimethoprim+sulfamethoxazole	Mild: cephalexin plus either doxycycline (8 years or older) or trimethoprim+sulfamethoxazole, or chloramphenicol alone Severe: vancomycin plus either ceftriaxone, ciprofloxacin or chloramphenicol IV. Or gentamicin plus either trimethoprim+sulfamethoxazole or chloramphenicol IV	Drain pus – this may be all that is needed for small, mild infected wounds Culture pus to guide antibiotic choice

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: amoxicillin+ clavulanate. If failing, amoxicillin+clavulanate plus either doxycycline (8 years or older) or trimethoprim+ sulfamethoxazole Severe: Ceftriaxone +/- either metronidazole IV or vancomycin. Or amoxicillin+clavulanate IV plus either doxycycline (8 years or older) or trimethoprim+ sulfamethoxazole	Mild: cephalexin plus either doxycycline (8 years or older), trimethoprim+ sulfamethoxazole or metronidazole. Or chloramphenicol alone Severe: chloramphenicol IV. Or vancomycin plus ciprofloxacin	Drain pus – this may be all that is needed for small, mild infected wounds Culture pus 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*	Cover any recent *Staphylococcus aureus* isolates Mild: amoxicillin+ clavulanate plus trimethoprim+ sulfamethoxazole Severe: amoxicillin+ clavulanate IV plus either trimethoprim+ sulfamethoxazole or ciprofloxacin	Mild: trimethoprim+ sulfamethoxazole plus metronidazole. Or chloramphenicol alone. If failing, ciprofloxacin plus either amoxicillin+ clavulanate or chloramphenicol Severe: chloramphenicol IV plus either ciprofloxacin, ceftriaxone or gentamicin	Same as Wound infection – post-trauma
Wound infection Water injuries (coral cuts, skin trauma in lagoon, fisherman hand injuries)	Cover any recent *Staphylococcus aureus* isolates Mild: amoxicillin+ clavulanate Severe: amoxicillin+ clavulanate IV	Mild: trimethoprim+ sulfamethoxazole plus metronidazole. Cephalexin plus either trimethoprim+ sulfamethoxazole or doxycycline (8 years or older). Chloramphenicol alone Severe: ceftriaxone, vancomycin or chloramphenicol IV	Drain and culture pus Hand cellulitis 2 to 7 days after injury handling fish, crabs or shrimps – cover *Erysipelothrix* with penicillin, amoxicillin, ceftriaxone, chloramphenicol or doxycycline (8 years or older) If infection after fresh water injury, cover *Pseudomonas aeruginosa* and Aeromonas sp. with ciprofloxacin, ceftazidime or meropenem[RESTRICTED]

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 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. diabetes, splenectomy).

FIRST CHOICE	ALTERNATIVES
Amoxicillin+clavulanate 500+125 mg (child: 25 to 50 mg of amoxicillin, with clavulanate) orally 3 times daily	Adult and child > 8 years: metronidazole 7.5 mg/kg up to 800 mg 2 times daily plus doxycycline 100 mg 2 times daily for 7 days. Child < 8 years: trimethoprim+sulfamethoxazole 4+20 mg/kg (up to 160+800 mg) orally 2 times daily in place of doxycycline

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 77 for bleach dilution instructions*), slow-release silver, or Microdacyn.

ENDOCARDITIS PROPHYLAXIS FOR DENTAL TREATMENT

International guidelines and experts disagree on whether endocarditis prophylaxis is needed for dental procedures in patients with underlying heart valve problems. The 2008 NICE guidelines do not recommend prophylaxis and no subsequent increase in endocarditis has occurred in the United Kingdom. The 2008 New Zealand guidelines and the 2016 Australian guidelines do recommend prophylaxis, including for patients with underlying rheumatic heart disease (which is common in the Cook Islands). Dentists in the Cook Islands may or may not 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

Prophylaxis is indicated for patients with one or more of the following heart valve conditions:

- Rheumatic heart disease (not for those with previous rheumatic fever without heart involvement)
- Prosthetic heart valves (biological or mechanical)
- 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.

Dental care and procedures

Patients with these high-risk heart valve conditions should have good oral and dental health and care. Prophylactic antibiotics are recommended for all 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:

- Ampicillin 2 g (child: 50 mg/kg up to 2 g), administered:
  - Orally (as amoxicillin), 1 hour before the procedure, or
  - IV, just 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.
- Mild penicillin allergy: cephalexin 2 g (child: 50 mg/kg up to 2) orally, 1 hour before the procedure; or cefazolin 2 g (child: 30 mg/kg up to 2 g) IV or IM (timing as above)
- Severe penicillin allergy 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 roxithromycin 300 mg (child 5 mg/kg up to 300 mg) orally, azithromycin 500 mg (child 12 mg/kg up to 500 mg) orally, or chloramphenicol 1 g (child 25 mg/kg up to 1 g) orally (or IV), 1 hour before the procedure. Note: these options are less studied than ampicillin and amoxicillin but likely to be effective.
- 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 (GBS) ANTENATAL PROPHYLAXIS

Based on the New Zealand guidelines 2013 and Australian guidelines 2016.

Streptococcus agalactiae (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

A risk-based GBS strategy is used in New Zealand and Australia, as it is more clinically and cost effective than routine laboratory screening.

Chorioamnionitis or GBS prophylaxis?

Criteria for chorioamnionitis treatment include maternal fever (≥ 38 0C) clinical manifestations such as uterine tenderness or purulent amniotic fluid.

If the mother has chorioamnionitis, take blood cultures and treat with broad-spectrum antibiotics (as per Empiric and Targeted guidelines – Pelvic inflammatory disease (PID))

Which mothers get intra-partum antibiotic prophylaxis?

Those who do not have active chorioamnionitis (as above) but who have any one or more of the following criteria:

- A previous GBS-infected baby
- GBS bacteriuria of any count during any trimester of the current pregnancy (even if successfully treated at the time)
- GBS identified by screening cultures from either vaginal or rectal swabs in late gestation during the current pregnancy
- Pre-term (< 37 weeks) labour and imminent birth
- Intra-partum fever (≥ 38°C)
- Membrane rupture for ≥ 18 hours.

Incidental finding of vaginal or rectal GBS colonisation during pregnancy more than 6 weeks before labour does not require intra-partum antibiotic prophylaxis. Instead, repeat low vaginal and rectal swabs at ≥ 37 weeks gestation to re-assess colonisation. Write “GBS screening” on the request form.

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
- Mild penicillin allergy: cefazolin 2 g IV 8-hourly until delivery
- Severe penicillin allergy or any cephalosporin allergy: vancomycin 1 g 12-hourly until delivery
- Oral azithromycin 500 mg daily is also likely to be active.

Timing of intra-partum antibiotic

If risk factors for GBS infection, start at the onset of intervention (e.g. induction of labour), whether or not the membranes have ruptured. The antibiotics are probably effective if there is at least 1 hour before the birth. Continue until the baby is born.

Women who have intact membranes and require pre-labour elective or emergency caesarean section do not require prophylaxis for GBS infection.

Discontinue prophylactic antibiotics if pre-term labour does not establish (and membranes are intact).

Management of the newborn baby

Based on Observation of mother and baby in the immediate postnatal period: consensus statements guiding practice. (New Zealand Ministry of Health, 2012. www.health.govt.nz/.../observation-mother-baby-immediate-postnatal-period)

Watch 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.*

PRE-OPERATIVE ANTIBIOTIC PROPHYLAXIS

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 1 to 2 hours before incision. Note: oral route less studied than IV.
- 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 (HRS)[1,2]
	ADULTS	PAEDIATRICS	
Amoxicillin / Clavulanate	2.4 g	50 mg/kg (of amox)	2
Cefazolin	2 g (3 g if > 120 kg)	30 mg/kg	4
Chloramphenicol	1 g	25 mg/kg up to 1 g	4
Gentamicin *(infuse over 30 min)*	5 mg/kg	2.5 mg/kg	
Metronidazole	500 mg IV or 800 mg oral	15 mg/kg (IV or oral) (7.5 mg/kg if < 1200 g)	
Trimethoprim+ sulfamethoxazole	160+800 mg oral	4+20 mg/kg up to 160+800 mg oral	
Vancomycin *(infuse over 1 to 2 hours)*	1 g up to 70 kg, then 15 mg/kg	15 mg/kg	

