

Surgical Wound Infection

Ebtesam Mohammed Alahmari, Roaa Fahad Alshabanah, Tahani Saeed Almohayya,
Norah Ibraheem Almanie, Reem Ali Almanie, Amal Nasser Alqahtani,
Sarah Saeed Alshahrani, Amjaad Saleh Aljelban

King Khalid Univerity, Abha, Saudi Arabia

Corresponding Author: Ebtesam Mohammed Alahmari, e.m.m.1993@hotmail.com

ABSTRACT

Surgical wound infections prompt antagonistic patient results, including delayed hospitalization and demise. Wound infection happens with every entry point, however demonstrated procedures exist to diminish the hazard of surgical injury diseases. Specifically, enhanced adherence to prove that based deterrent measures identified with fitting antimicrobial prophylaxis can diminish the rate of surgical wound infection. Various patient-related and technique related components impact the danger of surgical injury disease, and henceforth counteractive action requires a package approach, with deliberate consideration regarding numerous hazard factors, to diminish the hazard of bacterial pollution and enhance the patient's defences. Forceful surgical debridement and successful antimicrobial treatment are expected to enhance the treatment of surgical wound infections.

Keywords: Surgical wound infections, prophylaxis, Risk, antimicrobial.

INTRODUCTION

Infection at or near surgical notches within 30 days of an operative process, named surgical site infection, adds considerably to surgical morbidity and mortality every year. Surgical site infection (SSI) represents for 15% of every single nosocomial disease and, amid surgical patients, signifies the most widely recognized nosocomial infection ^[1]. Postsurgical infection prompts expanded length of postoperative hospital stay, radically raised cost, higher rates of hospital readmission, and risked wellbeing results. In view of that, the initial phase in the treatment of SSIs is in their avoidance. This includes careful operative procedure, timely administration of appropriate preoperative antibiotics, and an assortment of preventive measures directed at neutralizing the danger of bacterial, viral, and fungal infection posed by operative staff, the operating room environment, and the patient's endogenous skin flora. It is this last phase of contamination, and particularly mechanical strategies for aversion.

SSIs are allied not only with increased morbidity but also with considerable mortality. In a study, 77% of the deaths of surgical patients were allied to surgical wound infection ^[2]. Kirkland et al ^[3] considered a comparative hazard of death of 2.2 attributable to SSIs, in contrast with corresponding surgical patients without infection. Every single surgical wound are polluted by microorganisms, nevertheless in most cases, infection does not improve because innate host defenses are quite efficient in the elimination

of contaminants. A composite interaction between host, microbial, and surgical factors ultimately decides the counteractive action or foundation of a wound infection.

Microbiology

Microbial variables that impact the foundation of a wound infection are the bacterial inoculum, harmfulness, and the impact of the microenvironment. At the point when these microbial elements are favorable, weakened host protections set the phase for ordering the chain of occasions that create wound contamination. Most surgical site infections (SSIs) are contaminated by the patient's own endogenous flora, which are existent on the skin, mucous membranes, or hollow viscera. The customary microbial concentration mentioned as being highly allied with SSIs is that of bacterial counts greater than 10,000 organisms per gram of tissue (or on account of burned sites, organisms per cm² of wound) ^[4]. The typical pathogens on skin and mucosal surfaces are gram-positive cocci (remarkably staphylococci); be that as it may, gram-negative aerobes and anaerobic bacteria taint skin in the perineal ranges. The tainting pathogens in gastrointestinal surgery are the huge number of inherent entrail greenery, which incorporate gram-negative bacilli (eg, *Escherichia coli*) and gram-positive microorganisms, including enterococci and anaerobic life forms ^[5] (Figure 1).

