

SESLHD GUIDELINE COVER SHEET



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Reducing Cardiothoracic Surgical Site Infections through use of a Cardiothoracic Surgical Site Infection Care Bundle Guideline

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Introduction

Surgical site infections (SSI) are one of the most common and costly healthcare associated infections among hospitalised patients. SSIs result in increased length of stay, additional costs and potentially increase morbidity and mortality¹ and are preventable.^{2 3}

A Care Bundle is a group of evidence based interventions which are grouped together to achieve a particular outcome. Patient outcomes are maximised when all bundle elements are consistently performed or adhered to. Consequently the care bundle can be a powerful driver to improve the reliable delivery of evidence based care.

The World Health Organisation and the Centres for Disease Control and Prevention have developed evidence based guidelines to prevent surgical site infections. The core elements of the SESLHD Cardiothoracic SSI Care Bundle are based on high level recommendations from both documents.

The aim of the SESLHD Cardiothoracic SSI Prevention Care Bundle is to prevent surgical site infections by modifying patient risk factors and ensuring best practice is performed by clinicians.

The Care Bundle is divided into:

1. Modifying Patient Risk Factors Outpatient
2. Modifying Patient Risk Factors Inpatient
3. Reducing Risk Factors Intra-Operative
4. Reducing Risk Factors Post-Operative

Principles

Compliance with relevant National standards, NSW Policy Directives and other overarching documents such as:

- [Australian College of Perioperative Nurses \(ACORN\) Standards](#)
- [NSW Ministry of Health Policy Directive PD2017_013 - Infection Prevention and Control Policy](#)

Definitions and Abbreviations

ACORN: Australian College of Perioperative Nurses standards.

Decolonisation: Use of topical and/or systemic antibiotics and/or other measures to eradicate MRO's from colonised persons.

Immunonutrition: Oral or enteral formulae enriched with nutrients that have been determined to enhance immune function. Nutrients with an immune stimulatory function that have been studied are arginine, glutamine, glycine, omega-3 polyunsaturated fatty acids and nucleotides.

Malnutrition Screening Tool (MST): A validated tool used to screen malnutrition risk in adults. Nutrition screen parameters include weight loss and appetite. To be completed at pre-admission clinic, on admission and weekly throughout the patient's admission. It is part of the Adult Admission Assessment Form (completed on admission in the acute setting) and the Waterlow Assessment Tool.

MRSA: Methicillin-resistant Staphylococcus aureus. A strain of *S. aureus* that is resistant to beta-lactam antibiotics including penicillins and cephalosporins.

Incisional Negative Pressure Wound Therapy: Use of a negative pressure pump and specific dressings applied over closed surgical wounds to create a negative pressure environment at wound site, thereby preventing wound complications in patients at risk of surgical site infection.

Pre-operative load reduction: Use of topical or systemic antibiotics to reduce the burden of colonisation with *Staphylococcus aureus* prior to surgical procedures.

SEALS: South Eastern Area Laboratory Services

Overview of Recommendations

Modifying Patient Risk Factors Outpatient

Smoking Cessation

- Ask patients preoperatively about their smoking status
- Advise patients who smoke of the specific perioperative risks of smoking
- Refer patients to NSW Quitline or other smoking cessation support programs
- Offer nicotine replacement therapy such as nicotine lozenges, gum or medication.

Glycaemic Control

- HbA1c determination in those with known diabetes is an effective tool for identifying patients at risk of inpatient hyperglycaemia and who would benefit from detailed glycaemic review
- Test HbA1c level with the aim of identifying degree of glycaemic control prior to admission
- Patients with poor glycaemic control (HbA1c >9% or blood glucose levels >10 mmol/L) should be referred to patient's local diabetes care provider for stabilisation of diabetes while waiting for surgery. Referral to Endocrinologist recommended.
- HbA1c can be measured in patients without known diabetes who have elevated BGLs to help diagnose diabetes or pre-diabetes.

Screening and Decolonisation

- Screen for staphylococcus aureus 7-14 days before admission to a SESLHD facility
- Ensure positive patients start decolonisation therapy five days prior to surgery.

Enhanced Nutritional Support

- Record height / weight and screen for malnutrition using the Malnutrition Screening Tool (MST) during preadmission clinic visit
- Refer to a Dietitian if the patient is aged under 65 and BMI <18.5kg/m² or over 65 and BMI <22kg/m²

Modifying Patient Risk Factors Inpatient

Smoking Cessation

- Similar to smoking cessations for outpatients, smokers are identified and encouraged to quit
- Smokers are offered nicotine replacement therapy such as nicotine lozenges, gum or medication, see [SESLHDPR/494 - Nicotine Replacment Therapy](#).

Glycaemic Control

- Clinical staff refer to facility clinical Business Rule for Optimal Management of Diabetic Surgical Inpatients

Screening and Decolonisation of Emergency Admissions

- Screening and decolonisation of elective patients should ideally occur in the community or preadmission clinic within the optimal time range to optimise efficacy of treatment. If

MRSA or MSSA status is unknown at the time of admission (i.e. for emergency theatre) an assessment for risk should be undertaken

- If a patient is assessed high risk, load reduction therapy should commence until a negative result is confirmed or treatment has concluded (whichever occurs first).

Delirium Risk Screening

- Delirium is a disturbance of consciousness and cognition that presents over a short period of time with a fluctuating course. Patients undergoing cardiac surgery are considered to be high risk of development delirium
- Delirium is a serious condition associated with increased mortality. Prevention is the most effective strategy
- Prevent post-operative delirium in cardiothoracic patients through screening, implementation of strategies to prevent and treat underlying causes.

Enhanced Nutritional Support

- Patients are screened for nutritional status using the Malnutrition Screening Tool.
- Patients identified i.e. BMI < 18.5kg/m² and aged under 65 or BMI < 22kg/m² and aged over 65 should be referred to a Dietitian

Sternal Support Vest

- Patients are preoperatively assessed for risk of developing sternal wound complications
- In consultation with the Cardiothoracic Surgeon, patients identified as high risk are provided with a sternal support device and education regarding rationale for wearing the garment.
- Risk of sternal wound complications are reduced if the support vest is worn for the optimal period (i.e. six weeks postoperatively).

Preoperative Showering

- Patients are provided with an antiseptic agent to shower with at least the night before surgery

Surgical Hair Removal

- Hair clippers with a disposable head are used for any surgical hair removal
- Hair removal is timed as close as possible to the operating procedure
- Hair removal does not occur in the operating room.

