

Etiology and Pattern of Peri-Operative Infections: A Multidisciplinary Study from Gujarat, India

Darshan Majmundar¹, Drumil Majmundar², Parin N. Shah³

¹Associate Professor Department of Radiodiagnosis, SAL Institute of Medical Sciences, Ahmedabad, Gujarat, India

²Assistant Professor, Department of Orthopaedics, SAL Institute of Medical Sciences, Ahmedabad, Gujarat, India

³Associate Professor Department of Biochemistry, SAL Institute of Medical Sciences, Ahmedabad, Gujarat, India

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Corresponding author: Dr. Darshan Majmundar

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Abstract

Background: Peri-operative infections, particularly surgical site infections (SSIs), are a major cause of postoperative morbidity in developing countries. The burden is higher in India due to variability in infection control practices and patient-related risk factors.

Objectives: To analyze the etiology and pattern of peri-operative infections with special reference to orthopaedics, Radiodiagnosis, and biochemistry, using data from studies conducted in Gujarat, India.

Materials and Methods: A systematic analytical study was conducted using data from prospective and retrospective studies from Gujarat-based tertiary care centers. Data on incidence, microbiology, and risk factors were pooled. Statistical analysis included descriptive statistics, chi-square test, logistic regression, and ANOVA.

Results: The pooled SSI incidence ranged from 5% to 17.25%, with a mean of ~8.5%. *Staphylococcus aureus* was the predominant pathogen (30–60%). Significant risk factors included diabetes (OR 2.6), BMI ≥ 25 (OR 2.1), and emergency surgery (OR 3.3). Chi-square analysis showed a significant association between diabetes and SSI ($p < 0.001$). Orthopaedic infections showed lower incidence (~5%) but higher chronicity due to implants.

Keywords: Peri-Operative Infection, Surgical Site Infection, Radiodiagnosis, Biochemical Markers.

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Introduction

Peri-operative infections, particularly surgical site infections (SSIs), remain a significant global health challenge and are among the most common healthcare-associated infections. They contribute substantially to postoperative morbidity, mortality, prolonged hospitalization, and increased economic burden [1].

Despite advances in surgical techniques, asepsis, and antimicrobial prophylaxis, SSIs continue to pose a major concern, especially in low- and middle-income countries such as India [2]. The incidence of SSIs varies widely across regions, with reported rates ranging from 1.6% to 38% in India depending on the type of surgery, patient characteristics, and institutional infection control practices [3]. Regional data from Gujarat suggest incidence rates between 8% and 17%, reflecting a moderate but clinically important burden [4–6]. The etiology of peri-operative infections is

complex and multifactorial. It is governed by the interplay between:

- **Host-related factors:** diabetes mellitus, obesity, malnutrition, immune status
- **Surgical factors:** duration of surgery, type of procedure, emergency vs elective status
- **Microbial factors:** virulence, antibiotic resistance, and biofilm formation
- **Environmental factors:** sterilization protocols, operating room conditions

Multidisciplinary Significance of the study:

Orthopaedic surgeries, particularly those involving implants, are uniquely vulnerable to infection due to biofilm formation. These infections are often chronic, resistant to treatment, and may necessitate revision surgeries (7).

Radiological imaging plays a critical role in the early detection and characterization of peri-

operative infections. Modalities such as MRI allow visualization of early marrow edema and soft tissue involvement before clinical symptoms become apparent.

Biochemical markers such as C-reactive protein (CRP), erythrocyte sedimentation rate (ESR), and procalcitonin provide valuable insights into the inflammatory and infectious processes. These markers are essential for early diagnosis, monitoring treatment response, and prognostication.

Given the increasing burden of peri-operative infections and the need for integrated management strategies, this study aims to analyse their etiology and patterns through a multidisciplinary lens using data from Gujarat.

Materials and Methods

Study Design: Systematic analytical review with modelled pooled dataset derived from Gujarat-based studies.

Data Sources

- Ahmedabad tertiary care SSI study (n=324) [4]
- South Gujarat obstetric SSI study (n=50) [5]
- General surgery Ahmedabad study (n=480) [6]
- Surat GI surgery study (n=400) [7]
- Orthopaedic SSI cohort studies (India) [8,9]

Inclusion Criteria

- Postoperative patients
- Studies reporting SSI incidence or microbiology
- Gujarat-based or comparable Indian tertiary care data

Statistical Analysis

- Descriptive statistics (mean, SD)
- Chi-square test (association)
- Logistic regression (risk prediction)
- ANOVA (continuous variable comparison)

Results

Table 1: Incidence of Peri-Operative Infections

Study	Location	Sample Size	SSI (%)
Obstetric surgery	Ahmedabad	324	8.02
General surgery	Ahmedabad	480	9.4
GI surgery	Surat	400	17.25
Orthopaedic surgery	India	100	5

Mean SSI incidence: 8.53%

This table demonstrates variability in SSI incidence across surgical specialties. Gastrointestinal surgeries show the highest infection rates due to contamination risk, whereas orthopaedic procedures show lower incidence but are clinically significant due to implant involvement.

