



**GUIDELINES FOR SURGICAL
ANTIMICROBIAL
PROPHYLAXIS AND
PREVENTION OF SSI
AIIMS KALYANI
[Standard Operating Procedure]**



Prepared by HICC-AIIMS Kalyani



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TABLE OF CONTENTS

| | |
|-------------|--|
| I | INTRODUCTION |
| II | MICROBIOLOGY OF SSI |
| III | RISK FACTOR FOR SSI |
| IV | ANTIMICROBIAL PROPHYLAXIS |
| V | INDICATIONS |
| VI | TIMING 6.1. REDOSING 6.2. PROLONGATION OF SURGICAL ANTIMICROBIAL PROPHYLAXIS |
| VII | ANTIBIOTIC SELECTION |
| VIII | CHOICE OF ANTIBIOTICS |
| IX | IN CASE OF HISTORY OF BETA-LACTAM ALLERGY |
| X | OTHER MEASURES FOR THE PREVENTION OF SSI 10.1. PREOPERATIVE MEASURES 10.2. INTRAOPERATIVE MEASURES 10.3. POST-OPERATIVE MEASURES |
| XI | CHECKLISTS FOR SSI CARE BUNDLE |
| XII | REFERENCES |

I. INTRODUCTION

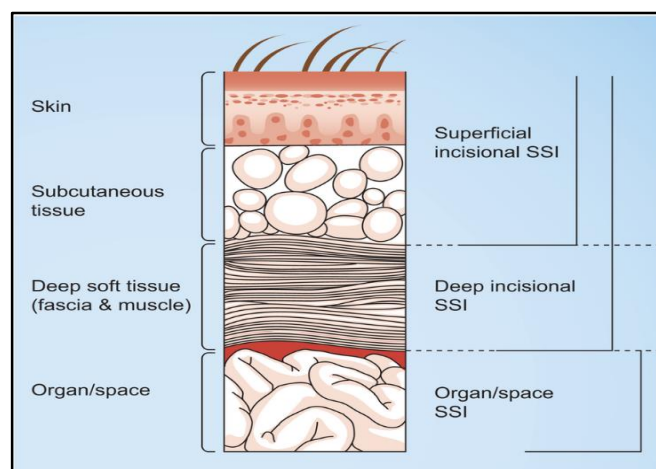
Definition:

As per the CDC, surgical site infection (SSI) is defined as infection related to an operative procedure that occurs at or near the surgical incision within 30 days of the procedure or within 90 days if prosthetic material is implanted at surgery. (one year in special cases as decided by the operating surgeon)

It describes 3 types of surgical site infections:

- **Superficial incisional SSI:** only involves the skin or subcutaneous tissue of the site of the incision.
- **Deep incisional SSI:** involves deep soft tissues of an incision, i.e., muscle and the tissues surrounding the muscles.
- **Organ or space SSI:** may involve any part of the anatomy (other than the incision) that was opened or manipulated during the operative procedure (includes a body organ or a space between organs). e.g., meningitis following an elective neurologic procedure.

Organ/space SSIs account for less than one-third of all SSIs but are associated with more than 90 percent of deaths related to SSIs.



Type of surgical site infections



Table-1: Definition of wound classification

| Class | Type of wound | Characteristics | Example | Estimate of occurrence of SSI |
|-------|---------------------------|--|--|-------------------------------|
| I | Clean | <ul style="list-style-type: none"> ➤ No signs of inflammation. ➤ No entry into the respiratory, alimentary, genital, or urinary tract. ➤ Clean wounds are primarily closed and, if necessary, drained with closed drainage. ➤ Operative incisional wounds that follow no penetrating (blunt) trauma are included in this category provided they meet the criteria. | Inguinal Hernioplasty, Thyroidectomy | <1-3% |
| II | Clean-contaminated | <ul style="list-style-type: none"> ➤ Low level of contamination. ➤ Entry into respiratory, alimentary, genital, or urinary tracts but only under controlled circumstances. | Surgeries involving biliary tract, appendix (elective), vagina, and oropharynx E.g. Cholecystectomy (without overflow bile) | 5-8% |
| III | Contaminated | <ul style="list-style-type: none"> ➤ Open, fresh, accidental wounds. ➤ Surgeries with major breaches in a sterile technique (e.g., open cardiac massage) or gross spillage from GIT. ➤ Incisions resulting from acute or non-purulent inflammation | Emergency Appendectomy, Colectomy Resection Anastomosis | 20-25% |
| IV | Dirty or Infected | <ul style="list-style-type: none"> ➤ Injuries occurred from inadequately treated traumatic wounds, gross purulence, and evident infections with retained devitalized tissue. ➤ Involves existing clinical infection or perforated viscera. | Perforative peritonitis, Degloving injury | 30-40% |



| Class | Type of wound | Characteristics | Example | Estimate of occurrence of SSI |
|-------|---------------|--|---------|-------------------------------|
| | | ➤ This suggests that the organisms causing postoperative infection were present in the operative field before the operation. | | |

