

## Observational Analysis of Surgical Site Infections in Gynecologic Procedures in a Tertiary Care Hospital

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### ABSTRACT:

**Background:** Surgical site infections (SSIs) remain one of the most significant postoperative complications in gynecologic surgery, contributing to prolonged hospitalization, increased healthcare costs, and heightened patient morbidity. Tertiary care hospitals frequently handle complex surgical cases and high-risk patients, making them particularly vulnerable to higher SSI rates. Understanding local incidence patterns and associated risk factors is essential for developing targeted preventive strategies. **Aim:** To assess the incidence, determinants, and microbiological profile of surgical site infections among patients undergoing gynecologic procedures in a tertiary care hospital. **Materials and Methods:** This observational study included 85 women who underwent various gynecologic procedures at a tertiary care hospital. Data were collected through structured proformas and medical records, capturing demographic factors, comorbidities, nutritional status, BMI, surgical type, wound classification, operative duration, prophylactic antibiotic timing, blood loss, transfusion requirements, and use of drains. SSI diagnosis followed CDC criteria, categorizing infections as superficial, deep, or organ/space. Microbiological cultures were performed when feasible. **Results:** The overall incidence of SSI was 14.12% (12/85). Higher infection rates were observed in patients aged  $\geq 40$  years (66.67%) and in those with BMI  $\geq 25$  kg/m<sup>2</sup> (75.00%). Diabetes mellitus (41.67% vs. 12.33%,  $p = 0.01$ ) and anemia (50.00% vs. 19.18%,  $p = 0.02$ ) were significant patient-related risk factors. Abdominal surgeries accounted for the majority of infections (66.67%), while clean-contaminated wounds had the highest SSI rate (58.33%,  $p = 0.04$ ). Procedures lasting  $\geq 90$  minutes showed significantly higher SSI incidence (66.67%,  $p = 0.03$ ). Use of drains (58.33%,  $p = 0.01$ ) and blood transfusion (33.33%,  $p = 0.04$ ) were also significantly associated with SSI. *Staphylococcus aureus* was the predominant pathogen (41.67%), followed by *Escherichia coli* and *Pseudomonas aeruginosa*. **Conclusion:** The study demonstrates that SSIs in gynecologic surgeries are influenced by both patient-specific and procedure-related factors. Early optimization of comorbidities, careful operative planning, evidence-based antibiotic prophylaxis, and strict adherence to infection-control practices are essential to minimize SSI risk and improve postoperative outcomes in gynecologic settings.

**Keywords:** Surgical site infection, Gynecologic surgery, Risk factors, Wound classification, Microbiological profile

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### INTRODUCTION

Surgical site infections (SSIs) are among the most common healthcare-associated infections and continue to pose a major challenge to surgical practice worldwide. They are typically defined as infections occurring at or near the surgical incision within 30 days of the procedure, or within one year if an implant is placed, and may involve superficial tissues, deeper fascial layers, or organ/space structures.<sup>1</sup> SSIs are associated with increased postoperative pain, delayed wound healing, unplanned readmissions, and the need for additional interventions such as drainage, debridement, and prolonged antibiotic therapy. In many series, SSIs account for a substantial proportion of all hospital-acquired infections in surgical patients, reflecting both the inherent vulnerability of surgical wounds and the complexity of perioperative care pathways. The global burden of SSIs is particularly pronounced in low- and middle-income countries, where infection prevention infrastructure, surveillance systems, and resources may be limited. A large

systematic review of healthcare-associated infections in developing countries demonstrated that overall rates of such infections, including SSIs, were at least two to three times higher than those reported from high-income settings, highlighting a considerable disparity in postoperative outcomes.<sup>2</sup> In these contexts, constraints related to overcrowding, limited operating theatre capacity, shortages of trained staff, and inconsistent access to sterilization and high-quality consumables may contribute to higher infection rates and more severe clinical consequences. SSIs therefore represent not only a clinical problem but also a marker of health system performance and patient safety. In addition to increasing morbidity, SSIs exert a significant economic impact on health services. Patients who develop SSIs often require longer hospital stays, intensive wound care, repeated dressing changes, radiological investigations, or reoperations, which collectively increase costs for both hospitals and families. Lost productivity due to delayed return to work or daily activities further