[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.*

PROCEDURE	FIRST CHOICE	ALTERNATIVES	COMMENTS
Gastrointestinal (open or laparoscopic) Oesophageal, gastric, duodenal, liver or biliary tract surgery (if obstruction as per colorectal)	Cefazolin	Amoxicillin+clavulanate, chloramphenicol	
Colorectal (appendicectomy), pancreatic surgery, acute laparotomy	Cefazolin plus metronidazole	Amoxicillin+clavulanate, chloramphenicol	

PROCEDURE	FIRST CHOICE	ALTERNATIVES	COMMENTS
Hernia repair With mesh If bowel lumen entry is expected, *see Gastrointestinal – colorectal (above)*	Cefazolin	Amoxicillin+ clavulanate, chloramphenicol	If MRSA grown from any site in the last 6 months, use a regimen that covers this strain
Obstetrics / Gynae Hysterectomy (abdominal or vaginal), prolapsed repair	Cefazolin (plus metronidazole if vaginal hysterectomy)	Amoxicillin+ clavulanate, chloramphenicol	Test and treat for bacterial vaginosis first
Caesarean section (elective or emergency)	Cefazolin	Amoxicillin+ clavulanate, or either vancomycin or azithromycin 500 mg orally, plus ciprofloxacin 500 mg orally	Give antibiotics before incision (not after cord clamp)
Termination of pregnancy	Doxycycline 100 mg pre-op, 200 mg post-op in all		Test and treat for bacterial vaginosis and chlamydia first
Repair of a third- or fourth-degree perineal tear during vaginal delivery	Cefazolin	Trimethoprim+ sulfamethoxazole plus metronidazole	If anal sphincter requires repair give amoxicillin+clavulanate 500+125 mg orally 3 times daily for 7 days after repair (if allergy: cephalexin plus metronidazole, or trimethoprim+sulfamethoxazole plus metronidazole)
Orthopaedic Prosthesis insertion or implantation of any foreign material (screws, plates, anchors, pins, nails)	Cefazolin (3 doses, 8- hourly, for 24 hours max)	Amoxicillin+ clavulanate, chloramphenicol, or trimethoprim+ sulfamethoxazole orally	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
Compound fracture	Cefazolin	Amoxicillin+ clavulanate, chloramphenicol, or trimethoprim+ sulfamethoxazole orally	Tetanus booster if indicated If MRSA grown from any site in the last 6 months, use a regimen that covers this strain
Compound fracture with wound soiling or extensive devitalised tissue	Cefazolin plus metronidazole	Amoxicillin+ clavulanate, chloramphenicol, or trimethoprim+ sulfamethoxazole orally	Tetanus booster if indicated If MRSA grown from any site in the last 6 months, use a regimen that covers this strain Treat for 5 to 7days, or longer if bone infection is established
Vascular or pacemaker insertion Aorta or lower limb artery reconstruction, or grafting	Cefazolin	Amoxicillin+ clavulanate, chloramphenicol, or trimethoprim+ sulfamethoxazole orally	If MRSA grown from any site in the last 6 months, use a regimen that covers this strain

PROCEDURE	FIRST CHOICE	ALTERNATIVES	COMMENTS
Urological	Test all elective patients pre-op for urine infection, even if asymptomatic, and treat based on culture results		
Vasectomy, scrotal surgery, varicocoele ligation, urodynamics, simple diagnostic cystoscopy or ureteroscopy (without manipulation)	Nil	Nil	If clinical or dipstick evidence of infection on day of surgery: cefazolin or trimethoprim+ sulfamethoxazole
Endoscopic intra-renal and ureteric stone procedures, simple cystoscopy in high-risk patients (see comments), resection of large tumours, likely heavy bleeding, open or laparoscopic procedures in which the urinary tract is entered	Cefazolin If radical prostatectomy or insertion of prosthetic material add gentamicin 2 mg/kg	Gentamicin 2 mg/kg IV plus trimethoprim+ sulfamethoxazole PO	High-risk patients for simple cystoscopy include those with bladder outlet obstruction with incomplete emptying or other anatomic abnormality, or immune-suppression
TURP	Cefazolin	Gentamicin 2 mg/kg	
If entering the GI tract (ileal conduit, rectocoele repair)	*See Abdominal – colorectal procedures above*		
Amputations Lower limb	Cefazolin (plus metronidazole if ischaemic limb)	Amoxicillin+ clavulanate, chloramphenicol, or trimethoprim+ sulfamethoxazole orally	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	Amoxicillin+ clavulanate, chloramphenicol, or trimethoprim+ sulfamethoxazole orally	
ENT / Head and neck Clean (thyroid, node excision), tympanostomy, T&As, septoplasty, FES	Nil	Nil	
Incision through oral, nasal, pharyngeal or oesophageal mucosa, stapedectomy or similar operations, the insertion of prosthetic material, or surgery in the presence of head or neck cancer	Cefazolin	Amoxicillin+ clavulanate, chloramphenicol	

PRE-TERM, PRE-LABOUR RUPTURE OF MEMBRANE PROPHYLAXIS

Antibiotic prophylaxis for women with membrane rupture before 37 weeks and before the onset of uterine contractions is not proven to alter outcomes but is commonly given. Consider giving amoxycillin 250 mg orally 3 times daily plus roxithromycin 150 mg daily, both for 7 days.

RHEUMATIC FEVER PROPHYLAXIS

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

For patients after probable or definite acute rheumatic fever give benzathine penicillin G (adult and child > 30 kg: 900 mg (1.2 MU); child < 30 kg: 450 mg (0.6 MU)) IM, every 3 or 4 weeks.

Oral prophylaxis is less effective than IM penicillin but options include penicillin V 250 mg orally 2 times daily (adult or child) or, if penicillin-allergic, roxithromycin 150 mg (child: 4mg/kg up to 150mg) orally daily.

The duration of secondary prophylaxis should be as follows:

SEVERITY OF CARDITIS	DEFINITION	DURATION
Mild or none	Any valve lesion(s) graded mild clinically, or by echocardiography, with no clinical evidence of heart failure and no evidence of cardiac chamber enlargement on chest x-ray, ECG or echocardiogram	Minimum of 10 years after most recent episode of acute rheumatic fever or until age 21 years (whichever is longer)
Moderate	• Any valve lesion of moderate severity clinically (e.g. mild or moderate cardiomegaly), or • Any moderate severity valve lesion on echocardiography, or • Any echocardiographic evidence of cardiac chamber enlargement	Minimum of 10 years after most recent episode of acute rheumatic fever or until age 35 years (whichever is longer)
Severe	• Any severe valve lesion clinically (significant cardiomegaly expected, and/or heart failure), or • Any severe valve lesion on echocardiography, or • Any impending or previous cardiac surgery for rheumatic heart disease	Minimum of 10 years after most recent episode of acute rheumatic fever or until age 40 years (whichever is longer), and then specialist review for consideration of the need for continuation of prophylaxis, probably lifelong

SPLENECTOMY PROPHYLAXIS, VACCINATION AND TREATMENT OF ACUTE FEVER

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 penicillin or cephalosporin allergy: trimethoprim+ sulfamethoxazole 80+400 mg (child: infant or toddler 10+50 to 20+100 mg, up to 40 kg 40+200 mg) orally, daily
- Secondary alternative: roxithromycin 150 mg (child: 4 mg/kg up to 150 mg) orally daily.

Duration of prophylaxis

Take prophylactic antibiotics for 1 to 3 years after splenectomy and 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 suppression (e.g. haematological malignancy) and for 6 months after an episode of severe infection.

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 section 4.3.4 in the New Zealand Immunization Handbook 2017 (www.health.govt.nz/immunisation).