II. MICROBIOLOGY OF SSI

The predominant organisms causing surgical site infections (SSIs) vary with the type of wound.

| Type of wound | Predominant organisms |
|-------------------------------------|--|
| Clean procedures | Skin flora, including <i>Staphylococcus aureus</i> , coagulase-negative Staphylococci and <i>Streptococcal</i> species. |
| Clean-contaminated procedures | Skin flora plus Gram-negative rods and <i>Enterococcus sp.</i> |
| Surgical procedure involving viscus | Endogenous flora of the viscus or nearby mucosal surface. Usually, polymicrobial. |
| Exogenous sources of infection | Contamination by organisms from the operating room, environment, or personnel. E.g. Non-tubercular Mycobacteria – Rapid growers, <i>Pseudomonas aeruginosa</i> , <i>Acinetobacter sp.</i> |

- Fungi (particularly *Candida albicans*) have been increasingly isolated from SSIs, probably due to the widespread use of prophylactic and empiric antibiotics, increased severity of illness, and greater numbers of immunocompromised patients undergoing surgical procedures.
- Anal, vaginal, or nasopharyngeal carriage of group A *Streptococci* by operating room personnel has been implicated as a cause of several SSI outbreaks.



III. RISK FACTORS FOR SSI

| PATIENT FACTORS | ENVIRONMENTAL FACTORS | TREATMENT FACTORS |
|---|--|--|
| <ul style="list-style-type: none">• Ascites• Chronic inflammation• Undernutrition• Obesity• Diabetes • Extreme of age• Hypercholesterolemia• Hypoxemia• Peripheral vascular disease• Postoperative anaemia• Previous site of irradiation• Recent operation• Remote infection• Skin carriage of staphylococci• Skin disease in area of infection• Immunosuppression | <ul style="list-style-type: none">• Contaminated medications• Inadequate disinfection/Sterilization• Inadequate skin antisepsis• Inadequate ventilation • Presence of foreign body | <ul style="list-style-type: none">• Drains • Emergency procedure • Inadequate antibiotic coverage• Preoperative hospitalization• Prolonged operation |



IV. ANTIMICROBIAL PROPHYLAXIS

Antimicrobial prophylaxis aims to prevent SSI by reducing the burden of microorganisms at the surgical site during the operative procedure. Patients receiving antimicrobial prophylaxis are at relatively low risk for adverse drug events such as the development of *Clostridioides difficile* infection and postoperative infection due to drug-resistant organisms.

V. INDICATIONS

Antimicrobial prophylaxis should be administered in the setting of

- a. Clean-contaminated surgery
- b. Contaminated surgery
- c. Dirty surgery

Prophylactic antibiotic is not recommended in clean wounds e.g., clean orthopedic surgeries not involving implantation or foreign material.

The use of antimicrobial agents for dirty procedures (established infection) is classified as treatment of presumed infection, not prophylaxis.

VI. TIMING

Antimicrobial prophylaxis for all elective surgeries should be initiated within 60 minutes prior to surgical incision to optimize adequate drug tissue levels at the time of initial incision.

The half-life of the antibiotic should be considered. Administration of Vancomycin or Fluoroquinolones should begin 120 minutes before surgical incision because of the prolonged infusion times required for these drugs. Preferably Antibiotic should be given at the time of induction or 30 min before incision (Intravenous)



6.1. Redosing:

Surgical antimicrobial prophylaxis in most of the surgeries is administered as a single dose.

However, redosing may be considered if:

1. Drugs with a low half-life (e.g., Cefazolin – 2.2 hrs, Cefuroxime-1 hr)- if the duration of surgery exceeds two half-lives of the antibiotic.
2. Excessive blood loss (> 1.5 L in adults or 25mL/kg in children)
3. Prolonged surgical procedures (> 4 h)

6.2. Prolongation of surgical antimicrobial prophylaxis

According to WHO, prolongation of surgical antimicrobial prophylaxis is not recommended.

