Volume 3, Issue 8, 2025

Frontier in Medical & Health Research

ISSN: (e) 3007-1607 (p) 3007-1593

CLASSIFICATION, RISK FACTORS AND PREVENTIVE STRATEGIES OF SURGICAL SITE INFECTIONS

Hirra Rizvia[1], Atifa Parveen[*2], Laraib Manzoor[3], Asma Saleh[4], Misbah Saleem[5], Samara Shaukat[6]

[1,*2,3]*Afro Asian Institute Affiliated with GCUF*
[4]*Begum Akhtar Rukhsana Memorial Trust Hospital, Lahore*
[5]*Prime Health Services, Lahore*
[6]*Superior University Lahore*

[1]rizvihira39@gmail.com, [*2]hafizaatifa320@gmail.com, [3]laraibmanzoor13@gmail.com, [4]asmasaleh924@gmail.com, [5]misbahsaleem1007@gmail.com, [6]samara.shaukat@superior.edu.pk

DOI: https://doi.org/10.5281/zenodo.17349984

Keywords
Surgical Site Infection, Infection, Surgery, Hospital, Patient, Incision, Medical, Antibiotic prophylaxis, HCIs (Healthcare Associated Infection)

Article History
Received: 24 August 2025
Accepted: 02 October 2025
Published: 14 October 2025

Corresponding Author: * Atifa Parveen

Abstract

This article provides a comprehensive examination of Surgical Site Infections (SSIs), encompassing their categorization, types, microbiology, epidemiology, and associated hazards. We highlight the importance of optimal prophylactic antibiotic administration, non-pharmacological strategies, and innovative "active" devices in minimizing SSI incidence. Effective patient preparation and meticulous care before and after surgery are crucial, as they significantly impact the risk of developing SSIs. The article explores various factors contributing to SSI risk, including patient health, pre-surgical preparation, and antibiotic prophylaxis. Furthermore, adherence to established surgical guidelines for perioperative care by surgeons can substantially mitigate patient risk of developing SSIs, this in turn yields better health outcomes, reduced medical expenses, and a more efficient healthcare framework.

INTRODUCTION

Surgical Site Infections (SSIs) occur when the surgical site becomes infected, posing serious risks. The CDC distinguishes between two main types of SSI: incisional, which affects the surgical incision, and organ space, which involves internal organs or spaces. Incisional SSI is further categorized into superficial, affecting skin and subcutaneous tissue, and deep, extending into deeper tissues, including muscle and fascial layers (1).

A patient safety crisis is evident in hospitals, where roughly 1 in 150 hospitalized patients die from preventable adverse events, with nearly two-thirds of these incidents tied to surgical care. This results in extended hospital stays, with an average increase of 7-10 days, and substantial additional healthcare expenditures, estimated at $20,000 per patient. The occurrence of SSIs can be linked to various factors, including inadequate preoperative skin preparation, suboptimal surgical techniques, contaminated

Frontier in Medical & Health Research

ISSN: (e) 3007-1607 (p) 3007-1593

instruments or equipment, and inadequate postoperative wound management. To combat this, healthcare providers must prioritize evidence-based preventive measures, including rigorous hand hygiene and antibiotic prophylaxis, to minimize the risk of SSIs and enhance patient outcomes (2).

The prevalence of Surgical Site Infections (SSIs) among surgical patients in the US is a major concern, contributing substantially to healthcare-associated morbidity, mortality, and costs. Surgical site infections (SSIs) are associated with a significantly increased risk of mortality, with studies suggesting a 2-11 times higher likelihood of death. Moreover, a staggering 77% of these fatalities are directly attributable to the SSI itself, highlighting the profound impact of these infections on patient outcomes and the need for effective prevention and treatment strategies (3).

Despite advances in infection control and surgical practices, surgical-site infections (SSIs) persist as a significant source of patient harm and healthcare burden. Ongoing vigilance is crucial to reduce the occurrence of these infections. A comprehensive and systematic approach is necessary, focusing on addressing the various risk factors associated with the patient, surgical procedure, and hospital environment, to minimize the incidence of SSIs and mitigate their impact on healthcare resources(4).

Most surgical wounds are colonized with microorganisms, but the immune system typically prevents them from causing infection. The chance of developing a surgical site infection (SSI) depends on three key factors: the type of harmful bacteria present, individual patient characteristics, and aspects of the surgical procedure. Notably, the most of SSIs are caused by bacteria that are typically present on the skin surface, highlighting the importance of proper wound care and infection prevention measures (5).

The skin's native microbial population, predominantly gram-positive organisms like S. aureus, is the leading cause of surgical site infections (SSIs). However, gram-negative bacteria may also contribute to SSIs, especially following surgical procedures involving the intestines. Incidence studies may underestimate SSIs since many cases occur after hospital discharge. Therefore, it's crucial to take measures to minimize the risk of infection across the entire surgical continuum. This includes preoperative patient preparation, such as skin decolonization and antibiotic prophylaxis, as well as healthcare worker preparation like hand hygiene and proper attire during surgery, sterile technique, antibiotic prophylaxis, and minimizing tissue trauma are essential. Postoperatively, proper wound care and dressing, monitoring for signs of infection, and antibiotic stewardship are vital to reducing the risk of SSIs and improving patient outcomes (6).