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, chloramphenicol or trimethoprim+ sulfamethoxazole in high doses (e.g. in adults - amoxicillin+clavulanate 500+125 mg x2, chloramphenicol 1 g or trimethoprim+sulfamethoxazole 80+400 mg x2-4). The patient should take these antibiotics STAT and seek medical help for investigation and ongoing treatment. *See Immune compromise and sepsis.*

TRAUMATIC WOUND INFECTION PROPHYLAXIS

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. In addition, wounds with the highest risk of infection should be managed with prophylactic antibiotics:

Relative indications for prophylactic antibiotic:

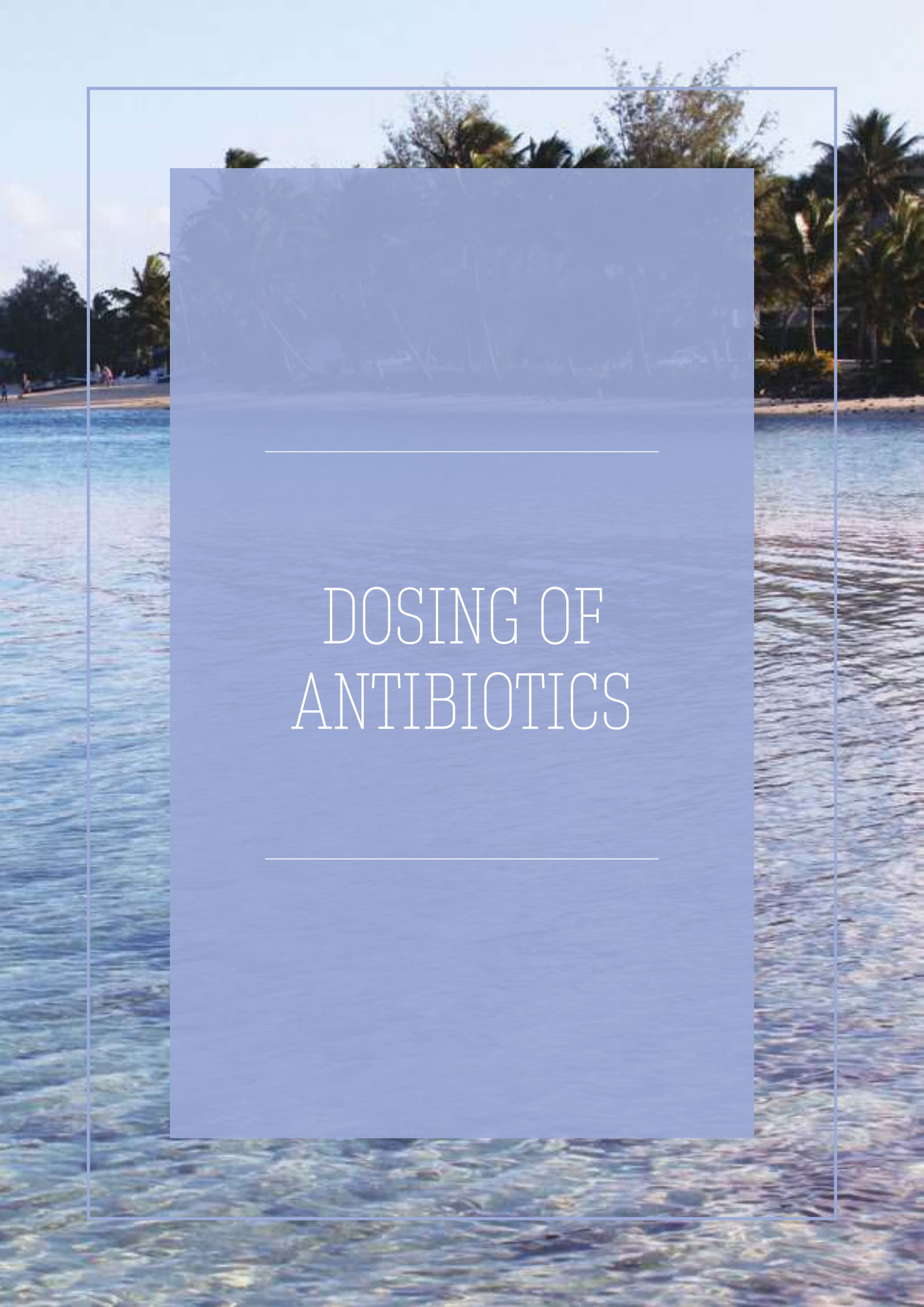
- Lots of soil or dirt in the wound
- Leg or arm wound PLUS either diabetic, weight over 100 kg, oedema or past skin infections
- Severe crush injury
- Deep (e.g. muscle, joint) or penetrating (e.g. stab) wound
- Presentation over 24 hours after injury.

Antibiotic options

Cover any recent *Staphylococcus aureus* isolates. First choice is doxycycline 100 mg (child over 8 years: 4 mg/kg up to 100 mg) orally daily. Alternative: both trimethoprim+sulfamethoxazole 160+800 mg (child > 1 month: 4+20 mg/kg up to 160+800) 2 times daily plus metronidazole 400 mg (child: 10 mg/kg up to 400 mg) 2 times daily. Secondary alternative: amoxicillin+clavulanate 500+125 mg (child: 15 to 30 mg/kg up to 500+125 mg) 3 times daily. Give prophylaxis for 3 to 5 days.

For water injuries (e.g. coral cuts) with indications for prophylactic antibiotics, use doxycycline, amoxicillin+clavulanate or roxithromycin for prophylaxis.

See also page 48, prophylaxis for compound fracture.



DOSING OF ANTIBIOTICS

DOSING FOR NEWBORNS (CHILDREN < 28 DAYS OLD)

Based on the NZ Formulary for Children 2014 and Sanford Guide to Antimicrobial Therapy 2013.

ANTIBIOTIC	DOSE (MG/KG PER DOSE AT FREQUENCY INDICATED)			
	BODY WEIGHT LESS THAN 2000 G		BODY WEIGHT MORE THAN 2000 G	
	0 TO 7 DAYS	8 TO 28 DAYS	0 TO 7 DAYS	8 TO 28 DAYS
Ampicillin (IV)	50 q12h	50 q8h	50 q8h	50 q6h
Amoxicillin (oral)	-	30 TDS	-	30 TDS
Amoxicillin+clavulanate (IV)	30 q12h	30 q12h	30 q12h	30 q12h
Amoxicillin+clavulanate (oral)	15 to 30 TDS	15 to 30 TDS	15 to 30 TDS	15 to 30 TDS
Azithromycin (IV, oral)	5 q24h	10 q24h	5 q24h	10 q24h
Cefazolin	25 q12h	25 q12h	25 q12h	25 q8h
Cefotaxime	50 q12h	50 q8h	50 q12h	50 q8h
Ceftazidime	50 q12h	50 q8h	50 q12h	50 q8h
Ceftriaxone	25 q24h	50 q24h	25 q24h	50 q24h
Cefuroxime (IV)	50 to 80 q12h	50 to 80 q12h	50 to 80 q12h	50 to 80 q12h
Cephalexin (oral)	25 BD	25 TDS	25 BD	25 TDS
Chloramphenicol (IV)	25 q24h	25 q24h	25 q24h	15 q24h
Clindamycin (IV)	5 q12h	5 q8h	5 q8h	5 q6h
Clindamycin (oral)	3 to 6 TDS	3 to 6 QID	3 to 6 TDS	3 to 6 QID
Erythromycin (IV, oral)	10 q12h	10 q8h	10 q12h	13 q8h
Flucloxacillin (IV)	25 to 50 q12h	25 to 50 q8h	25 to 50 q12h	25 to 50 q8h
Flucloxacillin (oral)	25 BD	25 TDS	25 BD	25 TDS
Gentamicin	*See Dosing of gentamicin in infants and children – page 67*			
Meropenem[1]	20 q12h	20 q8h	20 q12h	20 q8h
Metronidazole (IV, oral)	7.5 q24h	7.5 q12h	7.5 q12h	15 q12h
Penicillin (Benzyl, IV)	50 q12h	50 q8h	50 q8 to 12h	50 q8h
Rifampicin	10 q24h	10 q24h	10 q24h	10 q24h
Vancomycin	*See Dosing of vancomycin – page 68*			

BD = 2 times daily; TDS = 3 times daily; QID = 4 times daily.
[1] Double meropenem dose for meningitis.

DOSING FOR CHILDREN › 28 DAYS OLD

These doses do not apply to newborns < 28 days. See the following individual drug tables for amoxicillin, cephalexin, chloramphenicol, trimethoprim+sulfamethoxazole, flucloxacillin and penicillin V.

