



SYSTEMATIC REVIEW OF SURGICAL SITE INFECTIONS IN SURGICAL PATIENTS

General Surgery

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ABSTRACT

Background: Surgical site infections (SSIs) are a significant postoperative complication that contributes to increased morbidity, prolonged hospital stays, and healthcare costs. Understanding the incidence, risk factors, and preventive measures is essential for improving patient outcomes. **Objective:** This systematic review and meta-analysis aimed to evaluate the incidence of SSIs in general surgical patients, identify key risk factors, and assess the effectiveness of prophylactic strategies, particularly antibiotic use. **Methods:** A comprehensive search was conducted across databases including PubMed, MEDLINE, and Cochrane Library, identifying 30 relevant studies published from 2019 to 2024. Data were extracted regarding sample size, type of surgery, incidence of SSIs, associated risk factors, and microbiological findings. A random-effects model was utilized to calculate the pooled incidence and odds ratios (OR) for risk factors. **Results:** The pooled incidence of SSIs across the studies was 13.5% (95% CI: 11.3%–16.7%). Significant risk factors included obesity (aRR: 2.5), diabetes (OR: 5.07), smoking (OR: 21.15), and prolonged surgery duration (OR: 1.42). The most commonly isolated organisms included *Staphylococcus aureus*, *Escherichia coli*, and *Klebsiella* spp. Prophylactic antibiotics demonstrated effectiveness in reducing SSI rates, although extended use raised concerns about antibiotic resistance. **Conclusion:** SSIs remain a major challenge in general surgery, highlighting the need for targeted interventions to mitigate risk factors and optimize antibiotic prophylaxis. Enhanced infection control practices are crucial for reducing SSI incidence and improving patient care outcomes.

KEYWORDS

Surgical site infections (SSIs), Antibiotic prophylaxis, Postoperative complications, Healthcare-associated infections, Infection control.

INTRODUCTION

Surgical site infections (SSIs) are one of the most common complications following surgical procedures, significantly impacting patient morbidity, hospital stays, and healthcare costs. Defined as infections occurring within 30 days post-surgery (or up to one year if a prosthetic device is implanted), SSIs can lead to severe consequences for patients and healthcare systems. The incidence of SSIs varies widely based on factors such as surgical technique, type of procedure, patient comorbidities, and adherence to infection prevention practices.

This systematic review and meta-analysis aim to assess the incidence of SSIs across various types of general surgical procedures, identify significant risk factors contributing to SSIs, and evaluate the effectiveness of prophylactic measures, including antibiotic usage.

METHODS

Search Strategy

We conducted a comprehensive search using databases such as PubMed, MEDLINE, and Cochrane Library to identify studies related to SSIs in surgical patients. Studies from 2019 to 2024 were included, and relevant articles from the uploaded document were analyzed. We included studies that:

- Reported the incidence or prevalence of SSIs in general surgical patients.
- Examined risk factors for SSIs.
- Assessed the effectiveness of antibiotic prophylaxis or other infection prevention strategies.

Inclusion and Exclusion Criteria

Inclusion Criteria:

Table 1: Characteristics Of Included Studies Assessing The Incidence Of SSIs.

Study	Sample Size	Coun-try	Type of Surgery	Inci-dence of SSI (%)	Key Findings
Basany K et al (2024)	2015	India	Cesarean Section	4.6	Low SSI rate with single-dose prophylaxis.
Al-Hajri A et al (2024)	525	Oman	Gastrointestinal Surgery	16.4	Illiteracy, smoking, and diabetes identified as risk factors.
Nanaimo FM et al (2024)	85	Canada	Hemorrhoid, Cholecystectomy, Appendectomy	27.06	Effective antibiotic prophylaxis shown to reduce SSI occurrence.

- Studies involving general surgical patients undergoing procedures such as gastrointestinal surgery, gynecological surgery, and hernia repairs.
- Studies reporting the incidence or prevalence of SSIs, associated risk factors, and antibiotic prophylaxis outcomes.

Exclusion Criteria:

- Studies focused on non-general surgical specialties (e.g., orthopedic, neurosurgery).
- Studies with fewer than 50 participants or lacking sufficient follow-up data on SSIs.

Data Extraction

Data were extracted from 30 studies, including:

Study Characteristics: Author, year, country, sample size, type of surgery. **Outcome Measures:** Incidence of SSIs (percentage), risk factors (age, obesity, diabetes, smoking), and microbiological data (pathogens identified). For each study, odds ratios (OR) and 95% confidence intervals (CI) were collected where available.

Statistical Analysis

A meta-analysis was conducted to pool the incidence of SSIs and associated risk factors across studies. We used a random-effects model to account for heterogeneity between studies, which was assessed using the I^2 statistic. Subgroup analyses were performed based on the type of surgery and patient demographics.

RESULTS

Study Characteristics

A total of 30 studies were included in this systematic review. The characteristics of these studies are summarized in Table 1.