Intraoperative: Best Practices to Reduce Surgical Site Infections

Surgical Hand Scrub

- Members of the surgical team follow an established hand hygiene practice to maintain healthy skin and fingernail condition
- All jewellery is removed from hands and arms prior to the surgical scrub
- The surgical team follow a standardised procedure for the pre-surgical scrub using skin antiseptic

Prophylaxis Antibiotics (refer to 3.2) for further detail, additional information and references)

- Prophylaxis antibiotics are administered within 60 minutes but ideally 15-30 minutes before incision. This should be repeated postoperatively every eight hours for a further two doses
- Vancomycin should be added for patients who are known to be, or are at risk of being, colonised or infected with MRSA
- For patients with a history of immediate hypersensitivity to penicillins, vancomycin and gentamycin should be used as vancomycin lacks gram negative coverage.

Skin Preparation

- Ensure surgical site is free of soil, debris, cosmetics and jewellery
- Alcohol is highly bactericidal and effective for preoperative skin antisepsis but does not have persistent activity when used alone. Use a skin prep combining Chlorhexidine gluconate with alcohol or an iodophor eg povidone iodine with alcohol to achieve rapid, persistent and cumulative antisepsis
- Preparation commences from the cleanest area (operative or incision site) and proceeds to the least clean area
 - If a highly contaminated area is part of the preparation, the area with a lower bacterial count is prepared first, followed by the area of higher contamination
- Only appropriately skilled personnel should perform surgical skin preparation
- Ensure the skin prep has completely evaporated before placing the drape. Once the agent has dried it is no longer flammable.

Perioperative Oxygenation

- Aim to optimise tissue oxygenation and perfusion peri-operatively. Recommended strategies include appropriate oxygen therapy and ventilation; maintaining normovolemia and cardiac output.

Normothermia

- Maintain normothermia intraoperatively for off-pump cardiac surgery cases
- The temperature setting on the device should be set at maximum and then adjusted to maintain a patient temperature of at least 36.6°C
- All irrigation fluids used intraoperatively, except for a period of induced hypothermia should be warmed in a thermostatically controlled cabinet to a temperature of 38-40°C
- Fluid warmers are indicated when large amounts of blood, intravenous fluid and or blood products are administered.

Maintaining Normothermia following Transfer to Cardiothoracic Intensive Care (CT ICU)

- Apply Bair Hugger rewarming blankets as soon as the patient is admitted to CTICU
- Re-warm the patient to 36.5 degrees
- Use continuous blood temperature monitoring to ensure normothermia state
- Once the continuous core temperature monitoring is removed, monitor temperature four hourly via tympanic thermometer
 - If core temperature drops below 36 degrees, reapply the rewarming blanket.

Lavage of Surgical Cavity

- There is no evidence to support irrigation of the cavity in cardiac surgery or in irrigation of the wound. This practice is not recommended.

Sternal Wound Dressings

- Use an approved tool to determine patient's risk of sternal wound infection
- In low risk patients apply a hydrocolloid (comfeel) dressing to the sternal wound. Leave insitu until post-op day seven, or until day of hospital discharge
- In moderate to high risk patients apply an incisional negative pressure dressing in the operating theatre. Dressing should be left insitu until post-operative day seven or the day of hospital discharge.

Post-operative: Best Practices to Reduce Surgical Site Infections

Nutrition

- Commence postoperative nutrition as soon as medically stable
- For the management of nasogastric feeding in the intensive care setting refer to local clinical business rules.

Section 1 Modifying Patient Risk Factors Outpatient

- 1.1 Smoking Cessation
- 1.2 Glycaemia Control
- 1.3 MRSA and MSSA Screening and Decolonisation
- 1.4 Enhanced Nutritional Support

Responsibilities:

Cardiothoracic consultants or delegate/s are responsible for ensuring patients who are referred for cardiothoracic surgery are assessed for surgical site infection risk. When risk factors are identified the consultant or delegate is responsible for implementing strategies to mitigate risk. To maximise efficacy, mitigating strategies, should be implemented prior to hospital admission. The World Health Organisation and the Centres for Disease Control Prevention have identified the following modifiable patient risk factors:

Modifiable risk factors include:

- Current smokers
- HbA1c > 6.5% or BGL >10mmol/L
- MRSA or MSSA positive
- Underweight or malnourished

Strategies to modify risk factors include:

- Smoking cessation
- Glycaemia control
- MRSA and MSSA screening and decolonisation
- Enhanced nutritional support

1.1 Smoking Cessation

Overview: The American College of Surgeons & Surgical Infection Society Guidelines⁴ recommend smoking cessation four to six weeks before surgery for all current smokers, especially those undergoing procedures with implanted materials. The Centres for Disease Control Review recommends smoking cessation is initiated at least 30 days before surgery.^{5 6} The American College of Surgeons support the use of nicotine lozenges, gum and medication to aid in smoking cessation. The Australian and New Zealand College of Anaesthetists in their guidelines on smoking, as related to the perioperative period, emphasise the importance of asking patients preoperatively about their smoking status, advising patients of the specific perioperative risks of smoking and referring patients to locally available smoking cessation support programs.

Key Recommendations:

Clinicians referring patients for cardiothoracic surgery or clinicians in preadmission clinic will:

- Ask patients preoperatively about their smoking status
- Advise patients who smoke of the specific perioperative risks of smoking
- Refer patients to the NSW Quitline or other smoking cessation support programs
- Offer nicotine replacement therapy such as nicotine lozenges, gum or medication

NSW Quitline provides a free call-back service, including Aboriginal and multilingual advisors (13Quit or 137 848). (Cancer Institute 2018)

1.2 Glycaemic Control

Key Recommendations:

Clinicians referring patients for cardiothoracic surgery or clinicians in the preadmission clinic will:

- **Test HbA1c** level with the aim of identifying degree of glycaemic control prior to admission
- Where practicable patients with poor glycaemic control (HbA1c >9% or blood glucose levels >10 mmol/l) should be referred to the patient's local diabetes care provider for stabilisation of diabetes while waiting for surgery. Referral to an Endocrinologist recommended.

Target Levels:

Good Glycaemic Control	HbA1c ≤ 7%,
Suboptimal Control	7% to 9%
Poor Control	>9%

NB: Sodium-glucose co-transporter 2 Inhibitors (SGLT2)

Due to the high risk of euglycemic diabetic ketoacidosis, SGLT2 inhibitors must be ceased two days before theatre. Alternative diabetes medication cover may be required to ensure the patient does not become hyperglycaemic.

1.3 Screening and Decolonisation Process

Overview: Staphylococcus aureus carriage increases risk of postoperative infection. Decolonise Staphylococcus aureus in positive patients with intranasal mupirocin 2% will reduce risk of postoperative infection. To maximise efficacy of treatment, intra nasal Mupirocin 2% needs to start five days before surgery.³

Key Recommendations:

Clinicians referring patients for cardiothoracic surgery or clinicians in preadmission clinic will:

- Screen for staphylococcus aureus 7-14 days before admission to a SESLHD facility
- Ensure positive patients start decolonisation therapy five days prior to surgery.