ANTIBIOTIC	TOTAL DAILY DOSE (CHILD › 28 DAYS, MG/KG)	FREQUENCY OF DOSES
Amoxicillin or ampicillin	25 to 50	8-hourly, 3 times daily[1]
Amoxicillin+clavulanate	25 to 50 of amoxicillin	8-hourly, 3 times daily
Azithromycin	10	24-hourly, daily
Cefaclor	20 to 40	3 times daily
Cefazolin	75	8-hourly
Ceftriaxone	50 (meningitis 100)	24-hourly
Cefuroxime	150	8-hourly
Cephalexin	50 to 100	4 times daily
Chloramphenicol	50 to 100	4 times daily
Ciprofloxacin	25 to 30	12-hourly (max 1.5 g/24h)
Clindamycin	30	6-hourly
Doxycycline (> 8 yr only)	8	2 times daily
Erythromycin	40	4 times daily
Flucloxacillin	50 to 100	6-hourly, 4 times daily
Gentamicin[2]	7.5 (10 to 12 if *P. aeruginosa* in cystic fibrosis)	24-hourly
Meropenem	60 to 120	8-hourly
Metronidazole	15 to 30	12-hourly, 2 times daily
Penicillin V (oral)[3]	25 to 50	4 times daily
Penicillin (Benzyl, IV)	200 to 300	4 to 6-hourly
Roxithromycin	8	2 times daily
Trimethoprim+ sulfamethoxazole	8 to 12 (trimethoprim)	2 times daily
Vancomycin (IV)[2]	60	12-hourly

[1] *Amoxicillin proven effective in daily dosing for pharyngitis and 2 times daily for pneumonia (see empiric and targeted guidelines section).*

[2] *See guidelines for dosing in infants and children for gentamicin (page 67) or vancomycin (page 68).*

[3] *Oral amoxicillin is preferred because its pharmacokinetics are substantially better than penicillin V.*

DOSING FOR CHILDREN - ORAL AMOXICILLIN BY AGE AND WEIGHT

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

CHILD AGE	WEIGHT[1] (ESTIMATED)	AMOXICILLIN DOSE EVERY 8 HOURS[2]	DOSE AS AMOXICILLIN		DOSE AS CAPSULES
			125 MG/5 ML SYRUP	250 MG/5 ML SYRUP	
1 month	3.5 kg				
2 months					
3 months	6 kg	45 mg to 150 mg	1.8 to 6 mL	0.9 to 3 mL	
4 months					
5 months					
6 months	7.3 kg	54.75 mg to 182.5 mg	2.19 to 7.3 mL	1.1 to 3.7 mL	
7 to 11 months					
12 months	10 kg	75 mg to 250 mg	3 to 10 mL	1.5 to 5 mL	
2 years	12 kg	90 mg to 300 mg	Use 250 mg/5 mL syrup	1.8 to 6 mL	
3 years	14 kg	105 mg to 350 mg	Use 250 mg/5 mL syrup	2.1 to 7 mL	
4 years	16 kg	120 mg to 400 mg	Use 250 mg/5 mL syrup	2.4 to 8 mL	1 x 250 mg caps
5 years	18 kg	135 mg to 450 mg	Use 250 mg/5 mL syrup	2.7 to 9 mL	1 x 250 mg caps
6 years	20 kg	150 mg to 500 mg	Use 250 mg/5 mL syrup	3 to 10 mL	1 x 500 mg caps
7 years	22 kg	165 mg to 550 mg	Use 250 mg/5 mL syrup	3.3 to 11 mL	1 x 500 mg caps
8 years	25 kg	187.5 mg to 625 mg	Use 250 mg/5 mL syrup	3.8 to 12.5 mL	1 x 500 mg caps
9 years	28 kg	210 mg to 700 mg	Use 250 mg/5 mL syrup	4.2 to 14 mL	1 x 500 mg caps
10 years	31 kg	232.5 mg to 775 mg	Use 250 mg/5 mL syrup	4.6 to 15.5 mL	1 x 500 mg caps
11 years	35 kg	262.5 mg to 875 mg	Use 250 mg/5 mL syrup	5.3 to 17.5 mL	1 x 500 mg caps
12 years	39 kg	292.5 mg to 975 mg	Use 250 mg/5 mL syrup	5.8 to 19.5 mL	1 x 500 mg caps
13 years	43 kg	322.5 mg to 1075 mg	Use 250 mg/5 mL syrup	6.5 to 20 mL	1 x 500 mg caps
14 years	50 kg	375 mg to 1250 mg	Use 250 mg/5 mL syrup	7.5 to 20 mL	1 x 500 mg caps

[1] *If obese prescribe at high end of normal range.*

[2] *Based on a dose range of 7.5 to 25 mg/kg every 8 hours.*

DOSING FOR CHILDREN - ORAL CEPHALEXIN BY AGE AND WEIGHT

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

CHILD AGE	WEIGHT[1] (ESTIMATED)	CEPHALEXIN DOSE EVERY 6 HOURS[2]	DOSE AS CEPHALEXIN 250 MG/5 ML SYRUP
1 month	3.5 kg	44 to 87.5 mg	0.9 to 1.8 mL
2 months			
3 months	6 kg	75 to 150 mg	1.5 to 3 mL
4 months			
5 months			
6 months	7.3 kg	91 to 182.5 mg	1.8 to 3.5 mL
7 to 11 months			
12 months	10 kg	125 to 250 mg	2.5 to 5 mL
2 years	12 kg	150 to 300 mg	3 to 6 mL
3 years	14 kg	175 to 350 mg	3.7 to 7 mL
4 years	16 kg	200 to 400 mg	4 to 8 mL
5 years	18 kg	225 to 450 mg	4.5 to 9mL
6 years	20 kg	250 to 500 mg	5 to 10 mL
7 years	22 kg	275 to 550 mg	5.5 to 11 mL
8 years	25 kg	312.5 to 625 mg	6.3 to 12.5 mL
9 years	28 kg	350 to 700 mg	7 to 14 mL
10 years	31 kg	387.5 to 775 mg	7.8 to 15.5 mL
11 years	35 kg	437.5 to 875 mg	8.8 to 17.5 mL
12 years +	40 kg +	Use adult dosing (500 to 1000 mg)	10 to 20 mL (if unable to swallow capsules[3])

[1] If obese prescribe at high end of normal range.

[2] Based on a dose range of 50 to 100 mg/kg per day.

[3] Capsules are 500 mg.

DOSING FOR CHILDREN - ORAL CHLORAMPHENICOL BY AGE AND WEIGHT

Take chloramphenicol with food to reduce stomach upset.

CHILD AGE	WEIGHT[1] (ESTIMATED)	CHLORAMPHENICOL DOSE EVERY 6-8 HOURS[2]	DOSE AS CHLORAMPHENICOL 125 MG/5 ML SYRUP	DOSE AS CAPSULES, TO CONSIDER
1 month	3.5 kg	43.75 mg	1.75 mL	
2 months				
3 months	6 kg	75 mg	3 mL	
4 months				
5 months				
6 months	7.3 kg	91.25 mg	3.64 mL	
7 to 11 months				
12 months	10 kg	125 mg	5 mL	
2 years	12 kg	150 mg	6 mL	
3 years	14 kg	175 mg	7 mL	
4 years	16 kg	200 mg	8 mL	
5 years	18 kg	225 mg	9 mL	
6 years	20 kg	250 mg	10 mL	1 x 250 mg capsule
7 years	22 kg	275 mg	11 mL	1 x 250 mg capsule
8 years	25 kg	312.5 mg	12.5 mL	1 x 250 mg capsule
9 years	28 kg	350 mg	14 mL	1 x 250 mg capsule
10 years	31 kg	387.5 mg	15.5 mL	1 x 250 mg capsule
11 years	35 kg	437.5 mg	17.5 mL	1 x 250 mg capsule
12 years	39 kg	487.5 mg	19.5 mL	2 x 250 mg capsules
13 years	43 kg	537.5 mg	21.5 mL	2 x 250 mg capsules
14 years	50 kg	625 mg	25 mL	2 x 250 mg capsules