Indications:

- a. Head and neck surgery- Open reduction internal fixation (ORIF) of complete mandibular fracture, orthognathic surgery, complex septorhinoplasty including grafts - prolongation up to 24 hrs
- b. Cardiac surgeries – up to 48 hours

VII. ANTIBIOTIC SELECTION

An ideal antimicrobial agent for surgical antimicrobial prophylaxis should be

1. Active against the pathogens most likely to contaminate the surgical site
2. Given in an appropriate dosage and at a time that ensures adequate serum and tissue concentrations during the period of potential contamination
3. Safe
4. Administered for the shortest effective period to minimize adverse effects, the development of resistance, and costs.

The selection of an appropriate antimicrobial agent for a specific patient should take into account the characteristics of the ideal agent, the comparative efficacy of the antimicrobial agent for the procedure, the safety profile, and the patient's medication allergies.



VIII. CHOICE OF ANTIBIOTICS

| NATURE OF OPERATION | COMMON PATHOGENS | RECOMMENDED ANTIMICROBIALS | | |
|--|--|---|------------------------|---|
| | | INTERNATIONAL GUIDELINES (JOINT RECOMMENDATION OF ASHP, IDSA, SIS AND SHEA) | RE- DOSE INTERVAL | NATIONAL TREATMENT GUIDELINES (NCDC) |
| Cardiac procedures: coronary artery bypass, cardiac device insertion procedures (eg, pacemaker implantation), placement of ventricular assist devices | <i>Staphylococcus aureus</i> <i>Staphylococcus epidermidis</i> | Cefazolin: 2gm IV stat, Weight > 120 kg – 3 gm IV OR Cefuroxime 1.5 gm IV stat | 4 hours | Cefuroxime 1.5gm IV stat & BD for 48hrs |
| Gastroduodenal surgery: 1) Procedures involving entry into the lumen of the gastrointestinal tract. 2) Procedures not involving entry into the lumen of the gastrointestinal tract (selective vagotomy, anti-reflux) | Enteric Gram negative bacilli, Gram-positive cocci | Cefazolin: 2gm IV stat, Weight > 120 kg – 3 gm IV High risk - Severe obesity, gastrointestinal (GI) obstruction, decreased gastric acidity or GI motility, gastric bleeding, malignancy or perforation, or immunosuppression | 4 hours | Cefoperazone-Sulbactam 2gm IV stat & BD for 24hrs (maximum) |
| Biliary tract surgery | Enteric Gram-negative bacilli, <i>Enterococcus</i> sp., <i>Clostridium</i> sp. | 1) Cefazolin: <120 kg – 2gm IV, > 120 kg – 3 gm IV OR, 2) Cefotetan 2 g IV | 4 hours 6 hours | Cefoperazone-Sulbactam 2gm IV stat & BD for 24hrs(maximum) |
| Colorectal surgery | Enteric Gram-negative bacilli, Anaerobes, <i>Enterococcus</i> sp. | 1) Cefazolin <120 kg – 2gm IV, > 120 kg – 3 gm IV PLUS Metronidazole 500 mg IV OR, 2) Cefotetan 2 g IV | 4 hours 6 hours | Cefoperazone-Sulbactam 2gm IV stat & BD for 24hrs(maximum) |
| | | Oral (used in conjunction with mechanical bowel preparation): Neomycin | | |