MSSA MRSA Screening Process

Ordering Pathology

- Clinicians to order "Nose swab for Staphylococcal culture" screening on EMR
- Note "screening pre cardiothoracic surgery" on request form

Checking and Actioning Results

- Treating teams are responsible for checking results prior to surgery and actioning positive results

- POWH: Pre-admission staff member/s will ensure that results are communicated to the consultant. Cardiothoracic Registrar should check results and prescribe decolonisation regimen
- SGH: Infection Prevention and Control Clinical Nurse Consultant will email results directly to Consultant if screening undertaken in pre-admission clinic
- If the isolate is resistant to the decolonisation regimen, contact Infectious Diseases for input and advice.

Decolonisation Process

Prescribing Mupirocin 2%:

- Decolonisation should only be applied to patients with known colonisation, in line with general principles of antimicrobial stewardship.
- If patient is receiving a therapeutic course of anti-staphylococcal treatment, load reduction can still proceed although in general is more successful after active infection is treated
- Consider possible drug interactions and current medications prior to prescribing
- Provide the patient with a script for Mupirocin 2%
- Instruct patient to initiate treatment five days prior to surgery. The patient must be co-operative and able to follow the MSSA/ MRSA decolonisation regimen
- *The surgeon must be aware of the progress of results and status of load reduction program if applicable prior to commencement of surgery*

Staphylococcus aureus (MSSA and MRSA) Load Reduction

For details refer to [SESLHDPR/681 - Staphylococcus aureus \(MSSA and MRSA\) decolonization.](#)

1.4 Enhanced Nutritional Support

Overview: Surgery induces complex changes in the hemodynamic, metabolic and immune responses of the body, which can cause inflammation, affect wound healing and increase mortality.⁷ Patients who undergo major surgery have an increased risk of malnutrition due to fasting periods, the stress of surgery, and the subsequent increase in metabolic rate. Pre-existing nutritional status has a profound impact on the immune system.

Key Recommendations:

Clinicians referring patients for cardiothoracic surgery or clinicians in the preadmission clinic will:

- Record the patient's height / weight and screen for malnutrition. Use the Malnutrition Screening Tool (MST)
- Refer to a dietitian if the patient is aged under 65 and BMI <18.5kg/m² or over 65 and BMI <22kg/m²

Section 2 Modifying Patient Risk Factors Inpatient

- 2.1 Modifying Patient Risk Factors Pre-Operative**
 - 2.1.1 Smoking Cessation
 - 2.1.2 Glycaemic Control
 - 2.1.3 Decolonisation – Emergency Patients or Patients without a swab result
- 2.2 Delirium Risk Screening**
- 2.3 Enhanced Nutritional Support**
- 2.4 Sternal Support Vest**
- 2.5 Pre-Operative Shower**
- 2.6 Hair Removal**

2.1.1 Smoking Cessation

Overview:

Patients undergoing surgery are more receptive to advice and information provide by health care professionals⁸. Effective smoking cessation interventions are comprised of brief assessment and advice, nicotine replacement therapy (NRT) and referral to a smoking cessation service such as the NSW Quitline⁹.

Key Recommendations:

- Smokers are identified and encouraged to quit
- Smokers are offered nicotine replacement therapy such as nicotine lozenges, gum or medication, see [SESLHDPR/494 Nicotine Replacment Therapy](#).

NSW Quitline provides a free call-back service, including Aboriginal and multilingual advisors (13Quit or 137 848)

2.1.2 Glycaemic Control

Overview: Blood glucose levels rise during and after surgery due to surgical stress. Surgery causes a stress response that results in a release of catabolic hormones and the inhibition of insulin. Surgical stress influences pancreatic beta-cell function, which results in lower plasma insulin levels. Consequently surgical patients are at high risk of hyperglycaemia.³ Hyperglycaemia is associated with an increased risk of surgical site infections.

Key Recommendations:

For optimal management of diabetic surgical inpatients refer to facility clinical business rule:

POWH: [Surgery and Medical Procedures for Patients with Diabetes Mellitus](#)

SGH: [Diabetes - Intravenous Insulin Administration \(Adults\) SGSHHS CLIN226](#)

NB: Sodium-glucose co-transporter 2 Inhibitors (SGLT2)

Due to the high risk of euglycemic diabetic ketoacidosis, SGLT2 inhibitors must be ceased two days before theatre. Alternative diabetes medication cover may be required to ensure the

patient does not become hyperglycaemic. Refer to facility clinical business rule for detailed management.

2.1.3 Screening and Decolonisation of Emergency Patients

Pre-operative Decolonisation for Emergency surgery

- Where colonisation status is unknown at the time of surgery and the patient is assessed as high risk for MSSA/MRSA colonisation (see risk factors below), the patient should be swabbed and load reduction therapy commenced
- Screening swab results must be checked by treating team and load reduction ceased if negative

MSSA / MRSA Risk Factors¹⁰

- Current or recent hospitalisation
- Residing in a long-term care facility
- Invasive procedures such as urinary catheters, arterial lines, or central venous lines
- Recent or long-term antibiotic use
- Family members or close contacts who are health care workers
- Chronic renal dialysis
- Having a weakened immune system, such as in persons with HIV/AIDS
- Living in crowded or unsanitary conditions, such as prisons

Zeller JL, Golub RM. MRSA Infections. *JAMA*. 2011;306(16):1818. doi:10.1001/jama.306.16.1818 [cited April 2018]
<https://jamanetwork.com/journals/jama/fullarticle/1104555>

Ordering MSSA and MRSA screening swabs - SEALS Pathology

- Clinicians to order “Nose swab for Staphylococcal culture” screening on eMR
- Note “screening pre cardiothoracic surgery” on request form

Notification of Results

- It is the treating teams responsibility to check results
- If results are positive provide patient with a MSSA / MRSA Decolonisation factsheet

Mupirocin Resistant strains

- If the isolate is resistant to the decolonisation regimen, consultation with facility Infectious Diseases is recommended

2.2 Delirium Risk Screening

Overview: Delirium is an acute change in mental status that is common among older hospitalised patients. It is a serious condition that is associated with increased mortality. Prevention is the most effective strategy, but outcomes for patients with delirium can also be improved by early intervention. Confusion and delirium in post-operative cardiothoracic patients can reduce compliance to follow optimal sternal wound management, which in turn can increase risk of sternal dehiscence and sternal wound infection.

Predisposing risk factors	Precipitating risk factors
Age > 65 or ≥ 45 in Aboriginal and Torres Strait Islander peoples	Use of physical restraint
Pre-existing dementia	Use of indwelling catheter
Severe medical illness	Adding three or more medications
History of previous delirium	Multiple bed moves
Visual and hearing impairment	Pain
Depression	Surgery
Abnormal sodium, potassium and glucose	Anaesthesia and hypoxia
Polypharmacy	Malnutrition and dehydration
Alcohol / Benzodiazepine use	

Key Recommendations:

- Prevent post-operative delirium in cardiothoracic patients through screening, implementation of strategies to prevent and treat underlying causes.
- Refer to [SESLHDPR/345 - Prevention, Diagnosis and Management of Delirium in Older People](#) for screening tool and interventions to prevent and manage delirium
- Contact Delirium Clinical Nurse Consultants for advice regarding education, support and implementation of processes in relation to delirium.