[1] *If obese prescribe at high end of normal range.*

[2] *Based on dose of 12.5 mg/kg every 6 to 8 hours, to a max of 1 g per day.*

DOSING FOR CHILDREN - ORAL FLUCLOXACILLIN BY AGE AND WEIGHT

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

CHILD AGE	WEIGHT[1] (ESTIMATED)	FLUCLOXACILLIN DOSE EVERY 6 HOURS[2]	DOSE AS FLUCLOXACILLIN		DOSE AS CAPSULES
			125 MG/5 ML SYRUP	250 MG/5 ML SYRUP	
1 month	3.5 kg	43.75 to 87.5 mg	1.75 to 3.5 mL	0.875 to 1.75 mL	
2 months					
3 months	6 kg	75 to 150 mg	3 to 6 mL	1.5 to 3 mL	
4 months					
5 months					
6 months	7.3 kg	91.25 to 182.5 mg	3.6 to 7. 2 mL	1.8 to 3.6 mL	
7 to 11 months					
12 months	10 kg	125 to 250 mg	5 to 10 mL	2.5 to 5 mL	
2 years	12 kg	150 to 300 mg	6 to 12 mL	3 to 6 mL	
3 years	14 kg	175 to 350 mg	7 to 14 mL	3.5 to 7 mL	
4 years	16 kg	200 to 400 mg	8 to 16 mL	4 to 8 mL	
5 years	18 kg	225 to 450 mg	9 to 18 mL	4.5 to 9 mL	1 x 250 mg caps
6 years	20 kg	250 to 500 mg	10 to 20 mL	5 to 10 mL	1 x 250 mg caps
7 years	22 kg	275 to 550 mg	Use 250 mg/5 mL	5.5 to 11 mL	1 x 250 mg caps
8 years	25 kg	312.5 to 625 mg	Use 250 mg/5 mL	6.25 to12.5 mL	1 x 500 mg caps
9 years	28 kg	350 to 700 mg	Use 250 mg/5 mL	7 to 14 mL	1 x 500 mg caps
10 years	31 kg	387.5 to 775 mg	Use 250 mg/5 mL	7.75 to 15.5 mL	1 x 500 mg caps
11 years	35 kg	437.5 to 875 mg	Use 250 mg/5 mL	8.75 to 17.5 mL	1 x 500 mg caps
12 years	39 kg	487.5 to 975 mg	Use 250 mg/5 mL	9.75 to 19.5 mL	1 x 500 mg caps
13 years	43 kg	537.5 to 1075 mg	Use 250 mg/5 mL	10.75 to 21.5 mL	1 x 500 mg caps
14 years	50 kg	625 to 1250 mg	Use 250 mg/5 mL	12.5 to 26.5 mL	1 x 500 mg caps

[1] If obese prescribe at high end of normal range.

[2] Based on dose range of 12.5 to 25 mg/kg every 6 hours.

DOSING FOR CHILDREN - ORAL PENICILLIN V BY AGE AND WEIGHT

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

CHILD AGE	WEIGHT[1] (ESTIMATED)	PENICILLIN V DOSE EVERY 6 HOURS[2]	DOSE AS PENICILLIN V 250 MG/5 ML SYRUP	DOSE AS TABLETS
1 month	3.5 kg	35 to 43.75 mg	0.7 to 0.9 mL	
2 months				
3 months	6 kg	60 to 75 mg	1.2 to 1.5 mL	
4 months				
5 months				
6 months	7.3 kg	73 to 91.5 mg	1.5 to 1.8 mL	
7 to 11 months				
12 months	10 kg	100 to 125 mg	2 to 2.5 mL	
2 years	12 kg	120 to 150 mg	2.5 to 3 mL	
3 years	14 kg	140 to 175 mg	2.8 to 3.5 mL	
4 years	16 kg	160 to 200 mg	3.2 to 4 mL	
5 years	18 kg	180 to 225 mg	3.6 to 4.5 mL	
6 years	20 kg	200 to 250 mg	4 to 5 mL	1 x 250 mg tablet
7 years	22 kg	220 to 275 mg	4.4 to 5.5 mL	1 x 250 mg tablet
8 years	25 kg	250 to 312.5 mg	5 to 6.25 mL	1 x 250 mg tablet
9 years	28 kg	280 to 350 mg	5.6 to 7 mL	1.5 x 250 mg tablets
10 years	31 kg	310 to 387.5 mg	6.2 to 7.75 mL	1.5 x 250 mg tablets
11 years	35 kg	350 to 437.5 mg	7 to 8.75 mL	1.5 x 250 mg tablets
12 years	39 kg	390 to 487.5 mg	7.8 to 9.75 mL	1.5 x 250 mg tablets
13 years	43 kg	430 to 537.5 mg	8.6 to 10.75 mL	2 x 250 mg tablets
14 years	50 kg	500 to 625 mg	10 to 12.5 mL	2 x 250 mg tablets

[1] *If obese prescribe at high end of normal range.*

[2] *Based on dose range of 10 mg to 12.5 mg/kg (max 500 mg) every 6 hours.*

DOSING FOR CHILDREN - ORAL TRIMETHOPRIM+SULFAMETHOXAZOLE BY AGE AND WEIGHT

Take trimethoprim+sulfamethoxazole with food to reduce stomach irritation.

CHILD AGE	WEIGHT[1] (ESTIMATED)	TRIMETHOPRIM+ SULFAMETHOXAZOLE DOSE 2 TIMES DAILY[2]	DOSE AS TRIMETHOPRIM+ SULFAMETHOXAZOLE 40/200 MG/5 ML SYRUP	DOSE AS TABLETS 80/400 MG
1 month	3.5 kg	14/70 mg		
2 months				
3 months	6 kg	24/120 mg		
4 months				
5 months				
6 months	7.3 kg	29.2/146 mg		
7 to 11 months				
12 months	10 kg	40/200 mg	5 mL	0.5 of a tablet
2 years	12 kg	48/240 mg	6 mL	0.5 of a tablet
3 years	14 kg	56/280 mg	7 mL	0.5 of a tablet
4 years	16 kg	64/320 mg	8 mL	0.5 of a tablet
5 years	18 kg	72/360 mg	9 mL	0.5 of a tablet
6 years	20 kg	80/400 mg	10 mL	1 x tablet
7 years	22 kg	88/440 mg	11 mL	1 x tablet
8 years	25 kg	100/500 mg	12.5 mL	1 x tablet
9 years	28 kg	112/560 mg	14 mL	1 x tablet
10 years	31 kg	124/620 mg	15.5 mL	1.5 x tablets
11 years	35 kg	140/700 mg	17.5 mL	1.5 x tablets
12 years	39 kg	156/780 mg	19.5 mL	1.5 x tablets
13 years	43 kg	172/860 mg	21.5 mL	1.5 x tablets
14 years	50 kg	200/1000 mg	25 mL	2 x tablets

** If obese consider increase in dose.*

*** Based on dose range of 4/20 mg/kg 2 times daily.*

DOSING FOR ADULTS

ANTIBIOTIC	DOSE BY GLOMERULAR FILTRATION RATE (ML/MIN) [1, 2]				DOSE FOR HAEMODIALYSIS	DOSE IF >100 KG
	> 90 (NORMAL)	50-90	10-50	< 10		
Amoxicillin	500 mg to 1 g orally 3 times daily	3 times daily	2 to 3 times daily	2 times daily	As for GFR < 10	Increase by 50% for first 2 days
Amoxicillin+ clavulanate	500+125 mg orally 3 times daily, 1000+200 mg IV 8-hourly	8-hourly	12-hourly	12-hourly	As for GFR < 10	Add extra amox 500 – 1000 mg to each amox+ clav dose for first 2 days
Ampicillin	1 to 2 g IV 6-hourly	6-hourly	6 to 12-hourly	12 to 24-hourly	Dose AD	Increase by 50% for first 2 days
Azithromycin	250 to 500 mg orally daily	No dose adjustment required in renal impairment				Increase by 50% for first 2 days
Cefaclor	500 mg to 1 g orally 3 times daily	8-hourly	8-hourly	50% dose	Dose 8 to 12-hourly, dose AD	Increase by 50% for first 2 days
Cefazolin	1 to 2 g IV or IM 8-hourly	8-hourly	12-hourly	24 to 48-hourly	1 to 2 g after each dialysis	Increase by 50% for first 2 days
Ceftazidime	2 g IV 8-hourly	8 to 12-hourly	12 to 24-hourly	24 to 48-hourly	2 g after each dialysis	Increase by 50% for first 2 days
Ceftriaxone	1 to 2 g IV (or IM with 1% lignocaine*) daily	No dose adjustment required in renal impairment				Increase by 50% for first 2 days
Cefuroxime	750 mg to 1.5 g IV or IM 8-hourly	8-hourly	8 to 12-hourly	24-hourly	As for GFR < 10	Increase by 50% for first 2 days
Cephalexin	1 g orally 3 or 4 times daily	4 times daily	4 times daily	2 to 3 times daily	As for GFR < 10	Increase by 50% for first 2 days
Chloramphenicol	500 to 1000 mg PO or IV 4 times daily	No dose adjustment required in renal impairment				Increase by 50% for first 2 days
Ciprofloxacin	500 to 750 mg orally or 400 mg IV 12-hourly	100%	50 to 100%	50%	As for GFR < 10	Increase by 50% for first 2 days
Clindamycin	300 to 450 mg orally 4 times daily, 600 mg IV or IM 8-hourly	No dose adjustment required in renal impairment				Increase by 50% for first 2 days
Doxycycline	200 mg once daily or 100 mg 2 times daily	No dose adjustment required in renal impairment				Increase by 50% for first 2 days