amplifies the societal burden. Analyses from high-resource healthcare systems suggest that even modest reductions in SSI rates can translate into substantial savings, reinforcing the rationale for investing in comprehensive prevention strategies and robust surveillance programs.<sup>2-4</sup> The risk of SSI is determined by a complex interaction of patient, procedural, environmental, and organizational factors. Classical risk factors include advanced age, obesity, diabetes mellitus, anemia, malnutrition, smoking, and other comorbid conditions that impair immune function or tissue perfusion.<sup>5</sup> Operative characteristics such as wound class, duration of surgery, route of access, blood loss, and the use of foreign materials (including prostheses and drains) further modulate the likelihood of postoperative infection. Environmental and systems-level factors—such as operating theatre ventilation, traffic, adherence to aseptic technique, and the quality of cleaning and disinfection—also play a critical role. Reviews focusing on operating theatre quality have emphasized that SSI prevention requires coordinated attention to design features, air handling, staff behavior, and procedural discipline within the surgical environment.<sup>3</sup> Gynecologic surgery contributes substantially to the overall surgical workload of tertiary care hospitals, encompassing procedures that range from minor vaginal operations to major oncologic and reconstructive interventions. Many gynecologic operations are classified as clean-contaminated because they involve entry into the genital tract; this inherently increases the risk of bacterial inoculation from endogenous flora compared with purely clean procedures. Large database studies of hysterectomy, one of the most commonly performed gynecologic operations, have shown that the overall 30-day SSI rate (including superficial, deep, and organ-space infections) is in the low single digits, but varies by route of surgery, with abdominal approaches carrying a higher risk than vaginal or minimally invasive methods.<sup>4</sup> These findings underscore the importance of route selection and procedure complexity when considering SSI risk in gynecologic practice. Accurate risk prediction and stratification are essential for targeting prevention strategies to patients most likely to benefit. Work based on the American College of Surgeons National Surgical Quality Improvement Program has led to the development of models such as the Surgical Site Infection Risk Score (SSIRS), which combines patient factors (for example, body mass index, comorbidities, smoking status) with operative characteristics (such as urgency, wound contamination, and duration) to estimate an individual's probability of developing an SSI.<sup>5</sup> Such tools illustrate that SSI risk is not uniform across surgical populations and can be quantified using readily available perioperative variables. While these models have largely been derived from heterogeneous surgical cohorts, their conceptual framework is applicable to specialty areas such as gynecology, where high-risk subsets—such as women

with obesity, diabetes, anemia, or prolonged operations—can be identified and prioritized for intensified preventive measures. Over the past two decades, structured guidelines and checklists have emerged as key instruments in SSI prevention. National guidance, such as the clinical guideline on prevention and treatment of SSIs issued by the National Institute for Health and Clinical Excellence (NICE), has provided evidence-based recommendations on preoperative skin preparation, hair removal, antibiotic prophylaxis, and postoperative wound care, with the aim of standardizing practice and reducing unwarranted variation.<sup>6</sup> At the global level, the World Health Organization's "Safe Surgery Saves Lives" initiative and the accompanying guidelines for safe surgery have highlighted core safety practices, including the surgical safety checklist, appropriate antibiotic administration, and optimization of perioperative physiology, as fundamental components of infection prevention and patient safety.<sup>7</sup>

## MATERIALS AND METHODS

This study was designed as an observational analysis conducted in the Department of Obstetrics and Gynecology of a tertiary care hospital. The hospital functions as a high-volume referral center, providing comprehensive gynecologic and surgical services, thereby ensuring a representative mix of elective and emergency procedures. All relevant clinical, surgical, and postoperative care practices followed standard institutional protocols, enabling consistent assessment of potential factors associated with surgical site infections. A total of 85 patients who underwent gynecologic surgical procedures were included in the analysis. Patients represented varied age groups, indications, and types of surgeries such as abdominal, vaginal, laparoscopic, and oncologic gynecologic procedures. Inclusion criteria consisted of women who underwent any major or minor gynecologic surgery with complete perioperative documentation and postoperative follow-up until discharge. Patients with incomplete records, pre-existing infections unrelated to the surgical site, or those lost to immediate postoperative follow-up were excluded to ensure accuracy and completeness of the dataset.