2.3 Enhanced Nutritional Support

Overview: A meta-analysis review indicates perioperative nutritional support improves clinical outcomes in malnourished patients. Improved outcomes include reduction in infections, post-operative complications and length of hospital stay.⁷ Another study indicated maximising nutritional status pre-operatively reduced adverse clinical outcomes.¹¹

Key Recommendations:

- Record height / weight and screen for malnutrition using the Malnutrition Screening Tool (MST) during pre-admission clinic visit
- Refer to a dietitian if the patient is aged under 65 and BMI <18.5kg/m² or over 65 and BMI <22kg/m²

2.4 Sternal Support Vest

Overview: Evidence indicates wearing sternal support devices, in appropriately selected patients, reduces sternal wound complications and is associated with a shorter length of hospital stay^{12,13}

Recommendations:

- Patients are preoperatively assessed for risk of developing sternal wound complications (see table below)
- In consultation with the Cardiothoracic Surgeon, patients identified as high risk are provided with a sternal support device and education regarding rationale for wearing the garment
- Risk of sternal wound complications are reduced if the support vest is worn for the optimal postoperative period of six weeks

Preoperative Patient Risk Factors ^{12, 35}	Intraoperative Risk Factors	Postoperative Patient Risk Factors (identified Post-op)
BMI >30% Diabetes Mellitus Ongoing steroid therapy Redo medial sternotomy Respiratory Disease (COPD) Severe osteoporosis Renal insufficiency Female (breast size) Advanced age Current smoker Previous mediastinal irradiation	Use of bilateral internal mammary arteries Prolonged bypass Use of an intra-aortic balloon pump Re-operation Sternal rewiring	Post-operative non-union Confusion /agitation Clicky sternum Severe Cough Postoperative bleeding

2.5 Pre- Operative Showering

Recommendation: Advise patients to shower or bathe (full body) with soap (antimicrobial or non-antimicrobial) or an antiseptic agent on at least the night before the operative day.

Source: Centres for Disease Control and Prevention Guideline for the prevention of SSI
 Strength of Recommendation: Category IB–strong recommendation; accepted practice

Key Recommendations:

- Patients shower or bathe with an antiseptic agent at least the night before surgery

2.6 Surgical Hair Removal Prior to Open Heart Surgery

Recommendation: For patients undergoing any surgical procedure, hair should not be removed or only if absolutely necessary. If hair is to be removed, a clipper only should be used. Shaving is strongly discouraged at all times, whether preoperatively or in the operating room.

Source: WHO Global Guidelines for the Prevention of Surgical Site Infection
 Strength of Recommendation: Strong

Overview: Body hair from the perioperative area is traditionally removed prior to open heart procedures. Body hair may obscure visualisation of the surgical site, interfere with suturing, utilisation of adhesive drapes and dressing materials. Surgical site infection risk is reduced if clippers rather than razors are used for hair removal.¹⁴

Key Recommendations:

- If hair removal is required use clippers with a disposable head
- Hair removal should not occur in the operating room
- Time hair removal to occur as close as possible to the operating procedure.

Section 3 Peri-Operative: Best Practice Preventing Surgical Site Infections

- 3.1 Surgical Hand Scrub
- 3.2 Prophylaxis Antibiotics
- 3.3 Skin Preparation
- 3.4 Peri-operative Oxygenation
- 3.5 Normothermia
- 3.6 Lavage Surgical Cavity
- 3.7 Advanced dressings

3.1 Surgical Hand Scrub

Recommendation: Surgical hand preparation is performed either by scrubbing with a suitable antimicrobial soap and water or alcohol based hand rub before donning sterile gloves.

Source: WHO Global Guidelines for the Prevention of Surgical Site Infection
Strength of recommendation: Strong

Overview: The Centre for Diseases Control report that correct hand-washing reduces healthcare associated infections by 30%². A standardised procedure for the surgical scrub allows members of the surgical team to consistently follow a protocol designed to achieve an effective surgical scrub.

Key Recommendations:

- All members of the surgical scrub team must follow established hand hygiene practices to maintain healthy skin and fingernail condition. All jewellery should be removed from the hands and arms prior to commencing a surgical scrub
- The surgical team should follow a standardised procedure for the pre-surgical scrub using skin antiseptic.

Summary of Literature Review:

Traditionally, surgical hand scrubbing is performed with antibacterial agents and cleaning with stiff brushes and flowing water. Alcohol-based dry-fast hand scrubs have been introduced to surgical hand washing by the end of 1990s.¹⁵ Current evidence suggest that alcoholic hand rub is as effective as washing with povidone iodine.¹⁶

3.2 Prophylaxis Anti-biotics

Overview: Randomised controlled trials have shown conclusively that appropriate surgical antibiotic prophylaxis reduces the rate of superficial and deep surgical site infections. Gram positive organisms, in particular *Staphylococcus aureus* and coagulase negative staphylococci, and Aerobic Gram-negative organisms are important causes of postoperative infection.

The appropriate use of surgical antibiotic prophylaxis reduces the rate of surgical site infections. Compliance with local guidelines that recommend the selection of appropriate

antibiotic(s), correct antibiotic dose, ideal timing of administration, and correct redosing regimen is endorsed.

Key Recommendations:

- For prophylaxis the use of **cefazolin 2G within 60 minutes before incision**, ideally 15-30 minutes, this should be repeated postoperatively every eight hours for up to two further doses¹⁷
- Vancomycin should be added for patients who are known to be, or are at risk of being, **colonised or infected with MRSA**^{5, 17} at a dose of 15mg/kg started 30-120 minutes before incision (recommended at 10mg/minute, this dose should be repeated postoperatively 12 hours after the initial dose).¹⁷
 - Vancomycin is not recommended as the sole prophylactic antibiotic as it has a narrower antimicrobial spectrum, inferior tissue and bone penetration, less desirable pharmacokinetics and slower bactericidal effects compared to cephalosporins.⁵
- For patients with a history of immediate hypersensitivity to penicillins, vancomycin and gentamycin should be used as vancomycin lacks gram negative coverage^{5, 17}
 - It's recognised that the combination of vancomycin and an aminoglycoside is associated with both nephrotoxicity and ototoxicity with delayed excretion after cardiopulmonary bypass. Therefore a single preoperative dose of gentamicin is recommended.⁵ Local guidelines suggest ciprofloxacin as an alternative to gentamicin in patients with renal impairment¹⁸.