Surgical Wound Infection

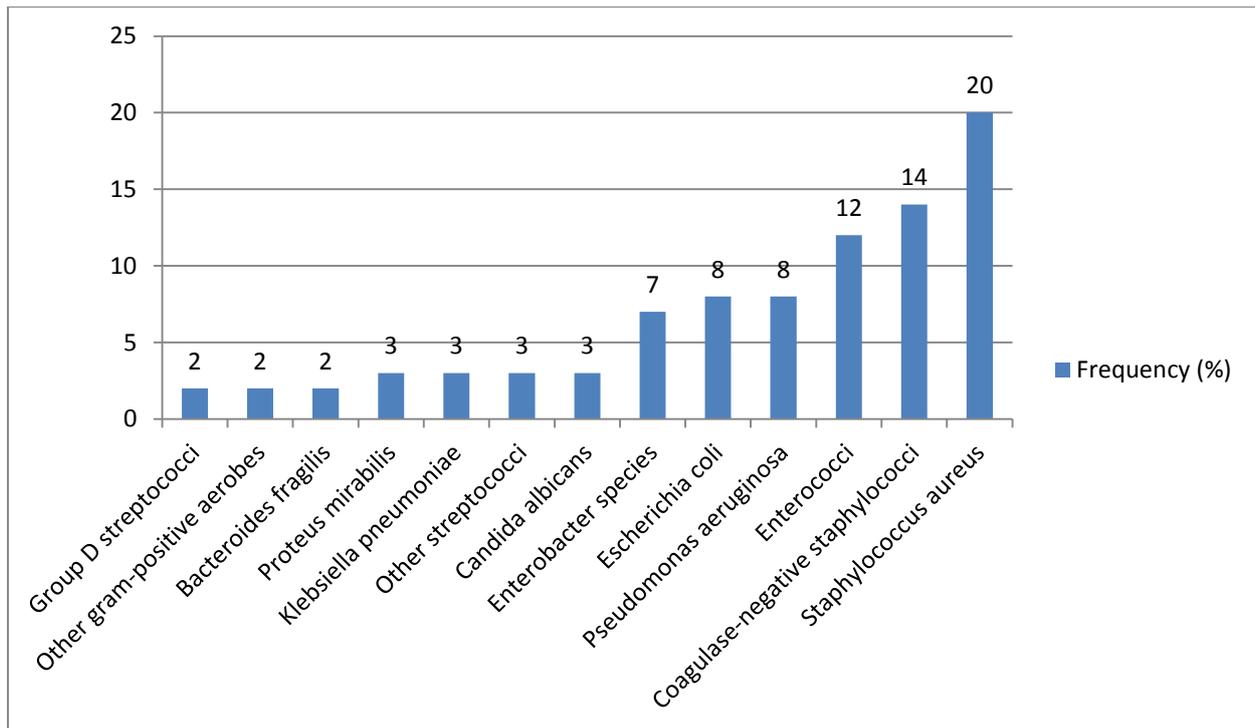


Figure 1: Pathogens Usually Allied with Wound Infections and Frequency of Incidence.

The group of microorganisms most usually in charge of SSIs are *Staphylococcus aureus* strains. The development of resistant strains has extensively expanded the weight of morbidity and mortality related with wound infections. Gram-positive organisms, especially staphylococci and streptococci, represent most exogenous flora associated with SSIs. Sources of such pathogens incorporate surgical/healing center work force and intraoperative conditions, including surgical instruments, articles gotten into the operative field, and the working room air. Methicillin-resistant *Staphylococcus aureus* (MRSA) is evidencing to be the scourge of today's surgery. Like different strains of *S. aureus*, MRSA can colonize the skin and body of a person without causing disorder, and along these lines, it can be passed on to other persons mistakenly. Issues emerge in the treatment of clear contaminations with MRSA on the grounds that anti-infection decision is extremely constrained. MRSA contaminations have all the earmarks of being expanding in recurrence and are showing imperviousness to a more extensive scope of antibiotics^[6]. Of specific concern are the vancomycin intermediate *S. aureus* (VISA) strains of MRSA. These strains are starting to create imperviousness to vancomycin, which is at present the best anti-toxin against MRSA. This new resistance has emerged on the grounds that

other types of microorganisms, called enterococci, moderately usually express vancomycin resistance.

Hazard causes other than microbiology

Reduced host resistance can be due to systemic causes affecting the patient's curative reaction, local wound features, or operational characteristics, as follows:

- Systemic causes - Age, diabetes, hypovolemia, steroids, obesity, malnutrition, poor tissue perfusion, and other immunosuppressants
- Wound features - Nonviable tissue in wound, dead space, foreign material (drains and sutures, hematoma, poor skin preparation (shaving), and pre-existent sepsis (local or distant)
- Operational characteristics - Poor surgical technique; lengthy operation (>2 hours); intraoperative contamination (eg, from infected theater staff and instruments or inadequate theater ventilation), prolonged preoperative stay in the hospital, and hypothermia

The type of procedure is a hazard causes. Particular processes are allied with a higher hazard of wound infection than others. Surgical wounds have been categorized as clean, clean-contaminated, contaminated, and dirty-infected^[5, 7] (Table 1).

