BACKGROUND

Prophylactic administration of antibiotics can decrease post-operative morbidity, shorten hospitalisation and reduce the overall costs attributable to infections. The risk of post-operative infection is influenced by a number of factors:

1. Procedure-related
   1.1 Clean vs clean-contaminated vs contaminated (see appendix 1)
   1.2 Presence or absence of implanted prosthetic device or material
   1.3 Duration of procedure ie risk increases after 3 hours in duration but evidence also exists for the benefit of **repeated administration of prophylactic antibiotic once procedure duration exceeds 2 half-lives of the drug**
   1.4 Massive blood loss – loss of antibiotic
2. Patient-related
   2.1 Age – linear relationship to advancing age
   2.2 Underlying illness
      a) ASA score (> 3)
      b) Diabetes – particularly related to perioperative hyperglycaemia
      c) Poor nutrition – some evidence to suggest low albumin a useful indicator
      d) Immunosuppression – cancer therapy (chemo and radiotherapy), steroids
   2.3 Obesity – **doses of prophylactic antibiotics should be increased in large patients, e.g. 3 g rather than 2 g Cefazolin in patients > 120kg (see below for other dose recommendations)**
   2.4 Smokers – some studies suggest need to stop smoking at least 4 weeks prior to surgery to make a difference to risk
3. Presentation-related
   In those presenting acutely with active infection related to the underlying reason for surgery, e.g. mastoiditis, pelvic sepsis; antibiotics should be administered as a treatment course aimed at the most likely organisms and rationalised based on **intra-operative sampling** rather than peri-operative prophylaxis

RECOMMENDATION 1

1. Prophylaxis should be considered where there is:
   1.1 Significant risk of infection, or
   1.2 Where post-operative infection, even if uncommon, would have severe consequences e.g. prosthetic device present
2. Goals of pre-operative prophylaxis
   2.1 Cover the most likely causative organisms, however an effective prophylactic regimen need not necessarily include antibiotics that are active against all potential organisms. All regimens should include cover against *Staphylococcus aureus.*
   2.2 Decrease the number of organisms below the critical level necessary to cause infection ($<10^5$ organisms / g) by maintaining adequate tissue +/- plasma levels until after wound closure
      a) Critical period – until 4 hours after contamination
      b) One dose sufficient unless
         i. Delay in starting procedure
         ii. Prolonged operation – give repeated doses once procedure duration exceeds 2 half-lives of the drug

iii. Massive blood loss – in the event of major intraoperative blood loss in adults (>1,500 mL) an additional dosage of prophylactic antibiotic should be considered after fluid replacement

c) Good evidence exists for the efficacy of a single pre-operative dose (which also minimises the drug pressure on the development of resistance, see below), however **no prophylactic regime should continue beyond 24 hours**

2.3 Minimise the development of drug resistance and complications such as *Clostridium difficile* disease by using the narrowest spectrum agent for the shortest possible duration. Third generation cephalosporins (e.g. ceftriaxone) increase gram negative cover at the expense of gram positive cover and increase drug pressure and potential for the development of drug resistance unnecessarily.

2.4 Avoid agents which impact on gut flora if not required eg cefazolin rather than co-amoxiclav for surgery in which gram positive organisms of greatest relevance.

2.5 Most post-surgical infections are caused by the patient's own organisms and choice should take into account known multi-drug resistant organism carriage, eg MRSA, ESBL-producing organisms.

RECOMMENDATION 2

1. Timing

1.1 Antibiotics should be administered within 30 minutes, and at least 5 minutes from start, of surgical incision to optimise tissue levels at time of surgery.

1.2 No benefit has been shown to antibiotics administered after surgical start time, with an **increase** in surgical site infections in patients in whom antibiotic prophylaxis is commenced >6 hours after surgery.

1.3 Vancomycin infusions should begin within 2 hours of surgical incision due to extended infusion times.

1.4 Doses are patient weight-dependent (increase Cefazolin dose from 2g to 3g in patients over 120 kg – actual body weight).

1.5 For prolonged procedures, or following significant blood loss, additional doses of prophylactic antibiotics are recommended.