Odada D et al (2024)	1262	Kenya	Cesarean Section	2.1	No significant association found between risk factors and SSI.
Chukwuma ST et al (2024)	438	Nigeria	General Surgery	12.3	Identified role of anaerobic bacteria in SSIs.
Ching PR et al (2024)	17353	Various	Gastrointestinal Surgery	1.6	Developed a prediction model for SSI risk.
Agarwal M et al (2024)	300	India	Total Laparoscopic vs. Abdominal Hysterec-tomy	17.6	TLH significantly reduced SSI rates compared to TAH.
Skender K et al (2024)	30000	India	General Surgery	15.5	Analyzed 10 years of antibiotic prescribing trends.
Hu H et al (2024)	60	China	Gastrointestinal Surgery	20	Higher incidence of complications in malnourished children.
Aderounmu AA (2024)	320	Nigeria	Hernia Surgery	14.4	Razors associated with higher SSI incidence compared to clippers.
Ademi et al (2024)	93	Turkey	Appendectomy	3.2	Triclosan-coated sutures did not significantly reduce SSI rates.
Sato T et al (2024)	15910	Japan	Orthopedic Trauma Surgery	2.4	Blood transfusion within 24h is a significant risk factor.
Deeming S et al (2024)	1000	USA	Various Surgical Procedures	6.5	No definitive evidence in favor of any skin preparation agent.
El-Rebigi AM et al (2024)	60	Egypt	Gastrointestinal Surgery	23.4	Nutritional status correlated with surgical outcomes in children.
Vierra M et al (2024)	1000	USA	Various Surgical Procedures	5.5	Proposed tailoring antibiotic prophylaxis to individual history.
Patel NV et al (2023)	300	India	Various Surgical Procedures	19.6	Identified significant gaps in prophylactic antibiotic practices.
Misganaw Desye et al (2020)	68	Ethiopia	Major Abdominal Surgery	23.4	Factors associated with SSI included wound class and timing of antibiotics.
Ghimire P et al (2022)	384	Nepal	General Surgery	16.9	Higher prevalence compared to similar studies in the region.
Rajouri J et al (2023)	82	India	General Surgery	14.6	Older age and longer duration of surgery increased SSI risk.
Harikumar V et al (2023)	45445	USA	Various Surgical Procedures	5.7	Patients with comorbidities at higher risk for SSI.
Ali A et al (2023)	338	Ethiopia	Obstetrics and General Surgery	14.5	High rates of multidrug-resistant infections reported.
Seidelman JL et al (2023)	669467	USA	Common Surgical Procedures	0.53	Trends in SSI prevalence remained stable over six years.
Nayak DR et al (2023)	867	India	Abdominal Surgery	11	Emergency surgeries associated with a higher incidence of SSIs.
Meena R et al (2023)	300	India	Emergency and Elective Surgery	20	Higher NNIS score correlated with increased SSI risk.
Alemayehu MA et al (2023)	454	Ethiopia	General Surgery	70.3	Majority of SSIs discovered post-discharge.
Tekam VK et al (2023)	207	India	Gastrointestinal Surgery	42.5	Identified Klebsiella as a common pathogen.
Bekiari et al (2021)	1058	Greece	Elective General Surgery	7.6	NNIS risk index correlated with increased SSI rates.
Panos G et al (2021)	133	Greece	Colorectal Surgery	21.8	Older age and comorbidities increased SSI risk.
Trisha V et al (2020)	281	Ethiopia	Various Surgical Procedures	19.6	Timing and choice of antibiotic prophylaxis significant for SSI rates.

Pooled Incidence of SSIs

The pooled incidence of SSIs across the 30 studies was found to be 13.5% (95% CI: 11.3%–16.7%). The incidence varied significantly based on surgical type:

- **Cesarean Sections:** 2.1% to 4.6%.
- **Gastrointestinal Surgeries:** 16.4% to 42.5%.
- **Emergency Surgeries:** Higher incidence rates compared to elective procedures.

Risk Factors for SSIs

The analysis identified several key risk factors associated with SSIs:

- **Obesity:** Adjusted Relative Risk (aRR) of 2.5 (95% CI: 1.4–4.6) for obese patients developing SSIs post-surgery.
- **Diabetes:** Odds Ratio (OR) of 5.07 (95% CI: 2.27–11.35) reported in studies analyzing GI surgeries.
- **Smoking:** OR of 21.15 (95% CI: 4.63–96.67), indicating a significantly higher risk of SSIs.
- **Prolonged Surgery Duration:** Operations lasting over two hours showed an OR of 1.42 (95% CI: 1.83–9.29) for developing SSIs.

Microbiological Findings

The studies highlighted the most commonly isolated organisms in SSIs, including:

- Staphylococcus aureus

- Escherichia coli
- Klebsiella spp.

High rates of multidrug-resistant organisms were reported, particularly in resource-limited settings, emphasizing the need for tailored antibiotic strategies.

DISCUSSION
Key Findings

This systematic review found that SSIs are significant concern in general surgical patients, with a pooled incidence of 13.5%. The identified risk factors such as obesity, diabetes, smoking, and prolonged surgery duration underscore the importance of targeted preventive measures. Prophylactic antibiotics effectively reduce the incidence of SSIs; however, extended use may contribute to resistance.

Clinical Implications

Improving preoperative risk assessment and management is crucial. Hospitals should implement standardized infection control protocols and personalized antibiotic strategies, particularly for high-risk patients.

LIMITATIONS

Heterogeneity among studies regarding definitions of SSIs and patient

populations may limit the generalizability of results. The potential for publication bias also exists, affecting the overall findings.

CONCLUSION

Surgical site infections remain a considerable challenge in general surgical practice, necessitating ongoing efforts to reduce their incidence. Future research should focus on refining risk assessment tools, optimizing antibiotic prophylaxis, and evaluating the effectiveness of infection control measures in diverse surgical settings.

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