The development of Surgical Site Infections (SSIs) is influenced by three categories of factors: patient-related health status, environmental factors where facilities offering surgical treatment, and clinical measures that augment patient risk factors. To minimize susceptibility to infection, specifically in surgeries with increased bacterial exposure, careful patient selection and preparation are crucial. The prevention of these infections involves a multifaceted approach that includes the strategic use of antibiotic prophylaxis, among other evidence-based measures. This targeted approach to antibiotic is aimed at lowering the risk of SSIs by administering antibiotics at critical moments, such as immediately before surgical incision, during prolonged procedures, or in cases where patients have compromised immune systems or other risk factors. By leveraging antibiotic prophylaxis in a judicious and evidence-based manner, healthcare providers can significantly minimize the incidence of SSIs, promote optimal patient outcomes, and reduce the overall burden on healthcare systems. However, antibiotics should not replace meticulous surgical technique and attention to detail, as their overuse can lead to a higher risk of hospital-acquired infections (7).

Surgical site infections (SSIs) have severe consequences, including significant patient morbidity, extended hospital stays, and increased healthcare costs. These factors not only affect patients and hospitals but also impose a substantial economic burden on the US healthcare system. Surgeons and hospitals must prioritize the prevention of Surgical Site Infections (SSIs) to guarantee a safe and sterile environment for surgical patients (8).

SSIs are a dominant factor in HAIs, causing notable patient suffering and adverse outcomes. While some infections can be mild, others can be life-threatening. The good news is that many SSIs can be prevented through a team-based approach, involving close collaboration among healthcare professionals,

Frontier in Medical & Health Research

ISSN: (e) 3007-1607 (p) 3007-1593

including surgeons, nurses, anaesthesiologists, and infection prevention experts. By working together, we can implement effective prevention strategies and significantly reduce the risk of SSIs (9).

The surgical team, comprising surgeons, support staff, and medical experts, is committed to providing a secure and hygienic environment for patients, striving to lower the incidence of surgical site infections. Every individual in the operating room is focused on adhering to strict protocols and best practices to minimize infection risks and deliver optimal care (10).

METHODOLOGY:

SURGICAL SITE INFECTIONS:

"Surgical Site Infections (SSIs) are defined as infections that occur within 30 days post-operatively (or up to 1 year for implant-related surgeries) and involve either the incisional site or deep tissue at the surgical site."

CLASSIFICATION OF SURGICAL SITE IFECTION:

We classify the surgical site infection into three types:

Superficial SSIs:

- Involve the skin and subcutaneous tissue only.
- Typically cause symptoms like redness, swelling, warmth, and drainage at the incision site.
- Usually treatable with antibiotics.

Deep SSIs:

- Involve tissues under the skin, such as fascia and muscle.
- Can cause more severe symptoms like fever, chills, and increased pain at the incision site.
- May require surgical drainage or debridement (removal of infected tissue).

Organ/space SSIs:

- Involve organs or spaces other than the incision site, such as the urinary tract, respiratory tract, or implanted material (e.g., joint replacements, surgical meshes).
- Can be life-threatening and require prompt medical attention.
- May require surgical intervention, antibiotics, or other targeted treatments (Spagnolo, 2013 #2339).

