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 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. ruptured appendix, cholecystitis, perforated viscous with contaminated peritoneum; 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 procedure – 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 e.g. 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, e.g. 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 SSI in patients in whom antibiotic prophylaxis is commenced >6 hours after surgery.

1.3 Vancomycin infusions should begin 2 hours prior to surgical incision due to extended infusion times, and completed prior to incision.

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

2. Dosages of common prophylactic drugs

Antibiotic	Timing of administration
Cefazolin (all adults all weights)	• 2 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
Clindamycin	• 600 mg by intravenous infusion over 20 minutes, timed to finish with induction of anaesthesia. • Repeat every 6 hours intra-operatively
Gentamicin	• 2 mg / kg IV (based on ideal body weight) at induction of anaesthesia
Metronidazole	• 500 mg by intravenous infusion over 20 minutes, timed to finish with induction of anaesthesia
Vancomycin	• Patients <70kg: 1 g, >70kg: 15mg/kg to max of 2g over 1-2 hours (maximum rate of 10 mg / minute) Start at least 60 minutes prior to induction of anaesthesia, infusion to be completed prior to incision • 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 or requiring endocarditis prophylaxis see next page

Clean procedures

• Breast surgery without prosthetic material	None Required
• Hernia repair without prosthetic material	
• Cholecystectomy in young patients uncomplicated by active infection or stones	
• Thyroid or parathyroid surgery	
• Fundoplication	

Clean-contaminated, contaminated procedures or those involving prosthetic material

Type of Surgery	Important post- surgery infecting bacteria	Prophylaxis or treatment	Antibiotics
Appendicectomy	Enteric Gram-negative bacilli Anaerobes	Treatment	Continue with cefuroxime and metronidazole (or co-amoxiclav) as part of treatment course
Biliary if cholecystitis, stones, older patients (>70yrs)	Enteric Gram-negative bacilli Gram-positive cocci Clostridia	Treatment	Continue with cefuroxime and metronidazole (or co-amoxiclav) as part of treatment course
Colorectal	Enteric Gram-negative bacilli Anaerobes	Prophylaxis (extend duration to treatment course where peritoneal soiling occurred)	Cefuroxime + Metronidazole
Gastric (malignancy) and duodenal	Gram-positive cocci Enteric Gram-negative bacilli	Prophylaxis	Cefuroxime or Cefazolin
Vascular (abdominal aorta and lower limb)	Staphylococci	Prophylaxis	Cefazolin
Breast surgery with implant or performed for cancer	Staphylococci	Prophylaxis	Cefazolin
Hernia repair with prosthetic material	Staphylococci	Prophylaxis	Cefazolin
Haemorrhoidectomy	Anaerobes	Prophylaxis	Metronidazole

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

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 indicated	Use **clindamycin** instead
If Cefuroxime (+ metronidazole) indicated	Use **clindamycin + gentamicin** instead (metronidazole not required)

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

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 the patient has a history of immediate IgE-mediated beta-lactam allergy – use clindamycin containing regimen (as under 'Beta-lactam allergy' section 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 the patient is known to be colonised with an ESBL-producing organism or another multi-drug resistant isolate, or where there is any concern regarding cover 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 Agents – 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 6 Antibiotics and Antimicrobials – Surgical Specialties – Recommendations for Pre-Operative Antibiotic Prophylaxis

Appendix One – Classification of procedure (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.