** If using ceftriaxone for IM injection, add 2 mL of 1% lignocaine to 1 g ceftriaxone vial and 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, 2]				DOSE FOR HAEMODIALYSIS	DOSE IF >100 KG
	> 90 (NORMAL)	50-90	10-50	< 10		
Erythromycin	250 to 500 mg orally 4 times daily, 500 mg to 1 g IV 6-hourly	100%	100%	50 to 75%	As for GFR < 10	Increase by 50% for first 2 days
Flucloxacillin	1 g orally 3 or 4 times daily, 2 g IV 4 to 6-hourly	6-hourly	6-hourly	8 to 12-hourly (max 4 g/day)	As for GFR < 10	Increase by 50% for first 2 days
Gentamicin	*See pages 66 to 67*					
Meropenem	1 g IV 8-hourly	8-hourly	0.5 g (GFR 10 – 25) to 1 g (GFR 25 – 50) 8 to 12-hourly	0.5 g 24-hourly	As for GFR < 10	Increase by 50% for first 2 days
Metronidazole	7.5 mg/kg (mild-moderate infection) or 15 mg/kg (severe infection) 12-hourly (up to 4 g/day)	No dose adjustment required in renal impairment				Increase by 50% for first 2 days
Nitrofurantoin	100 mg 3 times daily	100%	Avoid	Avoid	Avoid	No change
Penicillin G (benzylpenicillin)	600 mg to 1.8 g (1 to 3 MU) IV 4 to 6-hourly	100%	75%	25 to 50%	As for GFR < 10	Increase by 50% for first 2 days
Rifampicin	300 to 600 mg orally 2 times daily	100%	100%	50 to 100%	As for GFR < 10	Increase by 50% for first 2 days
Roxithromycin	300 mg orally daily	No dose adjustment required in renal impairment				Increase by 50% for first 2 days
Trimethoprim	300 mg orally daily	100%	< 15: as per < 10	Avoid or 150 mg daily	As for GFR < 15	No change
Trimethoprim+ sulfamethoxazole	160+800 mg orally 12-hourly	100%	100% for 14 days (GFR 25-50) or 3 days (GFR < 25) then 50%	Avoid	Avoid	Increase by 50% for first 2 days
Vancomycin	*See pages 68 and 69*					

[1] *For calculation of GFR see page 65 Calculation of Glomerular Filtration Rate.*

[2] *Adjust by changing the dose or the interval between doses.*

DOSING FOR CRITICALLY ILL ADULT PATIENTS

Infections in ICU 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 renal failure, oedema and low albumin; as a result, underdosing of antibiotics is common.

ANTIBIOTIC	DOSE IN CRITICAL ILLNESS	ADJUSTMENTS [1, 2]
Cefazolin	Loading dose: 2 g IV if not oedematous; 2.5 g if oedematous Maintenance dose: 2 g IV 6-hourly	GFR > 150: increase maintenance dose to approx 110 to 125% GFR 10–50: reduce maintenance dose to approx 60 to 70% GFR < 10: reduce maintenance dose to approx 20 to 30%
Ceftriaxone	Loading dose: 2 g IV if not oedematous; 3 g if oedematous Maintenance dose: 2 g IV 12-hourly	No change for renal impairment Seek advice if severe liver disease
Ciprofloxacin	400 mg IV 8-hourly	GFR 10–50: reduce maintenance dose to approx 400 mg 12-hourly GFR < 10: reduce maintenance dose to approx 400 mg daily Seek advice if severe liver disease
Flucloxacillin	Loading dose: 2 g IV if not oedematous; 3 g if oedematous Maintenance dose: 2 g IV 4-hourly	GFR > 150: increase maintenance dose to approx 13 to 15 g/24h GFR 10–50: reduce maintenance dose to approx 8 g/24h GFR < 10: reduce maintenance dose to approx 6 g/24h
Gentamicin	7 mg/kg 24-hourly for 48 hours (based on ideal body weight not actual body weight. *See page 65). See also pages 66 and 67.*	GFR 40-60: 5 mg/kg 24-hourly for 48 hours GFR < 40: 4 mg/kg 24-hourly for 48 hours
Meropenem	Loading dose: 2 g IV if not oedematous; 2.5 g if oedematous Maintenance dose: 2 g IV 8-hourly (infused over 3 hours)	GFR > 150: increase maintenance dose to approx 110 to 125% GFR 10–50: reduce maintenance dose to approx 4 g/24h GFR < 10: reduce maintenance dose to approx 1 g/24h

[1] *For calculation of GFR see page 65 Calculation of Glomerular Filtration Rate.*

[2] *Adjust by changing the dose or the interval between doses.*

ANTIBIOTIC	DOSE IN CRITICAL ILLNESS	ADJUSTMENTS [1, 2]
Metronidazole	Loading dose: 15 mg/kg IV Maintenance dose: 15 mg/kg IV 12-hourly (not more than 4 g/24h)	No change in renal impairment except if GFR < 10: halve maintenance dose Seek advice if severe liver disease
Penicillin G (benzylpenicillin)	Loading dose: 1.8 g (3 MU) IV if not oedematous; 2.4 g (4 MU) IV if oedematous Maintenance dose: 2.4 g (4 MU) IV 4-hourly	GFR > 150: increase maintenance dose to approx 110 to 125% GFR 10–50: reduce maintenance dose to approx 75% GFR < 10: reduce maintenance dose to approx 20 to 50%
Vancomycin *See also pages 68 to 69*	Loading dose: 25 mg/kg* IV if not oedematous; increase to approx 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	GFR > 150: increase maintenance dose to approx 110 to 125% GFR 60–90: reduce maintenance dose to approx 40 mg/kg/24h GFR 20–60: reduce maintenance dose to approx 20 mg/kg/24h GFR < 20: reduce maintenance dose to approx 10 mg/kg/24h

[1] *For calculation of GFR see page 65 Calculation of Glomerular Filtration Rate.*

[2] *Adjust by changing the dose or the interval between doses.*

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)). Calculate ideal weight using the formula or chart.

Cockcroft-Gault formula (adults)

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

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)

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

DOSING OF GENTAMICIN

Based on the Australian Therapeutic Guidelines – Antibiotics, 2014 and the Canterbury District Health Board 'Pink Book' 2015

Gentamicin is most often used as empirical therapy for suspected gram-negative bacillus infections for the first 48 hours, after which it is replaced to avoid toxicity. Gentamicin may be used for 2 to 6 weeks in combination with other antibiotics, including 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).

Gentamicin dosing in adults with acute systemic infection

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 65*). 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).

STEP 3. Estimate creatinine clearance by Cockcroft-Gault formula
See page 65 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 7 mg/kg Most other infections 4 – 5 mg/kg	2 doses (0 and 36 hours) then stop
Less than 40	Severe sepsis 7 mg/kg Most other infections 4 mg/kg	1 dose (0 hours) then stop

**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).

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 send-away 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 twice weekly.

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 or using the dosing for children tables on pages 53 to 60.

AGE		DOSE OF GENTAMICIN	DOSING FREQUENCY	MAXIMUM NUMBER OF EMPIRICAL DOSES
Neonates 30 to 34 weeks post-menstrual age[1]	Post-natal age 0 to 7 days	4.5 mg/kg[2]	36-hourly[2]	2 doses (at 0 and 36 hours)[2]
	Post-natal age 8 days or older	4 mg/kg	24-hourly	3 doses (at 0, 24 and 48 hours)
Neonates 35 weeks post-menstrual age[1] or older		4 mg/kg	24-hourly	3 doses (at 0, 24 and 48 hours)
Infants and children		7.5 mg/kg up to 320 mg[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] *The dose upper limit does not apply to critically ill children with severe sepsis or septic shock. 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.

DOSING OF VANCOMYCIN

Based on the Australian Therapeutic Guidelines – Antibiotics, 2014.

Loading dose

For all adults give a loading dose of 25 to 30 mg/kg of actual body weight. The role of a loading dose in children is unclear.