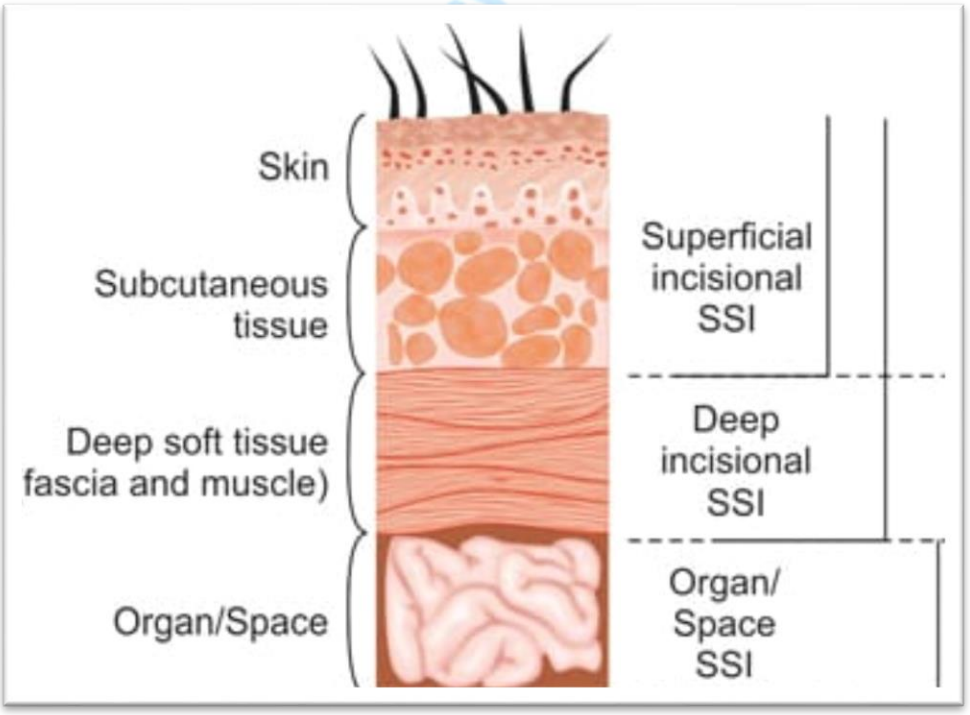

FIGURE 2.1 Categorization of Surgical Site Infections

Frontier in Medical & Health Research

ISSN: (e) 3007-1607 (p) 3007-1593

CLASSIFICATION ON THE BASIS OF INCISIONS:

I. SUPERFICIAL INCISIONAL SSI:

A superficial incisional SSI is defined as:

"An infection occurring during the first 30 days of surgery, confined to the skin or subcutaneous tissue of the incision".

Must have one of the following criteria:

- Purulent discharge (pus) from the superficial incision.
- Microorganisms are identified from a culture taken from the superficial incision.

Having one or more following signs or symptoms:

- Redness
- Swelling
- Warmth
- Tenderness or pain
- Swollen lymph nodes
- Fever (>38°C or 100.4°F)

These criteria help healthcare professionals diagnose superficial incisional SSIs and initiate appropriate treatment to prevent complications and promote optimal patient outcomes.(11).

II. DEEP INCISIONAL SSI:

A deep incisional SSI is defined as:

"An infection that develops during 30 days of surgery if no implant is present, or during 1 year (365 days) of surgery if an implant is present and the infection is surgery-related."

To diagnose a deep incisional SSI, must have one of the following criteria:

- The deep incision is surgically reopened and pus or other signs of infection are discovered.
- Pus or discharge is seen in the deep incision, excluding organ/space drainage.
- A culture of fluid or tissue from the deep incision yields a microorganism

The patient exhibits signs or symptoms such as:

- Fever (>38°C or 100.4°F)
- Localized pain or tenderness
- Swelling or redness
- Warmth or swelling

Other clear indications are detected through methods such as:

- Direct examination
- Secondary operation
- Histopathologic examination (microscopic examination of tissue)
- Radiologic examination (imaging studies like CT scans, MRI, or ultrasound) (Isik, Kaya, Dundar, & Sarkut, 2015).

III. ORGAN/ SPACE INCISIONAL SSI:

Organ/Space SSI is characterized by:

"Involvement of any anatomical structure, such as organs or spaces that were opened or manipulated during surgery, excluding the incision site".

Organ/Space SSIs can involve various internal areas, including:

- Organs (e.g., lungs, liver, spleen)
- Spaces (e.g., pleural, peritoneal, joint)
- Implanted material (e.g., prosthetic joints, surgical meshes

To diagnose an Organ/Space SSI, must have one of the following criteria:

- Discharge or pus is observed in the fluid being drained that has been inserted into the organ or space.
- Microorganisms that are detect through a culture obtained in a sterile manner from the affected organ or space.

Further indications within the organ or space are identified through:

- Direct inspection
- Further surgical intervention
- Histopathological examination (microscopic examination of tissue)
- Radiological evaluation (imaging studies like CT scans, MRI, or ultrasound)

Surgical site infections remain a critical concern in healthcare, contributing to both increased mortality and morbidity rates. Advances in surgery and infection control have not eliminated the significant healthcare burden of these infections. It is imperative that we maintain constant vigilance to minimize the occurrence of such infections.

To effectively combat surgical site infections, a systematic approach is necessary. This approach requires a comprehensive evaluation of the individual risk factors specific to each patient (12).

Frontier in Medical & Health Research

ISSN: (e) 3007-1607 (p) 3007-1593

RISK FACTORS OF SSIs:

The likelihood of developing SSIs differs substantially based on the surgical procedure and the patient's unique clinical profile. Studies have pinpointed crucial factors, both inherent to the patient (endogenous) and related to the procedure (exogenous), that impact the risk of SSI.

Factors related to the patient that increase the risk of SSI are:

- Malnutrition
- Older age
- Coexistent infection

External factors that increase the risk of SSI are:

I.Procedure-related factors:

- Type of operation
- Operation time
- Surgeon's qualifications and experience

II.Preoperative factors:

- Effectiveness of pre-surgery skin cleansing
- Optimal timing and selection of antimicrobial prophylaxis

III.Intraoperative factors:

- Implantation of foreign bodies or materials
- Lack of proper sterilization of surgical devices

IV.Environmental factors:

- Operating theatre quality, including:
- Ventilation and air quality
- Temperature and humidity control
- Cleaning and disinfection practices
- Sterilization and disinfection of equipment and surfaces

These external factors can significantly impact the risk of SSIs, and addressing them is crucial for preventing infections and promoting optimal patient outcomes. Understanding these risk factors is essential for developing effective strategies to prevent SSIs and improve patient outcomes (Spagnolo, 2013 #2340).