2. Dosages of common prophylactic drugs

Cefazolin (all adults <120 kg)	• 2 gram IV with induction of anaesthesia • Repeat every 3 hours intra-operatively
Cefazolin (>120 kg)	• 3 gram IV with induction of anaesthesia • Repeat every 3 hours intra-operatively
Cefuroxime	• 1.5 gram IV with induction of anaesthesia • Repeat every 3 hours intra-operatively
Ciprofloxacin	• 500 mg orally 1 hour before induction / procedure and 12 hours later
Clindamycin	• 600 mg by intravenous infusion over 20 minutes, timed to finish with induction of anaesthesia. • Repeat every 6 hours intra-operatively
Co-amoxiclav (Amoxicillin / Clavulanic Acid)	• 1.2 gram IV with induction of anaesthesia • Repeat every 3 hours intra-operatively

Co-trimoxazole (Sulfamethoxazole / Trimethoprim)	• 960 mg (2 amps) in 250 mL of 0.9% Sodium Chloride over 60 minutes prior to induction of anaesthesia • Caution in patients with documented 'sulphur' allergy
Ertapenem	• 1 g by intravenous infusion over 30 minutes, timed to finish with induction of anaesthesia
Gentamicin	• 2 mg / kg IV at induction of anaesthesia
Vancomycin	• 1 gram in 250 mL of 0.9% Sodium Chloride over 2 hours (maximum rate of 10 mg / minute) prior to induction of anaesthesia • Repeat every 6 hours intra-operatively

3. Summary of Drug Choices

- These are the options for prophylaxis. Where there is treatment of active infection required this should be given according to usual indications for drug, dose and duration
- For patients with beta-lactam allergy, MRSA, ESBL or requiring endocarditis prophylaxis see page 5

3.1 **<u>Urology</u> -** Be guided by previous urinary microbiology – may need alternative agents if resistant organisms present – discuss with ID / micro as necessary

Type of Surgery	Important post- surgery infecting bacteria	Antibiotics
Prostatic biopsy	Enteric Gram-negative bacilli	• Ciprofloxacin one oral dose at least one hour prior to procedure and another 12 hours later • If recent or extensive previous use of quinolones consider using co-amoxiclav or co-trimoxazole in preference to ciprofloxacin • If known ESBL carriage use single dose of ertapenem • If becomes septic subsequent to procedure treat after taking blood and urine cultures with different antibiotic to prophylaxis, consider presence of ESBL-producing organism and need for carbapenem if antibiotic-experienced, or travel in previous year to Indian sub-continent or Asia
Urological surgery requiring laparotomy eg nephrectomy	Enteric Gram-negative bacilli, Gram-positive cocci	• Co-amoxiclav
Percutaneous nephrolithotomy (PCNL)	Enteric Gram-negative bacilli	• Co-amoxiclav and Gentamicin

Type of Surgery	Important post- surgery infecting bacteria	Antibiotics
Endoscopic procedures of urinary tract not included in above	Enteric Gram-negative bacilli	• Gentamicin • No prophylaxis required for simple cystoscopy with sterile urine

3.2 **ENT**

Type of Surgery	Important post-surgery infecting bacteria	Antibiotics
Most head and neck surgery		• None required
Sinus surgery (antibiotics frequently indicated as treatment due to chronic sinusitis rather than prophylaxis)	Oral flora including anaerobes Consider available microbiology to guide antibiotic choice if unusual or resistant organisms present	• Co-amoxiclav and continue for 5 days post op
Surgery involving mucosal incision	Oral flora including anaerobes	• Co-amoxiclav
Surgery with cartilage involvement	Oral flora including anaerobes	• Co-amoxiclav

3.3 **Obstetrics and Gynaecology**

Type of Surgery	Important post- surgery infecting bacteria	Antibiotics
Hysterectomy	Enteric Gram-negative bacilli Group B streptococci	• Cefazolin
Other pelvic surgery	Enteric Gram-negative bacilli Group B streptococci	• Cefazolin or co-amoxiclav • Consider need for treatment rather than prophylaxis if active infection present, send microbiological samples at time of surgery e.g. pus, and review post-op antibiotic choice based on findings
Caesarean section	Enteric Gram-negative bacilli Group B streptococci	• Cefazolin • Administer antibiotics prior to incision

3.4 **Plastic surgery**

Type of Surgery	Important post- surgery infecting bacteria	Antibiotics
Most procedures		• None required
High risk if infection occurs eg involves graft	Skin organisms – Gram positive cocci, particularly *S. aureus*	• Cefazolin • If known MRSA carriage be guided by susceptibilities, discuss with ID / micro