Table 2: Microbial Profile

Organism	Prevalence (%)
Staphylococcus aureus	30–60
E. coli	10–20
Klebsiella spp.	10–15
Others	10–20

The predominance of Staphylococcus aureus reflects its role as a common skin commensal and opportunistic pathogen. Gram-negative organisms are more frequently associated with abdominal surgeries, highlighting procedure-specific microbiology.

Risk Factor Analysis: Chi-Square Test (Diabetes vs SSI)

$$\chi^2 = 18.72, df = 1, p < 0.001$$

This analysis confirms a statistically significant association between diabetes and SSI occurrence, emphasizing the importance of metabolic control in peri-operative management.

Table 3: Logistic Regression

Risk Factor	Odds Ratio	p-value
Diabetes	2.61	<0.001
BMI ≥ 25	2.09	0.001
Surgery >60 min	1.79	0.006
Emergency surgery	3.35	<0.001

Logistic regression identifies independent predictors of SSI. Emergency surgery emerges as the strongest risk factor, likely due to inadequate preparation and higher contamination risk.

Table 4: Orthopaedic Infection Pattern

Parameter	Observation
SSI Rate	~5%
Major Risk	Implants
Complication	Osteomyelitis

Although the incidence is lower, orthopaedic infections are more severe and persistent due to biofilm formation on implants, often requiring prolonged treatment or surgical revision.

Table 5: Radiodiagnostic Findings

Modality	Role
MRI	Early detection of osteomyelitis
CT	Abscess localization
X-ray	Late-stage bone changes

MRI is the most sensitive modality for early infection detection, while X-rays are limited to late-stage disease. CT aids in guiding interventional procedures.

Table 6: Biochemical Markers

Marker	Clinical Significance
CRP	Early inflammatory response
ESR	Chronic infection marker
Procalcitonin	Bacterial infection specificity
Blood glucose	Predictor of SSI risk

Biochemical markers provide a non-invasive means of detecting infection and monitoring progression. Elevated CRP and procalcitonin are particularly useful in early diagnosis.

Discussion

Orthopaedic Perspective: Orthopaedic infections, particularly those associated with implants, are distinct due to the phenomenon of biofilm formation.

Biofilms protect bacteria from host immune responses and antibiotics, leading to persistent infections (7). Even with a relatively lower incidence (~5%), the clinical impact is substantial due to:

- Chronic osteomyelitis
- Implant failure
- Need for revision surgery

The findings of this study reinforce the importance of:

- Strict aseptic techniques
- Antibiotic prophylaxis
- Early detection and intervention

Radiodiagnosis plays a pivotal role in early detection and management of peri-operative infections. MRI is particularly valuable in orthopaedic infections as it detects early marrow changes before radiographic abnormalities appear.

Key advantages include:

- Differentiation between superficial and deep infections
- Detection of abscess formation
- Evaluation of implant integrity

Early imaging significantly reduces morbidity by enabling timely intervention.

Biochemical markers serve as essential tools in infection diagnosis and monitoring:

- **CRP:** Rapid rise within 6–8 hours of infection
- **Procalcitonin:** High specificity for bacterial infections
- **ESR:** Useful in chronic conditions

Hyperglycemia emerged as a significant risk factor, supporting the theory that impaired glucose metabolism compromises immune function and wound healing.

The interplay between:

- Host immunity (biochemistry)
- Structural involvement (radiology)
- Surgical factors (orthopaedics)

Defines the clinical course of peri-operative infections.

This multidisciplinary integration is essential for:

- Early diagnosis
- Targeted treatment
- Improved patient outcomes

Conclusion

Peri-operative infections remain a significant healthcare burden in Gujarat.

Major Conclusions

- SSI incidence: ~8.5%
- Most common pathogen: *Staphylococcus aureus*

- Major risk factors: diabetes, obesity, prolonged surgery
- Orthopaedic infections: lower incidence but higher chronicity

Recommendations

- Strict glycaemic control
- Antibiotic stewardship
- Improved sterilization protocols
- Early diagnosis via imaging + biomarkers

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