"TABLE 2.1" RISK FACTORS THAT ARE ASSOCIATED WITH PATIENTS AND PROCEDURE.

PATIENT-RELATED	PROCEDURE-RELATED
Age	Duration of surgical scrub
Nutritional status	Skin antisepsis
Diabetes	Preoperative shaving
Smoking	Preoperative skin preparation
Obesity	Duration of operation
Coexistent infection at a remote body site	Antimicrobial prophylaxis
Colonisation with micro-organisms	Operating room ventilation

EPIDEMIOLOGY OF SURGICAL SITE INFECTIONS:

The epidemiology of Surgical Site Infections (SSIs) is complicated and multifaceted, characterized by a broad range of incidence rates that fluctuate significantly depending on various factors, including:

- Type of surgical procedure
- Hospital setting and quality of care
- Surgeon's expertise and experience
- Patient's underlying health conditions and risk factors.

To gather comprehensive data on SSIs, the United States (CDC) enforced the National Nosocomial Infections Surveillance (NNIS) system. Through this system, data that gain from multiple healthcare facilities across the country is collected and analysed. According to the CDC NNIS system, SSIs rank as the 3rd most commonly reported category of nosocomial infection. Nosocomial infections refer to infections acquired during a patient's stay in a healthcare facility. European data indicate SSI incidence may reach up to 20%, depending on procedure, surveillance criteria, and data quality. However, minimally invasive surgery has led to decreased SSI rates, with laparoscopic

Frontier in Medical & Health Research

ISSN: (e) 3007-1607 (p) 3007-1593

procedures showing lower rates than open procedures in cholecystectomy (1.1% vs 4%) and acute appendicitis (2% vs 8%).

Minimally invasive surgery is associated with a reduced risk of Surgical Site Infections (SSIs) due to decreased tissue trauma from smaller incisions, which leads to expedited postoperative mobilization, reducing immobility-associated risks. Additionally, minimized postoperative pain lowers the need for invasive analgesic interventions, and preservation of immune homeostasis maintains optimal host defense mechanisms. Furthermore, reduced utilization of central venous catheters decreases the risk of catheter-associated bloodstream infections. These factors collectively contribute to a lower incidence of SSIs in minimally invasive surgical procedures (Baker, 2016 #3).

HEALTHCARE RESOURCES BURDEN OF SSIs:

SSIs pose a major clinical challenge, resulting in severe patient outcomes and increased risk of adverse effects, disproportionately impacting those who develop these infections.

Patients are at risk of severe consequences, including:

- Requiring repeat hospitalization
- Needing intensive care unit (ICU) admission
- Facing a higher likelihood of fatal outcomes

A study of 215 matched patient pairs found that SSIs more than doubled the risk of mortality (95% confidence interval), highlighting the significant impact of SSIs on patient outcomes.. This highlights the critical need for effective prevention and management strategies to reduce the incidence of SSIs and mitigate their devastating impact on patient outcomes.

Furthermore, patients who develop SSIs require longer hospital stays. The infected patients with an average hospital stay of 11 days, whereas the uninfected patients with an average hospital stay of 6 days. SSIs contribute an additional median duration of 6.5 days to the hospital stay. This prolonged hospitalization not only affects the patient well-being but also has significant financial implications. Studies have shown that SSIs lead to considerable increases in healthcare costs.

Deep surgical site infections (SSIs) that involve organs or body spaces lead to significantly extended hospital stays and higher healthcare expenses compared to SSIs limited to the incision site (Baker, 2016 #3).

MICROBIOLOGY:

The primary cause of Surgical Site Infections (SSIs) is the introduction of microorganisms into the surgical wound during the operation.

Infection control teams perform thorough investigations to identify the potential sources and modes of transmission, which is crucial in understanding whether there are any specific factors contributing to the outbreak and implementing appropriate preventive measures. These investigations help to determine the root cause of the SSI outbreak, identify factors that contributed to it, and develop targeted strategies to prevent future SSIs, ultimately promoting a safe surgical environment (13).

FACTORS EXAMINATION DURING THE INVESTIGATION:

During the investigation of a Surgical Site Infection (SSI), the team examines the following factors:

- The medical background of patient, comprising existing health conditions, past infections, and current medications.
- The surgical procedure performed, including the type of surgery, duration, and surgical technique.

The operating room environment, including:

- Temperature and humidity control
- Ventilation and air quality
- Cleaning and disinfection practices
- Sterilization and disinfection of equipment and surfaces

The origin of the microorganisms responsible for the SSI, including:

- Endogenous sources (patient's own microbial population)
- Exogenous sources (external sources, such as contaminated instruments, equipment, or healthcare worker's hands)

These factors help the team identify potential causes of the SSI and implement measures to prevent future infections.