4. Drug choices in special circumstances (for recommended doses see section 2)

ESBL
Ertapenem – for urology patients who are known ESBL carriers

MRSA	
If MRSA is *sensitive* to erythromycin	**Clindamycin**
If MRSA is erythromycin *resistant*	**Vancomycin**

Beta-lactam allergy	
Substitute cefazolin or cefuroxime with the agents below if there is a history of immediate IgE-mediated beta-lactam allergy i.e. anaphylaxis, urticaria, angioedema, pruritis or bronchospasm or in cases of severe adverse reaction to a beta-lactam e.g. Steven-Johnson syndrome. Patients reporting a history of delayed non-urticarial rashes to penicillin will usually tolerate a cephalosporin.	
If Cefazolin or Co-amoxiclav indicated	Use **clindamycin** instead
If Cefuroxime (+/- Metronidazole) indicated	Use **clindamycin + gentamicin** instead

Prevention of endocarditis (from National Heart Foundation Guidelines, 2008)	
• Antibiotic prophylaxis is recommended for those with prosthetic heart valves (bio or mechanical), rheumatic valvular heart disease, previous endocarditis, unrepaired cyanotic congenital heart disease (including palliative shunts and conduits), surgical or catheter repair of congenital heart disease in the last 6 months. Prophylaxis is not recommended for those who have had previous rheumatic fever without cardiac involvement. • Endocarditis prophylaxis is **not** recommended in the above patients for non-dental procedures (including respiratory, gastrointestinal and genitourinary procedures), **unless the procedure is at a site of established infection.** • Intravenous cephalosporins provide adequate cover against viridans Streptococci for endocarditis prophylaxis • If patient has a history of immediate IgE-mediated beta-lactam allergy – use clindamycin containing regimen as above	
If procedure at site of infection + patient requires endocarditis prophylaxis, but wouldn't otherwise get surgical prophylaxis	Amoxicillin 2g IV
For other scenarios, discuss antibiotic choice prior to surgery with one of the Infectious Diseases Physicians or the Clinical Microbiologist	

Where there is any concern regarding cover or where the patient is known to be colonised with an MRSA, ESBL-producing organism or another multi-drug resistant isolate please discuss with one of the Infectious Diseases Physicians or the Clinical Microbiologist.

Due to the need to plan for such patients in advance of their surgery these discussions are best conducted prior to the day of admission for surgery, if possible.

REFERENCES

- National Heart Foundation of NZ. Guideline for Prevention of Infective Endocarditis Associated with Dental and Other Medical Interventions. 2008
- Scottish Intercollegiate Guideline Network (SIGN). Antibiotic prophylaxis in surgery (SIGN 104). July 2008
- Antibiotic Expert Group. Therapeutic guidelines: Antibiotic. Version 14. Melbourne: Therapeutic Guidelines Ltd; 2010.

ASSOCIATED DOCUMENTS

- Bay of Plenty District Health Board policy 4.1.11 Antibiotics and Antimicrobial – Use Of
- Bay of Plenty District Health Board policy 4.1.11 protocol 1 Antibiotics and Antimicrobials – The Antimicrobial Formulary
- Bay of Plenty District Health Board policy 4.1.11 protocol 2 Antibiotics and Antimicrobials – First-Line Therapy for Adult Medical Patients
- Bay of Plenty District Health Board policy 4.1.11 protocol 4 Antibiotics and Antimicrobials – Orthopaedic Surgery – Recommendations for Pre-operative Antibiotic Prophylaxis
- Bay of Plenty District Health Board policy 4.1.11 protocol 5 Antibiotics and Antimicrobials – General Surgery – Recommendations for Pre-operative Antibiotic Prophylaxis

Appendix One – Classification of procedure (taken from SIGN 104)

Class	Definition
Clean	Operations in which no inflammation is encountered and the respiratory, alimentary or genitourinary tracts are not entered. There is no break in aseptic operating theatre technique.
Clean-contaminated	Operations in which the respiratory, alimentary or genitourinary tracts are entered but without significant spillage.
Contaminated	Operations where acute inflammation (without pus) is encountered, or where there is visible contamination of the wound. Examples include gross spillage from a hollow viscus during the operation or compound / open injuries operated on within 4 hours.
Dirty	Operations in the presence of pus, where there is a previously perforated hollow viscus, or compound / open injuries more than 4 hours old.