Table 1: Surgical Wound Classification and Consequent Hazard of Infection, in case of no antibiotics are used.

Classification	Description	Infective Risk (%)
Clean (Class I)	Uninfected operative wound No acute inflammation Closed primarily Closed drainage used if necessary No break in aseptic technique Respiratory, gastrointestinal, biliary, and urinary tracts not entered	< 2
Clean-contaminated (Class II)	Elective entry into respiratory, biliary, gastrointestinal, urinary tracts and with minimal spillage. No evidence of infection or major break in aseptic technique	< 10
Contaminated (Class III)	Penetrating traumatic wounds < 4 hours Nonpurulent inflammation present Major break in aseptic technique Gross spillage from gastrointestinal tract	Around 20
Dirty-infected (Class IV)	Penetrating traumatic wounds >4 hours Preoperative perforation of viscera Purulent inflammation present	Around 40

Treatment of Wound Infection

Most patients with wound infections are managed in the community. Administration generally appears as dressing changes to enhance curing, which more often not performed by auxiliary goal. Resultant expanded healing facility remain because of surgical site infection (SSI) has been evaluated at 7-10 days, expanding hospitalization costs by 20% [8,9, 10]. Infrequently, assist intercession as wound debridement and ensuing pressing and successive dressing is important to permit recuperating by auxiliary goal. Guidelines for the management of SSI were published in 2014 by the Infectious Diseases Society of America [11] (IDSA), in 2016 by the World Health Organization [12] (WHO), and in 2017 by the Centers for Disease Control and Prevention [13].

Antibiotic Prophylaxis

The utilization of antibiotics was a turning point in the push to forestall wound infection. The idea of prophylactic antibiotics was set up in the 1960s when trial information built up that antibiotics must be in the circulatory framework at a sufficiently high dose at the time of incision to be compelling [14, 15]. It is commonly approved that prophylactic antibiotics are specified for clean-contaminated and contaminated wounds. Antibiotics for unclean wounds are portion of the treatment because infection is recognized already. Clean techniques may be an issue of level headed

discussion. Almost certainly exists with respect to the utilization of prophylactic antibiotics in clean techniques in which prosthetic devices are embedded; infection in these cases would be unfortunate for the patient. Nevertheless, other clean techniques (eg, breast surgery) might involve conflict [16, 17].

Criteria for the use of systemic preventive antibiotics in surgical procedures are as follows:

- Systemic preventive antibiotics should be used in the following cases: A high risk of infection is associated with the procedure (eg, colon resection); consequences of infection are unusually severe (eg, total joint replacements); the patient has a high NNIS risk index
- The antibiotic must be managed preoperatively but as close to the time of the incision as is clinically practical antibiotics must be managed before induction of anesthesia in most situations
- The antibiotic selected ought to have activity against the pathogens likely to be encountered in the procedure
- Postoperative management of preventive systemic antibiotics further than 24 hours has not been confirmed to reduce the risk of SSIs.

Characteristics of prophylactic antibiotics incorporate viability against anticipated bacterial microorganisms destined to cause contamination

Surgical Wound Infection

(Table 3), great tissue infiltration to achieve wound included, cost adequacy, and negligible unsettling influence to intrinsic body flora (eg, gut) ^[18].

The planning of management is fundamentally essential as the concentration of the antibiotic ought to be at therapeutic levels at the time of incision, amid the surgical procedure, and, preferably, for a few hours postoperatively.

Antibiotics are managed intravenously, normally 30 minutes prior to incision ^[19]; they ought not to be managed more than 2 hours prior to surgery. Colorectal surgical prophylaxis also requires bowel clearance with enemas and oral non-absorbable antimicrobial agents 1 hour before surgery ^[18]. High-risk cesarean surgical cases need antibiotic management once the clamping of the umbilical cord is completed ^[5].