Frontier in Medical & Health Research

ISSN: (e) 3007-1607 (p) 3007-1593

EXTERNAL SOURCES:

External sources of pathogens can include

- The atmosphere inside the surgical suite
- Medical equipment
- Prosthetics
- Surgical gloves or perioperative medications

The team conducts a thorough review of the potential sources to identify any lapses in sterile technique, instrument contamination, or inadequate disinfection practices that may have contributed to the SSI. Once the investigation identifies the sources and modes of transmission, the team can implement targeted preventive measures, such as:

- Reinforcing adherence to infection control protocols
- Enhancing sterilization procedures
- Improving air quality within the operating room
- Conducting additional staff training on aseptic techniques

These measures aim to strengthen the infection control practices and reduce the risk of future SSIs. The team's meticulous investigation and implementation of corrective actions help ensure a safer surgical environment for patients.

Effective communication and education are crucial in managing the risk of infections . By informing and educating both healthcare staff and patients about the outbreak and implemented preventive measures, healthcare facilities can ensure that everyone involved is aware of the situation and understands their role in preventing future infections. This promotes a culture of safety and accountability, fosters collaboration, and encourages adherence to infection control protocols. Continuous monitoring, strict adherence to protocols, and ongoing education are essential for maintaining a safe surgical environment and reducing the risk of SSIs. By prioritizing these elements, healthcare facilities can identify potential issues promptly, implement targeted corrective actions, and sustain long-term improvements in infection control practices, ultimately protecting patients, healthcare workers, and the broader community from the risks associated with SSIs (14).

TABLE 2.3 CDC Identifies Top 10 SSI-Causing Pathogens in Hospitals

Pathogen	Percentage of Infections (%)
S aureus	20
Coagulase-negative staphylococci	14
Enterococci	12
Pseudomonas aeruginosa	8
Escherichia coli	8
Enterobacter species	7
Proteus mirabilis	3
Streptococci	3
Klebsiella pneumoniae	3
Candida albicans	2

METHODS FOR SURVEILLANCE OF SSI:

DIRECT METHOD:

The most accurate method for monitoring surgical site infections is the direct observation approach, which involves:

- Regular evaluation of the surgical site by a trained healthcare expert (such as a doctor, nurse practitioner, registered nurse, or infection prevention and control specialist) beginning 24 to 48 hours after surgery.

Frontier in Medical & Health Research

ISSN: (e) 3007-1607 (p) 3007-1593

Despite being regarded as the most reliable approach for research purposes, this method is rarely utilized in real-world practice due to:

- Requires a high level of resources, making it unsustainable in many situations.
- Proves impractical in real-world settings due to its complexity and demands.

INDIRECT METHOD:

The indirect method of SSI surveillance involves a multi-faceted approach, including:

I. **Record Review:**
- Patient profiles
- Laboratory test results

II. **Surveys**:
- Operating room staff surveys
- Quality of care surveys

III. **Monitoring for:**
- Unplanned return to the hospital due to postoperative complications.
- Surgical reintervention to address postoperative issues.

IV. **Additional Data Sources:**
- Standardized diagnostic codes
- Standardized procedures codes
- Postoperative summaries
- Microbial treatment orders

This method relies on a combination of these data sources to identify potential SSIs.

ADVANTAGES OF DIRECT METHOD:

The indirect method of SSI surveillance offers several advantages:

- Reduced resource intensity
- Lower costs
- Increased efficiency
- Enhanced feasibility
- Improved scalability
- Minimized disruption to clinical workflows

The most effective components of indirect surveillance include:

- Identifying signs and symptoms documented by nurses
- Analyzing diagnostic codes for related conditions
- Monitoring antimicrobial use that may indicate infection

The limitations of indirect surveillance methods include:

- Unreliability in identifying superficial incisional infections, especially those that develop after patient is discharged (15).

Enhancing SSI Surveillance through Data Integration:

To augment SSI surveillance:

I. **Optimizing hospital data for SSI surveillance:**
- Hospital claims data
- Antimicrobial utilization data
- Review of postoperative outcome data

II. **Implementing an Integrated Surveillance System:**
- Automating culture results data import
- Incorporating operative procedure data
- Standard demographic data

By combining these data sources, a comprehensive surveillance database can be created, improving the detection and monitoring of SSIs.

The Growing Need for Post discharge Surveillance:

Over the past 30 years, significant changes have occurred in surgical care:

- Shift to Outpatient Care: More procedures are performed in ambulatory settings (free-standing or hospital-affiliated).
- Shorter Hospital Stays: The average hospital stay after surgery has shortened.

These leads to emphasize the importance of surveillance after patient discharge:

- Accurately track SSI rates: Without it, SSI rates will be underestimated.
- Improve healthcare delivery and patient safety: Identify opportunities for improvement and prevention of SSIs.