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 65)* 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 14 days	15 mg/kg	18-hourly	Before the second dose
	Post-natal age 14 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 7 days	15 mg/kg	12-hourly	Before the third dose
	Post-natal age 7 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 7 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 65*)	STARTING MAINTENANCE DOSE	TIMING OF TROUGH (PRE-DOSE) PLASMA CONCENTRATION MEASUREMENT [2]	TARGET TROUGH CONCENTRATION (MG/L)
Greater than 90	1.5 g 12-hourly	Before the fourth dose	15 to 20
60 to 90	1 g 12-hourly	Before the fourth dose	15 to 20
20 to less than 60	1 g 24-hourly	Before the third dose	15 to 20
Less than 20	1 g 48-hourly	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.*

Special circumstances

- For conventional haemodialysis, give 15 mg/kg if next dialysis in 1 day, give 25 mg/kg if next dialysis is in 2 days, and give 35 mg/kg if next dialysis is in 3 days.
- For CAPD (does not remove vancomycin from serum), dose as per ClCr less than 20 mL/min.
- For critically ill patients – *see page 63 and 64.*

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").

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
- Adults – continuous infusion: 20 to 23 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 dose in patients with renal impairment or concomitant nephrotoxins such as aminoglycosides 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.

DOSING WITH PROBENECID IN ADULTS

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%, doubles the area under the plasma flucloxacillin concentration-time curve and doubles the time that the plasma flucloxacillin concentration is above the likely MIC for *Staphylococcus aureus*. This interaction has been used since 1950 to 'boost' the concentration of some penicillin and cephalosporin antibiotic concentrations in the blood, thereby making the antibiotic more effective or need to be taken less often.

CLINICAL CIRCUMSTANCES	STANDARD TREATMENT[1]	PROBENECID-BOOSTED ORAL REGIMEN
Severe sepsis	High-dose IV antibiotic	Not appropriate
Deep moderate infection (e.g. bone, joint, diabetic foot) – after systemic and local sepsis is controlled	Ampicillin 1 g IV 8-hourly	Amoxicillin 1 g orally 4 times daily with probenecid 500 mg orally 4 times daily
	Flucloxacillin 2 g IV 6-hourly	Flucloxacillin 1 g orally 4 times daily with probenecid 500 mg orally 4 times daily
	Cefazolin 1 to 2 g IV 8-hourly	Cephalexin 1 g orally 3 or 4 times daily with probenecid 500 mg orally 3 or 4 times daily

[1] *Probenecid has no significant effect on clearance of ceftriaxone.*

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 pills 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.

INTRAVENOUS TO ORAL SWITCHING

Oral antibiotics may not be reliably absorbed in patients who are septic, but it makes sense to switch the patient to oral antibiotics when he/she is recovering 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.

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

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, unconscious, nil by mouth) — **YES** → CONTINUE IV ANTIBIOTICS

NO ↓

Oral medication available? — **NO** → CONTINUE IV ANTIBIOTICS

YES ↓

SWITCH TO ORAL ANTIBIOTICS

HIGH-DOSE ORAL ANTIBIOTICS IN ADULTS

Administration by the oral route can often achieve similar blood and tissue concentrations to the IV route.
Do not use oral antibiotics during severe sepsis as gastro-intestinal absorption is unreliable.

HIGH-EXPOSURE ORAL REGIMEN	REPLACEMENT FOR IV ANTIBIOTIC
Amoxicillin, flucloxacillin or cephalexin – combined with probenecid (*see page 70*)	Penicillin or ampicillin, flucloxacillin, or cefazolin, respectively
Amoxicillin+clavulanate 500+125 mg plus amoxicillin 500 mg, both 4 times daily	Amoxicillin+clavulanate
Trimethoprim+sulfamethoxazole 80+400 mg 4 to 6 tablets 2 times daily (with food, monitor creatinine and potassium) if susceptible	Vancomycin
Ciprofloxacin 750 mg 2 times daily (monitor for tendonopathy)	Gentamicin, meropenem

ANTIBIOTIC ALLERGY AND CROSS-REACTIVITY

Penicillins, cephalosporins and carbapenems (e.g. meropenem)

Patients may have an allergic reaction to the beta-lactam ring or a side chain of a penicillin or cephalosporin antibiotic. The risk of cross-reaction between these antibiotics depends on the similarities between the beta-lactam ring structures and between the side chains. For example, penicillins (especially ampicillin), cephalexin and cefaclor have similar or identical side chains so cross-reactions are common. On the other hand, ceftriaxone, cefotaxime, ceftazidime and cefuroxime have different side chains to penicillins so cross-reactions are less common. Cross reactions between carbapenems and either penicillins or cephalosporins are very uncommon.

HISTORY	RISK OF ALLERGIC REACTION	RECOMMENDATION	COMMENTS
Penicillin allergy	To another penicillin, 10 to 15%	Avoid [1]	
	To a cephalosporin, 1 to 2%	If mild (e.g. mild rash, vomiting) then it is safe to give a cephalosporin or meropenem If the allergy is IgE-mediated (urticaria, angioedema, hypotension, bronchospasm, anaphylaxis), associated with eosinophilia, or severe (Stevens-Johnson syndrome (SJS) or toxic epidermal necrolysis (TEN)) then do not give a cephalosporin or meropenem	Do not give cefaclor or cephalexin to patients with any kind of ampicillin reaction [1] If the penicillin allergy is IgE-mediated and it is thought to be essential to use a cephalosporin, give by graded challenge [2]. Do not challenge with a cephalosporin if the penicillin reaction involved eosinophilia or SJS/TEN
	To a carbapenem, < 1%	As above for a cephalosporin	As above for a cephalosporin
Cephalosporin allergy	To another cephalosporin, 40 to 90%	Avoid [1]	
	To a penicillin, 20 to 25%	Avoid [1]	
	To a carbapenem, 1%	Avoid if IgE-mediated, eosinophilia or severe reaction	

[1] *Probably OK if the patient has subsequently been given that other antibiotic without a reaction.*

[2] *Graded challenge. Perform in safe environment. Start with 1/100 or 1/10 of the full dose. Increase dose every 60 minutes until full therapeutic dose is reached. For example, a graded challenge of cephalexin might be 5 mg, 25 mg, 100 mg, then 500 mg at 60 minute intervals.*

Macrolides (e.g. erythromycin, roxithromycin, azithromycin)

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

Aminoglycosides (e.g. gentamicin, tobramycin, amikacin, streptomycin)

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

ANTIMICROBIAL AGENTS IN PREGNANCY AND BREASTFEEDING

From the Australian Therapeutic Guidelines (www.tg.org.au – November 2016 edition).

ANTIMICROBIAL	SAFETY IN PREGNANCY	SAFETY WHEN BREASTFEEDING
Acyclovir	B3	OK
Amoxicillin	A	OK, may cause diarrhoea in infant
Amoxicillin+clavulanate	B1	OK, may cause diarrhoea in infant
Ampicillin	A	OK, may cause diarrhoea in infant
Azithromycin	B1	OK, may cause diarrhoea in infant
Cefaclor	B1	OK, may cause diarrhoea in infant
Cefazolin	B1	OK, may cause diarrhoea in infant
Cefotaxime	B1	OK, may cause diarrhoea in infant
Ceftazidime	B1	OK, may cause diarrhoea in infant
Ceftriaxone	B1	OK, may cause diarrhoea in infant
Cefuroxime	B1	OK, may cause diarrhoea in infant
Cephalexin	A	OK, may cause diarrhoea in infant
Chloramphenicol	C	Avoid systemic use
Ciprofloxacin	B3	OK, may cause diarrhoea in infant
Clindamycin	A	OK, may cause diarrhoea in infant
Doxycycline	D (safe only in first 18 weeks)	OK for short courses (e.g. 10 days); may cause diarrhoea in infant
Erythromycin	A	OK, may cause diarrhoea in infant
Flucloxacillin	B1	OK, may cause diarrhoea in infant
Fluconazole	D	OK
Gentamicin	D	OK, may cause diarrhoea in infant
Itraconazole	B3	Avoid systemic use; insufficient data
Meropenem	B2	OK, may cause diarrhoea in infant

ANTIMICROBIAL	SAFETY IN PREGNANCY	SAFETY WHEN BREASTFEEDING
Metronidazole	B2	OK, may cause diarrhoea in infant (not single, high dose)
Nitrofurantoin	A (short term therapy, not prophylaxis)	OK, may cause diarrhoea in infant (healthy, full term infant only)
Penicillin	A	OK, may cause diarrhoea in infant
Probenecid	B2	Caution; insufficient data
Roxithromycin	B1	OK, may cause diarrhoea in infant
Terbinafine	B1	Avoid systemic use; insufficient data
Trimethoprim	B3	OK
Trimethoprim+ sulfamethoxazole	C	OK if newborn is healthy; use with caution if baby is premature, ill or jaundiced; avoid if infant has G6PD deficiency
Vancomycin	B2	OK, may cause diarrhoea in infant

A. Drugs that have been taken by a large number of pregnant women and women of childbearing age, without fetal damage.

B. Drugs that have been taken by only a limited number of pregnant women and women of childbearing age, without fetal damage.