Link to [Surgical Prophylaxis for Cardiac Surgery Antibiotic Guidelines - Timing and Duration - Clinical Excellence Commission](#)

Summary of Literature Review:

- The Australian Therapeutic Guidelines recommend the use of a first generation cephalosporin, such as **cefazolin as the preferred drug for prophylaxis** in cardiac surgical patients, however it emphasises that antibiotic selection may need to be modified according to patient risk factors such as the presence of a pre-existing infection, recent antibiotic use, known colonisation with multi-resistant organisms e.g. MRSA, and environmental factors such as the organisms causing infection and the patterns of antibiotic susceptibility within the hospital, and the potential selection pressure of antibiotic use.
- The **optimal time** for preoperative intravenous antibiotic administration is within the 60 minutes before surgical incision^{4,17, 19, 20} however ideally this should be within 15 to 30 minutes before surgical incision^{17, 21}
- Due to the long infusion time required for the administration of Vancomycin, it is recommended that it be commenced 30 to 120 minutes before surgical incision^{17, 20}
- A **repeat intraoperative dose** of antibiotic may be required if the procedure is prolonged and the drug half life is short. The interval between the preoperative and repeat dose should be equal to approximately two half-lives of the drug i.e. cefazolin should be repeated every four hours¹⁷

- This dosing interval should be adjusted depending on the patient’s renal function.¹⁸ Repeat dosing may also be required in the event of massive blood loss during the procedure. The American College of Surgeons and Surgical Infection Society Guidelines recommend antibiotic re-dosing for every 1500ml of estimated blood loss⁴
- **Postoperative doses** of intravenous antibiotics are recommended in cardiac surgery, but this should not extend beyond 24hours
- Antibiotic pharmacokinetics are altered in **obese patients**. Therefore dosage adjustment should be considered in this patient group. The American College of Surgeons and Surgical Infection Society Guidelines recommend antibiotic dosing for prophylaxis should be adjusted for weight.⁴

3.3 Skin Preparation

Recommendation: Use an alcohol based antiseptic solution preferably based on Chlorhexidine gluconate for surgical site skin preparation in patients undergoing surgical procedures. Solution must be allowed to dry by evaporation. Do not allow solution to pool under the patient. Staff should be trained/informed about potential harms and how to minimise risk.

Source: WHO Global Guidelines for the Prevention of Surgical Site Infection
Strength of Recommendation: Strong

Recommendation: Perform intraoperative skin preparation with an alcohol-based antiseptic agent unless contraindicated.

Source: Centres for Disease Control and Prevention Guideline for the Prevention of SSI
Strength of Recommendation: Category IA—strong recommendation; high-quality evidence

Overview: An effective antimicrobial agent should contain broad spectrum properties. Povidone–Iodine releases free Iodine during the drying process to kill bacteria. It is not required to be applied multiple times. Chlorhexidine-alcohol has been used as the gold standard to reduce surgical site infections worldwide for over a decade. Alcohol is highly bactericidal and effective for preoperative skin antisepsis, however does not have persistent activity when used alone. When combined with chlorhexidine gluconate or an iodophor (e.g. povidone iodine) antisepsis is persistent and cumulative.²¹

Alcohol based skin preparations are rapid acting and are considered one of the most effective bactericides affecting gram positive and negative bacteria.²² Alcohol solutions are flammable and can present a fire risk in the operating theatre due to the combination of alcohol in the skin preparation, oxygen rich environments and heat producing sources such as a diathermy.²² Once the agent is dried (via evaporation) it is no longer flammable.²¹ Despite the risk, fires in the operating theatre are rare and can be prevented by allowing the skin prep to thoroughly dry.²³

Key Recommendations:

- Use a dual agent skin preparation containing alcohol i.e. chlorhexidine gluconate or an iodophor

- Dual agent skin preparation is contraindicated if there is a known allergy to any of the components of the agent
- Ensure the surgical site is free of soil, debris, cosmetics and jewellery
- Preparation commences from the cleanest area (operative or incision site) and proceeds to the least clean area
- If a highly contaminated area is part of the preparation, the area with a lower bacterial count is prepared first, followed by the area of higher contamination
- The prepared area allows for extension of the incisions, potential drape shift and placement of drains and:
 - The preservation of skin integrity
 - The maintenance of aseptic technique
 - The prevention of pooling solution
 - The allowance of adequate contact time, drying time and vapour dissipation of the antimicrobial agent
- Skin preparation of the patient is performed as per relevant ACORN Standards in conjunction with manufacturer's recommendations
- Only appropriately skilled personnel should perform surgical skin preparation. The effectiveness of the skin prep is influenced by the knowledge of the:
 - Surgical site and procedure
 - Antimicrobial agent properties and application technique
 - The risk of the harm to the patient from interaction of the antimicrobial agent with other surgical equipment (such as ignition of the agent causing fire or chemical reaction)
- To eliminate the risk of fire ensure the prepped area is allowed to air dry completely before placing the drape on the patient and there is no pooling of solution under the patient
- The following criteria is documented:
 - Skin condition and integrity
 - Hair removal method, location and time
 - Type of antimicrobial agent used
 - Details of skin reaction, if any
 - Postoperative skin assessment
- The Instrument and Circulating Nurse must be aware of fire prevention strategies and how to manage a fire in the operating theatres, and ensure sufficient drying time is allowed for flammable skin prep solution and that the solution does not pool under the patient.

3.4 Perioperative Oxygenation

Overview: Tissue hypo perfusion and hypoxia is associate with an increased risk of surgical site infections. Tissue oxygenation is a strong predictor of SSI.²⁴ Bacteria in wounds are usually killed by intracellular oxidative mechanisms inside the leukocyte, and molecular oxygen is necessary for production of oxygen free radicals, especially bacterial superoxide. There is a direct correlation between the subcutaneous partial pressure of oxygen (pO₂) and resulting postoperative wound infection, the critical level for this is a pO₂ less than 30-40mmHg.²⁵ Improving tissue perfusion and oxygenation should therefore reduce the risk of wound infections.

Key Recommendations:

- Aim to optimise tissue oxygenation and perfusion peri-operatively
Recommended strategies include appropriate oxygen therapy and ventilation; maintaining normovolemia and cardiac output.

Summary of Literature Review:

A major aim in cardiac anaesthesia is to ensure optimal oxygenation and perfusion of the heart and other end organs and tissues.²⁶ This can be challenging, as often the patients have severe cardiac disease and a host of other comorbidities including lung disease. When possible the patient's medical condition is optimised preoperatively. Typically intraoperatively an FIO₂ of 1.0 is used during cardiac surgery in order to maximise the arterial oxygen tension.^{26, 27} A lower inspired oxygen concentration of 80% may prevent absorption atelectasis and reduce the risk of oxygen toxicity.²⁶ The use of PEEP, lung recruitment manoeuvres, aggressive pulmonary toilet and optimizing ventilatory strategies are also used to improve oxygenation.²⁸

Any reversible contribution to hypoxia is addressed such as treatment of pulmonary oedema, bronchospasm, mucous plugging or pneumothorax.