The effectiveness of surveillance after patient discharge varies depending on:

Frontier in Medical & Health Research

ISSN: (e) 3007-1607 (p) 3007-1593

- Techniques of surveillance
- Operative setting
- categories of SSI
- Operative procedure

Challenges in Post discharge Surveillance:

Despite its importance, post discharge surveillance lacks a standardized and reliable method. Current approaches, such as:

- Surgeon and patient questionnaires, low accuracy and precision

Outpatient care environment poses unique challenges:

- **Limited follow-up**: Patients don't return for standard post-surgical follow-up or issue resolution
- **Adapt acute care protocols**: Translate definitions and surveillance protocols to the ambulatory care setting (16).

SSI detection and management vary by setting:

- **Outpatient care:** Superficial surgical site infections (SSIs) are often identified and treated in a clinic or office setting.
-
- **Inpatient care:** More severe SSIs, such as deep incisional or organ/space infections, usually require hospitalization for proper management and treatment. (Anderson, 2014 #8).

Implementation of Post-Discharge Surveillance Increases Reported SSI Rates

Implementing post-discharge surveillance methods often leads to an increase in the overall rate of reported surgical site infections (SSIs) within a healthcare institution due to improved completeness of reporting, regardless of the method used (17) (Kent, 2001 #7) .This suggests that:

- Underreporting occurs without surveillance: SSIs may go undetected or unreported without post-discharge surveillance.
- Surveillance improves accuracy: Post-discharge surveillance methods help capture more accurate SSI rates, leading to an increase in reported rates (Manniën, 2006 #6).

SURGICAL SITE INFECTION PREVENTION:

Surgical Site Infection (SSI) prevention measures are intentional actions or a series of tasks taken to decrease the risk of SSIs. These measures aim to minimize the likelihood of bacterial or pathogenic exposure of the patient's tissues or sterile surgical equipment. Additional complementary measures, such as:

- Administering preventive antibiotic therapy
- Minimizing unnecessary tissue cutting can also help prevent SSIs.

To effectively implement SSI prevention measures, a thorough assessment of various factors is essential, including:

- Patient characteristics (e.g., health status, immune function)
- Specifics of the surgical procedure (e.g., type, duration, complexity)

By considering these factors, healthcare professionals can tailor SSI prevention strategies to individual patients and procedures, maximizing their effectiveness (Hranjec, Swenson, & Sawyer, 2010).

To prevent SSI we take Strategies.

STRATEGIES THAT PREVENT SSIs:

To effectively prevent Surgical Site Infections (SSIs), a multifaceted approach is necessary, focusing on both reducing bacterial contamination and enhancing the patient's immune system to combat infections. This comprehensive "bundle" approach considers various patient-related factors and procedural elements that contribute to SSI risk. Extensive research across diverse clinical settings has consistently shown that this approach significantly reduces SSI rates over a 2-year observation period, demonstrating its efficacy in minimizing SSIs.

The CDC has established evidence-based guidelines to reduce the risk of Surgical Site Infections (SSIs). However, developing these guidelines is a complex task due to the diverse and varied characteristics of Surgical Site Infections (SSIs) make it challenging to apply conclusions drawn from specific patient groups,

Frontier in Medical & Health Research

ISSN: (e) 3007-1607 (p) 3007-1593

like orthopedic surgery patients, to a wider range of patients or settings.. Furthermore, evaluating the effectiveness of certain routine practices, like wearing surgical gloves, may not be feasible due to ethical or logistical constraints, adding to the complexity of guideline development.

Please note that these guidelines aim to provide valuable insights and strategies for preventing SSIs in various healthcare settings.

Strategies include;

- Preoperative Strategies
- Perioperative strategies
- Postoperative Strategies

PRE OPERATIVE STRATEGIES:

Before surgery, preoperative measures aim to reduce patient-specific risks and ensure the surgical team's hands and forearms are thoroughly disinfected. It is crucial to identify and treat any pre-existing infections in areas of the body unrelated to the surgical site. If possible, elective procedures should be deferred until all pre-existing infections have been effectively managed and cleared, minimizing the risk of adverse events and optimizing patient results.

It is recommended to encourage;

- Obese patients to achieve weight loss before undergoing surgery
- Encourage smokers to quit smoking

While acknowledging the challenges of lifestyle changes for many patients, preoperative preparations can reduce the chance of SSIs. Patients can take steps by:

- Using an antiseptic agent to wash or shower the night before surgery
- Ensuring adequate skin cleaning with an antiseptic solution immediately before the procedure

Additionally, removal of hair must be avoided untill necessary, and if its necessary, clippers are used instead of shaving to minimize the risk of skin cuts and subsequent colonization and infection.

To further reduce SSI risk, compact programs of bacterial prophylaxis are commonly employed. However, routine prophylaxis with vancomycin is not recommended (18).

PERIOPERATIVE STRATAGIES:

According to the guidelines provided by the **CDC**, it is crucial to prioritize good surgical technique and aseptic precautions in order to decrease the chance of SSIs.