   B1. Studies in animals have not shown evidence of fetal damage.

   B2. Studies in animals are inadequate or may be lacking, but available data show no evidence of fetal damage.

   B3. Studies in animals have shown evidence of an increased occurrence of fetal damage, the significance of which is considered uncertain in humans.

C. Drugs that, owing to their pharmacological effects, have caused or may be suspected of causing, harmful effects on the human fetus or neonate without causing malformations. These effects may be reversible.

D. Drugs that have caused, are suspected to have caused or may be expected to cause, an increased incidence of human fetal malformations or irreversible damage. These drugs may also have adverse pharmacological effects.

ANTIBIOTIC SUBSTITUTIONS WHEN OUT-OF-STOCK

If temporarily unable to obtain an antibiotic, choose another antibiotic from the 'alternatives' column in the guideline or from the table below.

OUT-OF-STOCK ANTIBIOTIC	ANTIBIOTICS WITH A SIMILAR (OR BETTER) SPECTRUM OF ACTIVITY
Amoxicillin	Ampicillin, Amoxicillin+clavulanate
Amoxicillin+ clavulanate	Cephalexin plus metronidazole, chloramphenicol
Azithromycin	Roxithromycin, erythromycin or chloramphenicol
Cefazolin	Amoxicillin+clavulanate
Cefotaxime	Ceftriaxone
Ceftazidime	Ciprofloxacin, meropenem[RESTRICTED]
Ceftriaxone	Cefotaxime
Cephalexin	Amoxicillin+clavulanate
Chloramphenicol	Amoxicillin+clavulanate, cephalexin plus metronidazole, doxycycline plus metronidazole
Ciprofloxacin	Gentamicin, meropenem[RESTRICTED], ceftriaxone (not if *Pseudomonas*), ceftazidime[RESTRICTED]
Doxycycline	Chloramphenicol or azithromycin. If MRSA then trimethoprim+sulfamethoxazole or vancomycin
Flucloxacillin	Cephalexin, cefazolin, amoxicillin+clavulanate, doxycycline, roxithromycin
Gentamicin	Ceftriaxone; if *Pseudomonas* suspected then meropenem[RESTRICTED], ciprofloxacin, ceftazidime[RESTRICTED]
Meropenem	Ampicillin plus gentamicin plus metronidazole, or amoxicillin+clavulanate plus either ciprofloxacin or gentamicin, ceftazidime[RESTRICTED]
Penicillin	Amoxicillin, ampicillin
Roxithromycin	Azithromycin, erythromycin, doxycycline or chloramphenicol
Trimethoprim+ sulfamethoxazole	Amoxicillin+clavulanate, cefazolin. If MRSA then doxycycline, vancomycin or chloramphenicol
Vancomycin	If MRSA then trimethoprim+sulfamethoxazole, doxycycline or chloramphenicol

TOPICAL ANTISEPTIC AGENTS

What are topical antiseptic agents used for?

For treatment of impetigo and other minor skin infections. For treatment of heavy colonisation (including *Pseudomonas aeruginosa*, *E. coli*, *Staphylococcus aureus*, beta-haemolytic streptococci) and prevention of infection in burns, eczema, ulcers (e.g. diabetic, venous) and traumatic wounds (*see page 51*).

Topical antiseptic agents are preferred over topical antibiotic agents

Topical antiseptic agents (*see table below*) 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 in a wound.

Which is the best topical antiseptic for the Cook Islands?

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 Cook Islands. *See page 77 for bleach dilution instructions for skin, wounds and ulcer*. **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.

Dilute bleach is the first-choice topical antiseptic in the Cook Islands for prevention and treatment of infection acute traumatic wounds (*see page 51)*, burns (*see page 43*), post-op wounds, recurrent boils, infected eczema (*see page 18*), and chronic ulcers (e.g. diabetic, venous, arterial, pressure). Dilute bleach may also be effective for impetigo and other minor skin infections (*see page 22*).

Povidone iodine 10% is also effective, available and affordable in the Cook Islands. Povidone iodine 10% is the first choice topical antiseptic in the Cook Islands for impetigo and other minor skin conditions (*see page 22*) and may also be used for acute traumatic wounds and post-operative wounds. Povidone iodine 10% is probably too strong to use on chronic ulcers (e.g. diabetic, venous, arterial, pressure).

Natural products that contain antiseptics can be found in the Cook Islands (*see page 78*) and may be effective for post-traumatic wounds and even minor skin infections.

The best topical antiseptic products available overseas are generally expensive. If available, you may use super-oxidized solutions (e.g. Microdacyn) in any situation where a topical antiseptic is used. Other products that are effective and safe in chronic ulcers and wounds include polyhexanide with betaine (Prontosan), cadexamer iodine or slow-release silver dressings. Other products that are commonly used for post-traumatic wounds include Savlon (chlorhexidine + cetrimide) and Dettol (chloroxylenol).

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.g 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 tp 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).

NATURAL COOK ISLANDS PRODUCTS WITH LABORATORY-PROVEN ANTIMICROBIAL ACTIVITY

Key reference: Huish RD et al. J Medicinal Plant Res 2014; 8(41): 1215-22

For skin conditions traditional healers often advise that certain leaves are chopped up and crushed then mixed with coconut oil or water. (This is safer than chewing the leaves and spitting out the leaf mixture because the mouth contains some bacteria that could cause harm on skin wounds.) The leaf mixture itself, or liquid squeezed from this mixture, is then applied to the skin. Laboratory scientific studies of Pacific Island natural products show that several have antimicrobial activity (*see table below*). No formal clinical trial of these natural products has been published.

SCIENTIFIC NAME	COOK ISLANDS NAME	ACTIVE PART	ACTIVE *IN-VITRO* AGAINST
Calophyllum inophyllum	Tamanu	Nuts	*Staphylococcus aureus,* possibly *Candida* spp. and beta-haemolytic streptococci
Psidium guajava	Tuava	Leaves	*Staphylococcus aureus, Candida* spp.
Syzygium malaccense	Ka'ika	Leaves	*Staphylococcus aureus, Candida* spp
Syzygium cumini	Pistati	Leaves, bark and fruit	*Staphylococcus aureus,* beta-haemolytic streptococci
Bidens pilosa	Piripiri Kerekere	Leaves and flowers	*Staphylococcus aureus*

In-vitro activity may be stronger in the first day after picking and processing the leaves.
In-vitro activity may also be stronger when mixed with cold water compared with hot water or saliva.

REFERENCES

- American Society of Health-system Pharmacists (ASHP), Infectious Diseases Society of America (IDSA), Surgical Infection Society (SIS) and Society for Healthcare Epidemiology of America (SHEA) guidelines – 2013. Am J Health-Syst Pharm 2013; 70: 195-283
- Australian Therapeutic Guidelines, December 2014
- Ellis-Pegler R, Sharpe N, Everts R, Chambers S, Hornung T, Hay KD, Ting G (National Heart Foundation of New Zealand Advisory Group). Guideline on the prevention of infective endocarditis associated with dental and other medical interventions. NHF, December 2008
- Heart Foundation of New Zealand. Group A Streptococcal Sore Throat Management Guideline. 2014 Update. Auckland, Heart Foundation of New Zealand
- New Zealand antimicrobial resistance data from hospital and community laboratories 2015. Institute of Environmental Science and Research Limited (ESR), Wellington, New Zealand. Surv.esr.cri.nz/antimicrobial/antimicrobial_resistance.php
- New Zealand Formulary for Children – www.nzfchildren.org.nz/
- Sanford (USA) Guide to Antimicrobial Therapy, 2016
- Starship Clinical Guidelines – www.starship.org.nz/for-health-professionals/starship-clinical-guidelines/
- Global guidelines for the prevention of surgical site infection. World Health Organization 2016

CONTACT

Richard Everts
Infectious Diseases Specialist
and Medical Microbiologist

Sunview Heights, RD 1, Nelson, New Zealand 7081
Ph. (0064) 27 463 3284
Fax (0064) 3 544 4551
richard.everts@nbph.org.nz

March 2018