### Methodology

Data were collected using a structured proforma and hospital medical records. Information was captured regarding patient demographics, clinical history, comorbid conditions, nutritional status, body mass index (BMI), smoking status, and relevant laboratory parameters. Perioperative variables such as type of surgery, wound class, duration of surgery, blood loss, use of drains, prophylactic antibiotics, level of aseptic precautions, and intraoperative events were recorded. Postoperative monitoring included daily wound assessments, documentation of symptoms, wound discharge characteristics, dressing changes, and

adherence to postoperative care protocols. Surgical site infections were identified and classified using standardized definitions following CDC guidelines.

### Infection Assessment and Diagnostic Criteria

SSI diagnosis was based on clinical evaluation performed by attending surgeons and infection control personnel. Criteria included the presence of purulent discharge, erythema, localized swelling, pain, warmth, fever, or positive microbial culture obtained from the wound site where applicable. Each identified SSI was categorized into superficial incisional, deep incisional, or organ/space infection. Microbiological investigation was performed when feasible to identify causative organisms, and antibiotic sensitivity testing guided subsequent therapeutic decisions.

### Outcome Measures and Parameters Studied

Primary outcome measured was the incidence of surgical site infections among the study population. Secondary parameters included association of SSI with patient-related factors (age, BMI, comorbidities, anemia, diabetes), surgery-related factors (type of procedure, duration, emergency vs. elective, wound class, use of drains), and perioperative factors (timing and selection of prophylactic antibiotics, operative room sterility practices, blood transfusion, postoperative wound care). Additional variables such as length of hospital stay, need for re-intervention, and microbiological profile of isolates were evaluated to understand the clinical impact of SSIs.

### Statistical Analysis

All collected data were compiled, tabulated, and analyzed using appropriate statistical software. Descriptive statistics such as mean, standard deviation, and percentages were used to summarize baseline characteristics and infection rates. Inferential analyses including chi-square tests or Fisher's exact test were employed to assess associations between categorical variables and SSI occurrence. Student's t-test or Mann-Whitney U test was used for continuous variables depending on data distribution. A p-value of <0.05 was considered statistically significant.

## RESULTS

### Table 1: Incidence of Surgical Site Infection (SSI)

The overall incidence of surgical site infections among the 85 patients undergoing gynecologic procedures was **14.12%**, with 12 patients developing SSI. The remaining **85.88%** (73 patients) did not develop any postoperative infection. This incidence reflects the proportion of patients who experienced postoperative wound-related complications within the study cohort.

### Table 2: Association of SSI with Patient Characteristics

The relationship between demographic and clinical variables and the occurrence of SSI was evaluated.

Patients aged  $\geq 40$  years showed a higher proportion of infections (66.67%) compared to those <40 years (33.33%), although this difference did not reach statistical significance ( $p = 0.12$ ). Similarly, patients with a BMI  $\geq 25$  kg/m<sup>2</sup> demonstrated a higher infection rate (75.00%) compared to those with BMI <25 kg/m<sup>2</sup> (25.00%), suggesting a trend toward increased SSI risk among overweight individuals; however, this association was also not statistically significant ( $p = 0.09$ ). A significant association was observed with diabetes mellitus, where 41.67% of patients with diabetes developed SSI compared to only 12.33% of non-diabetic patients ( $p = 0.01$ ). This finding indicates that impaired glycemic control may increase susceptibility to postoperative wound infections. Anemia also showed a statistically significant association with SSI ( $p = 0.02$ ), with 50.00% of anemic patients developing infections compared to 19.18% among non-anemic individuals.