Pulse oximetry and arterial blood gases are used to guide oxygenation and ventilation intraoperatively. Transfusion of blood products is frequently required to ensure optimal delivery of oxygen to the tissues. Cardiac output, atrial and ventricular filling pressures and transoesophageal ECHO as well as indicators of end organ and tissue perfusion such as mixed venous oxygen saturation, blood lactate, base excess, urinary output and near infrared spectroscopy are used to guide optimal volume resuscitation and the administration of vasopressors and inotropic agents.^{26, 27, 28}

3.5 Normothermia

Recommendation: Maintain perioperative normothermia except for the period of cardiopulmonary bypass.

Source: Centres for Disease Control and Prevention Guideline for the Prevention of Surgical Site Infections

Strength of Recommendation: Category IA—strong recommendation; high to moderate-quality evidence

Overview: Hypothermia, defined as a core body temperature less than 36.8⁰ Celsius, commonly develops in patients during anaesthesia and surgery. Even mild hypothermia can be associated with adverse outcomes including myocardial ischemia, arrhythmias, coagulopathy and platelet dysfunction leading to increased blood loss, and an increased risk of SSI.

The benefits of induced hypothermia during cardiopulmonary bypass is well described; normothermia should be maintained at other times intraoperatively. Pre-warming using forced air warming devices, the use of forced air warming devices intraoperatively, the warming of irrigation fluid and the use of intravenous fluid warmers are recommended.

Forced air warming devices are the most effective method to maintain temperature during surgery.²⁹

Key Recommendations:

- It is recommended that normothermia is maintained intraoperatively for off- pump cardiac surgery cases. The temperature setting on the forced air warming device should be set at maximum and then adjusted to maintain a patient temperature of at least forced 36.6°C.³⁰
- Core temperature is the best single indicator of body temperature. During open heart and thoracic surgery core temperature is best measured from the nasopharynx or tympanic membrane, as the ambient temperature may affect the open thoracic cavity (i.e. the temperature measured from the oesophagus will be less accurate)
- Heat loss from the administration of cold intravenous fluids also contributes to hypothermia. The administration of 1 litre of fluid at room temperature will reduce the mean body temperature by 0.25°C²⁹. Fluid warmers are indicated when large amounts of blood, intravenous fluid and or blood products are administered
- All irrigation fluids used intraoperatively, except for a period of induced hypothermia should be warmed in a thermostatically controlled cabinet to a temperature of 38-40°C in order to prevent heat loss.²⁹

Normothermia following Transfer to CT ICU

- Apply Bair Hugger rewarming blankets as soon as the patient is admitted to CTICU.
- Re-warm patients to 36.5 degrees
- Use continuous blood temperature monitoring to ensure normothermia state
- Once the continuous core temperature monitoring is removed, monitor temperature four hourly via tympanic thermometer
- If core temperature drops below 36 degrees, reapply the rewarming blanket

Summary of Literature Review:

Normally following the induction of anaesthesia, the fall in body temperature occurs in three phases. The greatest drop occurs in the first half hour or phase one, this is due to vasodilatation combined with an altered cold threshold in the hypothalamus which allows a redistribution of body heat from the core tissues to the skin where heat is lost through radiation, phase two commences after about an hour as core temperature falls more slowly and proceeds in a linear manner as heat lost is greater than heat production. The final phase commences at three to five hours as equilibrium is reached where heat lost is matched by heat production and thermoregulatory vasoconstriction.

Traditionally induced intraoperative hypothermia has been extensively used in cardiac surgery involving cardio-pulmonary bypass or circulatory arrest. Relatively small degrees of hypothermia can offer significant cerebral protection, as the structural and functional cerebral metabolic rate decreases by six to seven% per degree centigrade reduction in temperature.

In off pump cardiac surgery (OPCAB) a patient's temperature is influenced by the same environmental sources of heat loss as that of patients having non cardiac surgery. Additionally because the thorax is open and the extremities are exposed for vein harvest, maintaining normothermia is difficult. Hannan et al demonstrated that OPCAB patients who developed even mild hypothermia had significantly higher rates of sternal wound infection, sepsis, respiratory failure and bleeding³¹). Normally for patients that require

cardiopulmonary bypass a fall in core temperature occurs after bypass has been terminated, in part because of redistribution of heat within the body and further because of heat loss. This decline in temperature will be greater if difficulties are encountered and the chest remains open for an extended period and if transfusion of large volumes of blood products are needed for excessive bleeding. Often by the time the patient is admitted to the intensive care unit the core temperature may be 35°C, especially after off-pump cases.

The operating room temperature is the most critical factor influencing heat loss, because it determines the rate at which metabolic heat is lost by radiation and convection from the skin and by evaporation from within skin incisions. Consequently increasing the room temperature is one way to minimise heat loss. The National Institute for Healthcare and Care Excellence (NICE) guidelines recommend that the room temperature should be above 21°C when the patient is exposed and that the patient should be covered during the procedure. The **forced air_warming device** is the most effective method to maintain temperature during surgery.²⁹ It is best placed over the patient as it provides insulation and cutaneous warming.

3.6 Lavage Surgical Cavity

Overview: The evidence to support intracavity lavage and wound irrigation with either an antiseptic or antibacterial is the subject of a recent Cochrane Review³²

The summary from the Cochrane review goes on to state:

“Twenty studies involving 7192 participants compared washing out with no washing. The results showed no clear difference in SSI rates (low-certainty evidence). Antibacterial washing solutions may reduce infection rates compared with non-antibacterial solutions (low certainty evidence from 36 trials involving 6163 participants.)

Two studies involving 484 participants compared standard washing methods (pouring using a jug or a syringe) with pumping or pulsing the washing solution. There may be fewer SSIs when the solution is pumped into the wound (low-certainty evidence).

There may be fewer SSIs when a solution of povidone iodine is used compared with an alternative antiseptic (superoxidised water, Dermacyn) (low-certainty evidence from one trial with 190 participants). The results for all other comparisons showed no clear differences or were very uncertain. Wound reopening (dehiscence), infections, which are hard to treat with antibiotics, and deaths were not widely reported. Washing out wounds may not affect the length of time people stay in hospital (low- or moderate-certainty evidence)”

Key Recommendations:

- There is no evidence to support irrigation of the cavity in cardiac surgery or in irrigation of the wound. This practice is not recommended.

Summary of Literature Review:

A total of 20 studies were reviewed involving 7192 participants. This included one study, which examined wound irrigation in 190 patients having cardiac surgery (Mohd 2010 Dermacyn in reducing infection of a median sternotomy wound). Patients having cardiac bypass surgery had the closed wound soaked in either povidone iodine or Dermacyn (superoxidised water) for 15 minutes. There appeared to be a reduction in infections in the Dermacyn group, but the quality of the evidence was deemed low. An earlier study (1990), compared intracavity lavage with povidone iodine versus no lavage for patients undergoing early repeat sternotomy (22 had lavage and 21 did not). The results suggested a reduction in post-operative wound infection. No further publications were identified.