Table 2: Recommendations for Prophylactic Antibiotics ^[5, 19]

Operation	Expected Pathogens	Recommended Antibiotic
Gastroduodenal surgery	Gram-negative bacilli and streptococci	Cefazolin 1-2 g
Appendectomy, biliary procedures	Gram-negative bacilli and anaerobes	Cefazolin 1-2 g
Colorectal surgery	Gram-negative bacilli and anaerobes	Cefotetan 1-2 g or cefoxitin 1-2 g plus oral neomycin 1 g and oral erythromycin 1 g (start 19 h preoperatively for 3 doses)
Urology procedures	Gram-negative bacilli	Cefazolin 1-2 g
Vascular surgery	<i>S aureus</i> , <i>Staphylococcusepidermidis</i> , gram-negative bacilli	Cefazolin 1-2 g
Obstetric and gynecological procedures	Gram-negative bacilli, enterococci, anaerobes, group B streptococci	Cefazolin 1-2 g
Orthopedic surgery (including prosthesis insertion), cardiac surgery, neurosurgery, breast surgery, noncardiac thoracic procedures	<i>S aureus</i> , coagulase-negative staphylococci	Cefazolin 1-2 g
Colorectal surgery	Gram-negative bacilli and anaerobes	Cefotetan 1-2 g or cefoxitin 1-2 g plus oral neomycin 1 g and oral erythromycin 1 g (start 19 h preoperatively for 3 doses)
Head and neck surgery	<i>S aureus</i> , streptococci, anaerobes and streptococci present in an oropharyngeal approach	Cefazolin 1-2 g

Hazard Assessment

The current hazard index used to forecast the hazard of increasing a wound infection is the NNIS system of the CDC [5]. The hazard index category is recognized by the added total of the hazard causes present at the time of surgery. For each hazard cause existent, a point is allocated; hazard index values range from 0-3. This hazard index is a better predictor for SSIs (Table 3) than the surgical wound classification is [20] (Table 1).

Table 3: Predictive Percentage of SSI Occurrence by Wound Type and Hazard Index* [20]

Hazard Index	Predictive Percentage of SSI
0	1.5
1	2.9
2	6.8
3	13

*Hospital Infection Control Practices Advisory Committee (HICPAC) recommendations (partial) for the prevention of SSIs, April 1999 (non-drug based)

The NNIS risk index integrates the three main determinants of infection—namely, bacteria, local environment, and systemic host defences (patient health status). The hazard index does not contain other hazard factors, like smoking, tissue oxygen tension, glucose control, shock, and maintenance of normothermia. All these factors are relevant for clinicians but difficult to monitor and fit into a manageable hazard assessment.

The elements constituting this index are as follows:

- Preoperative patient physical status evaluated by the anesthesiologist and categorized by the American Society of Anesthesiologists (Table 4) as more than 3
- Operation status as either contaminated or dirty-infected (Table 2)
- Operation lasting longer than T hours, where T is the 75th percentile of the specific operation performed.

Table 4: American Society of Anesthesiologists (ASA) Classification of Physical Status [21]

ASA Score	Characteristics
1	Normal healthy patient
2	Patient with mild systemic disease
3	Patient with a severe systemic disease that limits activity but is not incapacitating
4	Patient with an incapacitating systemic disease that is a constant threat to life
5	Moribund patient not expected to survive 24 hours with or without operation

Preoperative patient preparation

Category IA recommendations for preoperative patient preparation include the following:

- Identify and treat all infections remote from the surgical site; delay operation in elective cases until infection is treated
- Do not remove hair unless it infringes on the surgical field; if hair removal is required, it should be removed immediately before operation and preferably with electric clippers

Category IB recommendations include the following:

- Patients ought to cease tobacco consumption in any form for at least 1 month preoperatively
- Enhance blood glucose level and avoid hyperglycemia
- Patients are to shower/bathe with antiseptic on at least the night before surgery
- Required blood products may be managed

The category II recommendation is as follows: Provided that preoperative patient preparation is adequate, minimize preoperative hospital stay.

No recommendations are made regarding the following:

- Gradual reduction/discontinuance of steroid use before elective surgery
- Improved nutritional intake solely to prevent SSI
- Preoperative topical antibiotic use in nares to prevent SSI
- Measures to improve wound space oxygenation

CONCLUSIONS

Strategies went for counteractive action of disease in the operating room have fluctuating levels of information to substantiate their practice, sometimes screened by solid randomized, controlled trials demonstrating clear advantage,

while in others spread through legend or presence of mind. In any case, attention to the vital ramifications of SSI for understanding wellbeing and expenses of nurture any specialist, and surveilling one's own practices in the operating room regarding the current literature is an essential stride in monitoring infection and amplifying advantageous results.