In order to achieve good surgical technique, several factors must be considered. These includes;

- Maintaining effective hemostasis during the procedure
- Thoroughly removing any devitalized tissue and
- Foreign objects from the surgical site
- Ensuring that there is no dead space left behind.

To prevent the introduction of potential pathogens to the surgical site, it is crucial to use personal protective equipment (PPE) and surgical drapes. This includes:

- Hand coverings (gloves)
- Face coverings (masks)
- Head coverings (caps or hoods)
- Coveralls (gowns)
- Surgical drapes (sterile drapes to cover the patient and surrounding area)

These protective measures create a barrier, significantly reducing the risk of introducing harmful microorganisms into the surgical site. Furthermore, adhering to established guidelines for sterilizing surgical instruments is essential to ensure their proper decontamination and minimize the risk of infection (19).

POSTOPERATIVE STRATAGIES:

Patients remain at risk for Surgical Site Infections (SSIs) for an extended period after surgery, ranging from within a month to up to a year following implant-related surgeries. Notably, a major proportion of SSIs are not identified until after hospital discharge. To minimize this risk, the CDC suggests:

- Protecting primarily closed incisions with sterile dressings for 24 to 48 hours
- Adhering to sterile techniques when changing bandages

By following these guidelines, healthcare personnel can reduce the risk of SSIs and promote optimal postoperative recovery.

Frontier in Medical & Health Research

ISSN: (e) 3007-1607 (p) 3007-1593

Surgical site infections can lead to severe consequences, including:

- Impaired wound healing
- Prolonged hospitalizations
- Increased healthcare costs
- Rarely, life-threatening complications

To mitigate these risks, it is essential to implement rigorous infection control measures, such as:

- Maintaining strict sterile conditions
- Judicious use of antibiotics
- Adherence to established surgical protocols

By following these guidelines, healthcare professionals can significantly reduce the incidence of surgical site infections, ensuring better patient outcomes and safer surgical practices (20).

ELEMENTS CONTRIBUTING TO SSIs:

Surgical Site Infections can occur due to various elements. Some of the common contributing elements include:

- Poor Hand Hygiene
- Contaminated Surgical Equipment
- Inadequate Preoperative Skin Preparation
- Impaired Immune System
- Prolonged Surgical Duration
- Obesity
- Smoking
- Diabetes
- Use of Steroids and Immunosuppressants
- Poor Postoperative Care

USE OF SURGICAL SAFETY CHECKLIST:

Checklists have proven to be a valuable tool for ensuring best practices in various fields, including surgery. In the perioperative setting, the World Health Organization (WHO) surgical safety checklist has been shown to improve surgical outcomes.

The WHO checklist consists of 19 essential items, categorized into three phases:

I. **Sign In**: Pre-operative preparations
II. **Time Out**: Critical safety checks during surgery
III. **Sign Out**: Post-operative procedures

During the Time Out phase, the surgical team verifies crucial details, such as:

- Appropriate administration of prophylactic antibiotics (or confirmation that they were not indicated)

By using this checklist, surgical teams can ensure adherence to best practices, reducing errors and improving patient safety (21).

ADVANCES IN PROPHYLACTIC ANTIBIOTIC USE FOR SURGICAL PATIENTS:

Over the past 20 years, the practice of administering antibiotics before surgery has undergone significant developments. Key improvements include:

- Optimized timing: Refining the timing of initial antibiotic administration
- Targeted antibiotic selection: Choosing the most effective antibiotic agents
- Shorter treatment durations: Minimizing the length of antibiotic administration

These advancements have clarified the benefits of prophylactic antibiotics in reducing postoperative wound infections. A review of historical milestones from the last 40 years provides valuable context for current practices (21)

Historical Background:

Administering preventive antibiotics in surgical procedures sparked intense debate in the 1950s, following the publication of clinical trials. However, these early studies were marred by significant methodological flaws, including:

- Suboptimal timing of initial antibiotic administration
- Prolonged and unnecessary antibiotic use
- Inappropriate selection of antimicrobial agents
- Poor choice of control agents

These errors led to inconclusive and conflicting results, power the controversy surrounding the efficacy of prophylactic antibiotics in surgery (Nichols, 2001 #4).

Optimal Timing of Antibiotic Prophylaxis in Surgery

To maximize surgical site infection prevention, the antibiotic concentration in the patient's tissue should reach its highest level at the moment of incision, when the chance of pathogen entry is greatest. This key principle supports the SCIP guideline, which advises

Frontier in Medical & Health Research

ISSN: (e) 3007-1607 (p) 3007-1593

administering antimicrobial prophylaxis within a 60-minute window before incision for most antibiotics, ensuring optimal protection against infection.

Furthermore, for a standard patient (weighing 70 kg) undergoing a surgery lasting three hours or less, administering the antibiotic within the recommended 60-minute window prior to incision ensures that:

- Tissue antibiotic levels remain optimal: Concentrations stay above the threshold needed to reduce infection risk throughout the procedure.