| | | | | | |
|---|--|--|---|---------|--|
| | | PLUS erythromycin base or metronidazole | | | |
| ERCP | | | | | Piperacillin-Tazobactam 4.5gm or Cefaperazone-Sulbactam 2gm IV stat |
| Hernia repair | Aerobic Gram-positive organisms | Cefazolin <120 kg – 2gm IV, > 120 kg – 3 gm IV | | 4 hrs | Cefazolin 2gm or Cefuroxime 1.5gm IV stat |
| Breast surgery | <i>Staphylococcus aureus</i> , <i>Staphylococcus epidermidis</i> , <i>Streptococcus sp.</i> | 1) Cefazolin <120 kg – 2gm IV, > 120 kg – 3 gm IV Or 2) Vancomycin 15 mg/kg (max 2 g) | | 4 hrs | Cefazolin 2gm or Cefuroxime 1.5gm IV stat |
| Orthopaedic surgery 1) Spinal procedure 2) Hip fracture 3) Internal fixation 4) Total joint replacement 5) Removal of orthopaedic hardware used for treatment of lower extremity fractures | <i>Staphylococcus aureus</i> , <i>Staphylococcus epidermidis</i> and other coagulase-negative staphylococci | No known MRSA colonization, and no history of IgE-mediated or other severe beta-lactam allergy | Cefazolin <120 kg – 2gm IV, > 120 kg – 3 gm IV | 4 hours | Cefuroxime 1.5gm IV stat & BD for 24 hrs(maximum) or Cefazolin 2gm IV stat Open reduction of closed fracture with internal fixation- Cefuroxime 1.5gm IV stat and q 12h or Cefazolin 2gm IV stat and q 12h for 24 hrs |
| | | Known MRSA colonization | Cefazolin <120 kg – 2gm IV, > 120 kg – 3 gm IV Plus Vancomycin 15 mg/kg (max 2 g) | | |
| Urologic procedures: Cystoscopy with or without manipulation OR upper tract instrumentation - ureteroscopy, shock wave lithotripsy | Enteric Gram-negative bacilli, Enterococci | Ciprofloxacin 500 mg orally or 400 mg IV OR trimethoprim-sulfamethoxazole One 160/800 mg (double strength, DS) tablet orally | | | Antibiotics only to patients with documented bacteriuria. |
| Open or laparoscopic surgery - Trans- | | Cefazolin <120 kg – 2gm IV, > 120 kg – 3 gm IV | | 4 hours | Cefaperazone-Sulbactam 2gm IV stat |



| | | | | |
|--|-----|---|---------|-----------------------------|
| rectal prostatic surgery | | | | |
| Gynaecologic and obstetric surgery | | | | |
| Laparoscopy (diagnostic, tubal sterilization, operative except for hysterectomy) Other transcervical procedures: Cystoscopy Hysteroscopy (diagnostic or operative) Intrauterine device insertion Endometrial biopsy Oocyte retrieval D&C for nonpregnancy indication Cervical tissue biopsy, including LEEP or endocervical curettage Hysterosalpingogram, including chromotubation or saline infusion sonography | N/A | N/A | N/A | N/A |
| Laparotomy without entry into bowel or vagina | | Cefazolin: <120 kg – 2gm IV, > 120 kg – 3 gm IV | 4 hours | Cefuroxime 1.5gm IV stat |
| Hysterectomy, Pelvic reconstruction procedures, including colporrhaphy or those involving mesh or vaginal sling placement | | 1) Cefazolin: <120 kg – 2gm IV, > 120 kg – 3 gm IV OR, 2) Cefoxitin or Cefotetan: 2 g IV | 4 hours | |
| Cesarean delivery (intact membranes, not in labor) | | Cefazolin: <120 kg – 2gm IV, > 120 kg – 3 gm IV | 4 hours | |
| Cesarean delivery (in labor, ruptured membrane) | | Cefazolin: <120 kg – 2gm IV, > 120 kg – 3 gm IV PLUS Azithromycin 500 mg IV | | |
| Uterine evacuation (including surgical abortion, suction D&C, and D&E) | | Doxycycline 200 mg Orally | | |



| | | | | |
|--------------------------|---|---|------------------|-----------------------|
| | | | | |
| Head & Neck/ ENT surgery | Clean with placement of prosthesis (excludes tympanostomy tube placement) - <i>Staphylococcus aureus</i> , <i>Staphylococcus epidermidis</i> , <i>Streptococcus sp.</i> | 1) Cefazolin: <120 kg – 2gm IV, > 120 kg – 3 gm IV OR , 2) Cefuroxime 1.5 gm IV OR , 3) Vancomycin 15 mg/kg (max 2 g) | 4 hrs N/A | Cefazolin 2gm IV stat |
| | Clean-contaminated - Anaerobes, enteric Gram-negative bacilli, <i>S. aureus</i> | 1) Cefazolin <120 kg – 2gm IV, > 120 kg – 3 gm IV PLUS Metronidazole 500 mg IV 2) Cefuroxime 1.5 gm IV PLUS Metronidazole 500 mg IV | 4 hours | |
| | | | | |

IX. IN CASE OF HISTORY OF BETA-LACTAM ALLERGY

- Avoid all the beta-lactam group of drugs (Cephalosporin's, beta lactam-beta lactamase inhibitor combination drugs)
- Alternative antibiotics like Inj. Vancomycin, Gentamicin, Metronidazole, Fluoroquinolones, and Doxycycline can be given as per the type and site of surgery.