3.7 Sternal Wound Dressings / Advanced dressings

Overview: There is a substantial body of evidence to support the use of negative pressure wound therapy on closed surgical wounds to prevent post-operative SSI.³³

The majority of studies, in relation to closed incisional negative pressure therapy, reported negative pressure therapy was associated with decreases in wound complications, wound dehiscence, SSIs, haematoma/ seroma formation and incisional drainage.³⁴

Key Recommendations:

- Use of an approved tool (eg. Fowler score) to determine patient's risk of sternal wound infection (see appendix)
- In low risk patients apply a hydrocolloid (comfeel) dressing to the sternal wound. Leave insitu until post-op day seven or until day of hospital discharge.
- In moderate to high risk patients apply an incisional negative pressure dressing in the operating theatre. Dressing should be left insitu until post-operative day seven or the day of hospital discharge.

3.8 Nutritional Support

Oral diet should be commenced as soon as suitable to avoid unnecessary fasting³⁵ For patients in the critical care setting who are not suitable for oral diet, enteral nutrition should be commenced within 24-48 hours. If enteral nutrition is not tolerated after the usual troubleshooting (e.g. prokinetics, post-pyloric feeding), parenteral nutrition should be commenced.

Key Recommendations:

- Commence postoperative nutrition as soon as medically stable
- For the management of nasogastric feeding in the intensive care setting refer to local clinical business rules.

Appendix A: SESLHD Cardiothoracic Surgical Site Infection Care Bundle

SESLHD Cardiothoracic Surgical Site Infection Care Bundle				
Modifying Patient Risk Factors <u>Outpatient</u>	Bundle Elements	Yes	No	N/A
Smoking Cessation	Smokers are identified and encouraged to quit at the time of referral.			
	Referral to NSW Quitline or other service (13Quit or 137 848)			
	Nicotine replacement therapy offered to those receptive to quit			
Glycaemic Control	HbA1c level tested pre admission			
	If HbA1c 7% - 9% or BGL > 10mmol/L referred to GP for diabetes management			
	If HbA1c ≥ 9% or BGL ≥ 12 mmol/L referred to local Diabetes Care provider for diabetes stabilisation prior to surgery			
MRSA & MSSA Screening	Screened for MRSA and MSSA (nose and groin), 10-14 days prior to OT			
	Results checked within 48 hours			
Decolonisation Treatment	+ve patients start intranasal mupirocin 2% ointment five days before OT date			
	+ve patients start aqueous Chlorhexidine washes five days before OT date			
	Decolonisation patient information provided			

Modifying Patient Risk Factors Outpatient

Most patients attending NSW Health Services who smoke do not receive smoking cessation interventions (Cancer Institute, 2018). Patients undergoing surgery have been found to be more receptive to advice and information provided by health care professionals (Fong, 2018).

Effective smoking cessation interventions comprise brief assessment and advice, nicotine replacement therapy (NRT) and referral to a smoking cessation service.

Benefits of smoking cessation are exponential over time. Within weeks of cessation immune function is improved in individuals who quit smoking. Two meta-analyses demonstrated reduced wound complications four weeks after smoking cessation (Truntzer, 2017). In another study a perioperative smoking intervention at 4 weeks prior to surgery demonstrated a significant reduction in the complication rate.

There is also convincing evidence that active smokers at the time of cardiac surgery have a higher incidence of infective complications and increased mortality (Sepebripor AH, 2012) (Jones R, 2011).

Quitting for 3 weeks has been shown to improve wound healing (Kuri M, 2005). Quitting for 6 weeks decreases sputum volumes to normal and improves pulmonary function and at 6 months immune function is significantly recovered (Kotani N, 2001).

Hyperglycaemia is associated with an increased risk of surgical site infections. (World Health Organisation, 2016).

Staphylococcus aureus is a common cause of infections. A large proportion of infections due to Staphylococcus aureus originate from the patient's own flora (World Health Organisation, 2016). MRSA and MSSA can be effectively treated with nasal Mupirocin 2% (Schweizer, 2015). To maximise efficacy of treatment, Mupirocin 2% needs to start 5 days before OT.

Modifying Patient Risk Factors Inpatient	Bundle Elements	Yes	No	N/A
Smoking Cessation	Smokers are identified and encouraged to quit using the 5 “A” approach			
	Smokers are referred to QUIT line or other service (13Quit or 137 848)			
	Nicotine replacement therapy offered to those receptive to quit			
Glycaemic Control	Local CBRs are followed for the management of diabetic surgical patients POWH http://seslnweb/POWH/documents/cpm/Section15/SurgeryandMedicalProceduresPatientswithdiabetes.pdf			
	SGH http://seslnweb/SGSHHS/Business_Rules/Clinical/documents/D/Diabetes_IV_Insulin_Administration_Adults_SGSHHS_CLIN226.pdf			
MRSA and MSSA Screening Decolonisation	If MRSA and MSSA results not available within 5 days of OT, patient is risk assessed for MRSA and MSSA carriage (see MRSA /MSSA risk assessment tool)			
	If identified as high risk intranasal Mupirocin 2% ointment commenced			
	Decolonisation treatment ceased if swabs return -ve			
Delirium Prevention	Prevent post-operative delirium in cardiothoracic patients through screening, implementation of strategies to prevent and treat underlying causes. Screening and strategies are followed as per SESLHDPR/345 Procedure - Prevention, Diagnosis and Management of Delirium in Older People			

Enhanced Nutritional Support	Patient screened for underweight / at risk of malnutrition using the Malnutrition Screening tool			
	<p>Patients with a Malnutrition Screening score ≥ 2 are referred to a Dietitian</p> <ul style="list-style-type: none"> • Patients aged 65 years or over with a BMI $< 22 \text{ kg/m}^2$ are referred to a Dietitian • Patients aged under 65 years with a BMI $< 18.5 \text{ kg/m}^2$ are referred to a Dietitian 			
Wound Management Sternal Support Vest	Patients are risk assessed for potential to develop sternal wound complications			
	Patients identified high risk, are considered for a sternal support vest			
Pre-operative shower	Patient has showered or bathed with an antiseptic agent at least the night before theatre			

Modifying Patient Risk Factors Inpatient

Patients who undergo major surgery have an increased risk of malnutrition due to fasting periods, the stress of surgery, and the subsequent increase in metabolic rate. Nutritional status can have a profound impact on the immune system. (Zhong, 2015)