REFERENCES

1. **Watanabe A, Kohnoe S, Shimabukuro R et al. (2008):** Risk factors associated with surgical site infection in upper and lower gastrointestinal surgery. *Surg Today*, 38:404–412.
2. **Mangram A, Horan T, Pearson M et al. (1999):** Guideline for prevention of surgical site infection, 1999. Hospital Infection Control Practices Advisory Committee. *Infect Control Hosp Epidemiol.*, 20(4):250-78.
3. **Kirkland K, Briggs J, Trivette S et al. (1999):** The impact of surgical-site infections in the 1990s: attributable mortality, excess length of hospitalization, and extra costs. *Infect Control Hosp Epidemiol.*, 20(11):725-30.
4. **Krizek T and Robson M (1975):** Evolution of quantitative bacteriology in wound management. *Am J Surg.* , 130(5):579-84.
5. **National Nosocomial Infections Surveillance (NNIS) System(1996):** NNIS report, data summary from October 1986-April 1996, issued May 1996. A report from the NNIS System. *Am J Infect Control.* , 24(5):380-8.
6. **Hsiao C, Chuang C, Tan H et al.(2012):** Methicillin-resistant *Staphylococcus aureus* ocular infection: a 10-year hospital-based study. *Ophthalmology*,119(3):522-7.
7. **Cruse P, Foord R(1980):** The epidemiology of wound infection. A 10-year prospective study of 62,939 wounds. *Surg Clin North Am.* , 60(1):27-40.
8. **Mahmoud N, Turpin R, Yang G, Saunders W (2009):** Impact of surgical site infections on length of stay and costs in selected colorectal procedures. *Surg Infect (Larchmt)*, 10(6):539-44.
9. **Haley R, Schaberg D, Crossley K et al.(1981):** Extra charges and prolongation of stay attributable to nosocomial infections: a prospective interhospital comparison. *Am J Med.* , 70(1):51-8.
10. **Eagye K, Kim A, Laohavaleeson S et al.(2009):** Surgical site infections: does inadequate antibiotic therapy affect patient outcomes?. *Surg Infect (Larchmt)*, 10(4):323-31.
11. **Stevens D, Bisno A, Chambers H et al.(2014):** Practice guidelines for the diagnosis and management of skin and soft tissue infections: 2014 update by the infectious diseases society of america. *Clin Infect Dis.* , 59(2):e10-52.
12. **Global guidelines for the prevention of surgical site infection. World Health Organization(2016):** Available at <http://apps.who.int/iris/bitstream/10665/250680/1/9789241549882-eng.pdf?ua=1>.
13. **Berriós-Torres SI, Umscheid CA, Bratzler DW et al. (2017):** Healthcare Infection Control Practices Advisory Committee. Centers for Disease Control and Prevention Guideline for the Prevention of Surgical Site Infection. *JAMA.* , 152(8):784-791.
14. **Burke J (1961):** The effective period of preventive antibiotic action in experimental incisions and dermal lesions. *Surgery*, 50:161-8.
15. **Barchitta M, Matranga D, Quattrocchi A et al. (2012):**Prevalence of surgical site infections before and after the implementation of a multimodal infection control programme. *J Antimicrob Chemother.*, 67(3):749-55.
16. **Gupta R, Sinnott D, Carpenter R et al.(2000):** Antibiotic prophylaxis for post-operative wound infection in clean elective breast surgery. *Eur J Surg Oncol.* , 26(4):363-6.
17. **Platt R, Zucker JR, Zaleznik DF et al. (1993):** Perioperative antibiotic prophylaxis and wound infection following breast surgery. *J Antimicrob Chemother.* , 31 (B):43-8.
18. **Woodfield JC, Beshay N, van Rij AM(2009):** A meta-analysis of randomized, controlled trials assessing the prophylactic use of ceftriaxone. A study of wound, chest, and urinary infections. *World J Surg.* , 33(12):2538-50.
19. **Woods RK, Dellinger EP(1998):** Current guidelines for antibiotic prophylaxis of surgical wounds. *Am Fam Physician.* , 57(11):2731-40.
20. **Culver DH, Horan TC, Gaynes RP et al. (1991):**Surgical wound infection rates by wound class, operative procedure, and patient risk index. National Nosocomial Infections Surveillance System. *Am J Med.* , 91(3B):152S-157S.