X. OTHER MEASURES FOR THE PREVENTION OF SSI

10.1. Preoperative measures:

- Preoperative bathing should be performed by using either plain soap or antimicrobial soap (CHG 4%)



- Decolonization with mupirocin ointment (2%) is advocated in *Staphylococcus aureus* nasal carriers undergoing cardiothoracic and orthopedic surgeries.
- ESBL: Neither screening for fecal colonization of ESBL carriage nor their decolonization is recommended prior to surgery. Modifying surgical antimicrobial prophylaxis is also not recommended, regardless of local ESBL prevalence.
- Mechanical bowel preparation, along with the use of oral non-absorbable antibiotics (e.g. oral neomycin 1000 mg administered in combination with erythromycin or metronidazole at 2 pm, 3 pm, and 10 pm on the day before the surgery) prior to surgery, can be instituted in patients undergoing elective colorectal surgery with the recommendations of treating Surgeon
- Hair removal: Hair should be removed only with a clipper shortly before surgery or outside the OT. **Shaving by a razor is strongly discouraged.**
- Preoperative scrubbing with 4 % CHG can be done in OT table.
- Enhanced nutritional support is recommended in underweight patients undergoing major surgical operations (oncology and cardiovascular procedures)

10.2. Intraoperative measures:

- Surgical site preparation: Alcohol-based antiseptic (70%) solutions based on chlorhexidine (CHG) (4%) or 10% povidone iodine should be used for surgical site skin preparation.
- Antimicrobial skin sealants: As there is no added advantage, these should not be used after surgical site skin preparation
- Surgical hand preparation by 4% CHG hand scrub or alcohol-based hand rub should be performed inside the OT, before donning the sterile gloves before and in between surgeries.
- Immunosuppressive agents, if going on, should not be discontinued perioperatively
- Perioperative oxygenation of FIO₂ (80%) should be maintained for patients undergoing general anesthesia with endotracheal intubation.
- Perioperative normothermia (36°C) should be maintained for surgical patients (excluding cardiac patients) having anaesthesia duration of >60 min
- Perioperative blood glucose control (140-200 mg/dL) is essential for both diabetic and non-diabetics.



- Perioperative normovolemia must be maintained by goal-directed fluid therapy (colloid or crystalloid) to prevent tissue hypoxia
- Drapes and gowns (disposable or reusable) should be used over the surgical site. Changing of drapes or gowns in the course of a surgical operation or use of plastic adhesive incise drapes are not recommended.
- Incisional wound irrigation can be performed with an aqueous povidone-iodine solution for clean and clean-contaminated wounds. Irrigation with antibiotic solution is not recommended.
- Prophylactic negative pressure wound therapy should be used in patients on primarily closed surgical incisions in high-risk wounds.
- Surgical gloves are for single use and should not be reused. Intraoperative changing of gloves is not required unless when perforated or damaged. Double-gloving is recommended by IDSA and SHEA.
- Changing surgical instruments used in contaminated (colorectal surgery) surgeries with a new sterile set before wound closure is a common practice. However, WHO does not formulate any recommendations due to lack of evidence.
- Antimicrobial-coated sutures: IDSA is against the use of Triclosan-coated sutures as a strategy to prevent SSI. However, Surgeon shall decide on its usage on case to case basis.
- Ventilation systems in OT: A conventional airflow system is used for most surgeries. Eg. Laminar flow system may be used during arthroplasty surgery.

10.3. Post-operative measures:

- Surgical dressings: perioperative wound dressing is necessary. Advanced wound dressing (e.g., Hydrocolloid or hydrogels or polyurethane matrix hydrocolloid) shall be used for special situation as per the surgeon's recommendations.
- Drain removal: presence of drain in-situ is not an indication to continue post-operative antibiotic prophylaxis. Wound drain can be removed only when clinically indicated



XI. CHECKLISTS FOR SSI CARE BUNDLE

| Components of SSI bundle | Compliance |
|---|------------|
| Preoperative | |
| Preoperative bathing | |
| Screening for <i>S.aureus</i> | |
| Hair removal not done or removed by clipper | |
| Surgical antimicrobial prophylaxis | |
| • Right choice | |
| • Right timing | |
| • Right dosage | |
| • Right frequency | |
| Peri - operative | |
| Surgical site skin preparation - Antiseptics (4% Chlorhexidine) + Alcohol (70%) | |
| Hand scrub before and in – between cases | |
| Oxygenation of FiO ₂ (80 %) | |
| Normothermia (36° C) | |
| Blood glucose (140-200 mg / dL) | |
| Normovolemia | |
| Post - operative | |
| Surgical dressing | |
| Hand hygiene | |

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