Surgery induces complex changes in the hemodynamic, metabolic and immune responses of the body, which can cause inflammation, affect wound healing and increase mortality (Culebras, 2013). Patients who undergo major surgery have an increased risk of malnutrition due to fasting periods, the stress of surgery, and the subsequent increase in metabolic rate. Nutritional status can have a profound impact on the immune system. Malnutrition associated with a weakened immune system and impaired stress resistance results in an inability to effectively respond when it encounters stress such as major surgery, trauma and infection with an estimated 55% of patients undergoing major cardiovascular surgery acquiring an infection (Zhong J, 2015) , (Culebras, 2013) (Tepaske R, 2001)

There is evidence that early use of external non-elastic sternal support devices reduces sternal wound complications and may be associated with a shorter length of hospital stay (Tsang, et al. 2016)

Randomized controlled trial evidence suggested uncertain trade-offs between the benefits and harms regarding the optimal timing of the preoperative shower or bath, the total number of soap or antiseptic agent applications, or the use of Chlorhexidine gluconate washcloths for the prevention of SSI. (Berrios-Torres S, Umscheid C, Bratzler D, Leas B, Stone E et al, 2017)

Reducing SSIs Intra-Operative	Bundle Elements	Yes	No	N/A
Surgical Hair Removal	Hair removal is restricted to what is surgically necessary			
	Hair removal is via electric clippers with a single-use head			
	Hair removal is timed to occur as close as possible to the operating procedure			
	Hair removal is performed in non OT area			
Prophylactic Antibiotics	First dose of prophylactic cefazolin 2G given within 60 minutes (ideally 15-30 minutes) before incision			
	An alternative prophylactic antibiotic is given to patients with a history of immediate hypersensitivity to penicillins			
Skin Preparation	Skin prepped with 2% Chlorhexidine gluconate in 70% isopropyl alcohol solution or iodine/alcohol solution (unless contraindicated) and allowed to dry by evaporation			
	Skin prep timed to occur immediately before incision			
	Pooling of preparation avoided			
	Skin prep applied with the appropriate technique			
Normothermia	Aim for normothermia pre and post bypass			
	Forced air warming devices set at maximum and then adjusted to maintain a patient temperature of at least 36.6°C			
	All irrigation fluids used intraoperatively, except for a period of induced hypothermia should be warmed in a thermostatically controlled cabinet to a temperature of 38-40°C to prevent heat loss (National Institute for Healthcare and Care Excellence, 2008)			
	Fluid warmers are indicated when large amounts of blood, intravenous fluid and or blood products are administered			
Glycaemic Control	BGL within target range 5mmol/L to 10mmol/L			

	If on an insulin infusion, BGL checked hourly			
Optimal Tissue Oxygenation and Tissue Perfusion	Maintain appropriate FiO2 / Ventilation / cardiac output			
Wound Management Negative Pressure Dressing	Patients with risk factors for sternal wound complications are identified Patients identified as high risk (modified Fowler score > 10) are considered for negative pressure wound management			
	In appropriately selected patients PICO negative pressure dressing applied in the operating theatre and left insitu for six to seven days			
	Low risk patients have a hydrocolloid (comfeel) dressing applied in the operating theatre and left insitu until post-op day seven or until day of hospital discharge			

Reducing SSIs Intra-Operative

For patients undergoing any surgical procedure hair either should not be removed or only on the basis of necessity, removed only with a clipper. Shaving is strongly discouraged at all times, whether preoperatively or in the OR. (World Health Organisation, 2016)

Prophylactic antibiotics are timed to optimise bactericidal concentration in the serum and tissues when the incision is made. (Australian Therapeutic Guidelines , 2014). Aim for appropriate antibiotic selection, dose, and timing of first and repeat dose.

The Australian therapeutic guidelines (Antibiotics, Australian Therapeutic Guidelines for, 2014) recommend the use of a first generation cephalosporin, such as cefazolin as the preferred drug for prophylaxis in cardiac surgical patients, however it emphasises that antibiotic selection may need to be modified according to patient risk factors such as the presence of a pre-existing infection, recent antibiotic use, known colonisation with multi-resistant organisms e.g. MRSA, and environmental factors such as the organisms causing infection and the patterns of antibiotic susceptibility within the hospital, and the potential selection pressure of antibiotic use

Alcohol based antiseptic solutions for surgical site skin preparation are more effective to aqueous solutions in reducing SSI (World Health Organisation, 2016)

The benefits of induced hypothermia during cardiopulmonary bypass is well described; normothermia should be maintained at other times during the intraoperative period.

Core temperature is the best single indicator of body temperature. During open heart and thoracic surgery core temperature is best measured from the nasopharynx or tympanic membrane, as the ambient temperature may affect the open thoracic cavity (i.e. the temperature measured from the oesophagus will be less accurate)

There is a substantial body of evidence to support the use of negative pressure wound therapy on closed surgical wounds to prevent post-operative SSI (Dohmen et al, 2014).

A majority of studies of closed incisional negative pressure therapy reported that use was associated with decreases in wound complications, wound dehiscence, SSIs, haematoma/ seroma formation and incisional drainage (Willy et al 2016).

Reducing SSIs Post –Operative	Bundle Elements	Yes	No	N/A
Normothermia	Warming device (i.e. Bair Hugger rewarming blankets) applied to patient directly on admission to CTICU			
	Re-warmed to 36.5 degrees			
	If the patient's core temperature drops below 36 degrees, the rewarming blanket is re applied			
Prophylactic Antibiotics	For prophylaxis the use of cefazolin 2G repeated postoperatively every eight hours for up to two further doses. (Australian Therapeutic Guidelines for Antibiotics Version, 2014)			
Glycaemic Control	BGL within target range 5mmol/L to 10mmol/L			
Timely Extubation	Protocol driven extubation			
Nutrition	Oral diet should be commenced as soon as suitable to avoid unnecessary fasting			
	For patients in the critical care setting who are not suitable for oral diet, enteral nutrition should be commenced within 24-48 hours.			
	If enteral nutrition is not tolerated after the usual troubleshooting (e.g. Prokinetics, post-pyloric feeding), parenteral nutrition should be commenced			
Wound Management Sternal Support Vest	Patients are risk assessed for sternal wound complications (see Preoperative, Intra operative and postoperative risk factors)			
	Patients at high risk are provided with a sternal support device			

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Appendix B: Pre-operative decolonisation factsheet





Appendix C: SGH and POW Cardiothoracic Surgery Admission Checklist



Revision and Approval History

Date	Revision no:	Author and approval
September 2018	DRAFT	Suzanne Schacht
September 2018	DRAFT	Draft for comment period
November 2018	DRAFT	Processed by Executive Services prior to Clinical and Quality Council approval.
December 2018	1	Approved by the Clinical and Quality Council to publish.
January 2020	2	Addition of appendices B and C. Approved by Executive Sponsor. Published by Executive Services.
March 2021	3	Minor review. Load Reduction Process removed. Replaced with link to SESLHDPR681 added (page 11); Pre-operative decolonisation for emergency surgery section amended (page 15). Appendix B replaced with updated brochure.
April 2021	3	Approved by Executive Sponsor.