The connection between preventive antibiotic and SSI risk reduction can be likened to a vehicle's gas tank. Just as a driver fills up the tank before a trip (incision time), the antibiotic concentration in the patient's tissue slowly decreases over time, eventually reaching a level insufficient to prevent SSI (running out of gas).

Standard dosing strategies typically provide enough antibiotic coverage (gas in the tank) for average procedures and patients. However, two scenarios increase the risk of inadequate coverage:

I. Obese patients: Require adjusted dosing due to altered pharmacokinetics.

II. Prolonged surgery: Extended procedure duration depletes antibiotic levels, necessitating additional doses.

To optimize antimicrobial prophylaxis, two supplementary approaches are needed for these specific scenarios (21).

3. CONCLUSION:

Surgical Site Infections (SSIs) significantly impact healthcare, causing substantial mortality, morbidity, and economic burdens due to extended hospital stays and increased costs. Additionally, SSIs result in indirect costs from lost productivity for patients and their families. Despite these challenges, many SSI-related complications are preventable. Research shows that addressing various patient and procedure-related risk factors can significantly reduce SSI risk across different clinical settings. Moreover, innovative solutions like microbial sealants offer promising opportunities to further decrease infection rates and associated healthcare costs. Therefore, evaluating and potentially integrating these technologies into standard clinical practice is crucial to mitigate the burden of SSIs and optimize healthcare outcomes.

4. REFRENCES:

1. Kirby JP, Mazuski JE. Prevention of surgical site infection. Surgical Clinics of North America. 2009;89(2):365-89.
2. Pittet D, Ducel G. Infectious risk factors related to operating rooms. Infection Control & Hospital Epidemiology. 1994;15(7):456-62.
3. Hranjec T, Swenson BR, Sawyer RG. Surgical site infection prevention: how we do it. Surgical infections. 2010;11(3):289-94.
4. Owens C, Stoessel K. Surgical site infections: epidemiology, microbiology and prevention. Journal of hospital infection. 2008;70:3-10.
5. Bagnall NM, Vig S, Trivedi P. Surgical-site infection. Surgery (Oxford). 2009;27(10):426-30.
6. Gould D. Causes, prevention and management of surgical site infection. Nursing Standard (through 2013). 2012;26(47):47.
7. Barie PS. Surgical site infections: epidemiology and prevention. Surgical infections. 2002;3(S1):s9-s21.
8. Barie PS, Eachempati SR. Surgical site infections. Surgical Clinics. 2005;85(6):1115-35.
9. Seidelman J, Anderson DJ. Surgical site infections. Infectious Disease Clinics. 2021;35(4):901-29.
10. Bashaw MA, Keister KJ. Perioperative strategies for surgical site infection prevention. AORN journal. 2019;109(1):68-78.
11. Horan TC, Gaynes RP, Martone WJ, Jarvis WR, Emori TG. CDC definitions of nosocomial surgical site infections, 1992: a modification of CDC definitions of surgical wound infections. Infection Control & Hospital Epidemiology. 1992;13(10):606-8.
12. Gaynes RP. Surveillance of nosocomial infections: a fundamental ingredient for quality. Infection Control & Hospital Epidemiology. 1997;18(7):475-8.
13. Krizek TJ, Robson MC. Evolution of quantitative bacteriology in wound management. The American Journal of Surgery. 1975;130(5):579-84.

Frontier in Medical & Health Research

ISSN: (e) 3007-1607 (p) 3007-1593

14. Dohmen PM. Influence of skin flora and preventive measures on surgical site infection during cardiac surgery. Surgical infections. 2006;7(S1):s13-s7.
15. Ming DY, Chen LF, Miller BA, Sexton DJ, Anderson DJ. The impact of depth of infection and postdischarge surveillance on rate of surgical-site infections in a network of community hospitals. Infection Control & Hospital Epidemiology. 2012;33(3):276-82.
16. Burke JP. Infection control-a problem for patient safety. New England Journal of Medicine. 2003;348(7):651-6.
17. Manian FA. Surveillance of surgical site infections in alternative settings: exploring the current options. American journal of infection control. 1997;25(2):102-5.
18. Korantzopoulos P, Sideris S, Dilaveris P, Gatzoulis K, Goudevenos JA. Infection control in implantation of cardiac implantable electronic devices: current evidence, controversial points, and unresolved issues. Europace. 2016;18(4):473-8.
19. Holman WL, Park SJ, Long JW, Weinberg A, Gupta L, Tierney AR, et al. Infection in permanent circulatory support: experience from the REMATCH trial. The Journal of heart and lung transplantation. 2004;23(12):1359-65.
20. Haley RW, Culver DH, White JW, Morgan WM, Emori TG, Munn vP, et al. The efficacy of infection surveillance and control programs in preventing nosocomial infections in US hospitals. American journal of epidemiology. 1985;121(2):182-205.
21. Anderson DJ. Prevention of surgical site infection: beyond SCIP. AORN journal. 2014;99(2):315.