### Table 3: Association of SSI with Surgical Variables

Surgical characteristics were assessed for their influence on SSI rates. Abdominal procedures showed a higher proportion of infections (66.67%) compared to vaginal (16.67%) and laparoscopic surgeries (16.67%). Although this distribution suggests that open abdominal surgeries pose a higher infection risk, the association was not statistically significant ( $p = 0.10$ ). Regarding the nature of surgery, emergency procedures were associated with a higher risk of SSI (50.00%) compared to elective surgeries (26.03%), although this difference showed a borderline significance ( $p = 0.07$ ). A statistically significant association was noted with wound class ( $p = 0.04$ ). Clean-contaminated wounds had the highest infection rate (58.33%), followed by contaminated wounds (16.67%), while clean wounds demonstrated the lowest rate (25.00%). This trend aligns with established infection patterns seen with increasing microbial exposure during surgery. Duration of surgery also significantly impacted SSI occurrence ( $p = 0.03$ ). Procedures lasting  $\geq 90$  minutes had more than double the infection rate (66.67%) compared to shorter surgeries (33.33%), reinforcing the role of prolonged operative time as a key risk factor.

### Table 4: Perioperative Factors Associated with SSI

Among the perioperative variables evaluated, patients receiving prophylactic antibiotics more than 60 minutes before incision showed a higher infection rate (33.33%) compared to those receiving them within 60 minutes (66.67% infection-free), though this difference did not reach statistical significance ( $p = 0.08$ ). The use of surgical drains exhibited a significant relationship with SSI ( $p = 0.01$ ). Patients with drains had a notably higher infection rate (58.33%) than those without drains (24.66%), suggesting drain placement as a potential contributor to postoperative contamination. Increased intraoperative blood loss ( $\geq 500$  ml) was associated

with a higher infection rate (58.33%) compared to patients with lower blood loss (41.67%), but the association did not reach statistical significance ( $p = 0.06$ ). However, the need for blood transfusion demonstrated a statistically significant association ( $p = 0.04$ ), with 33.33% of transfused patients developing SSI compared to 12.33% of non-transfused individuals.

**Table 5: Microbiological Profile of SSI Cases**

Microbiological evaluation of the 12 SSI cases revealed that *Staphylococcus aureus* was the most

frequently isolated organism, accounting for 41.67% of infections. This highlights its predominant role in postoperative wound infections, particularly in procedures involving skin flora contamination. *Escherichia coli* was the second most common organism (25.00%), followed by *Pseudomonas aeruginosa* (16.67%). Mixed microbial growth was detected in 8.33% of cases, and 8.33% of samples yielded no growth, possibly due to prior antibiotic administration or inadequate sample collection.

**Table 1. Incidence of Surgical Site Infection (SSI)**

Outcome	Number (n=85)	Percentage (%)
Patients with SSI	12	14.12%
Patients without SSI	73	85.88%

**Table 2. Association of SSI with Patient Characteristics**

Parameter	Category	SSI (n=12)	No SSI (n=73)	p-value
Age Group	<40 years	4 (33.33%)	41 (56.16%)	0.12
	≥40 years	8 (66.67%)	32 (43.84%)	
BMI	<25 kg/m <sup>2</sup>	3 (25.00%)	37 (50.68%)	0.09
	≥25 kg/m <sup>2</sup>	9 (75.00%)	36 (49.32%)	
Diabetes Mellitus	Present	5 (41.67%)	9 (12.33%)	<b>0.01*</b>
	Absent	7 (58.33%)	64 (87.67%)	
Anemia (Hb <10 g/dl)	Present	6 (50.00%)	14 (19.18%)	<b>0.02*</b>
	Absent	6 (50.00%)	59 (80.82%)	

\*Significant at  $p < 0.05$

**Table 3. Association of SSI with Surgical Variables**

Parameter	Category	SSI (n=12)	No SSI (n=73)	p-value
Type of Surgery	Abdominal	8 (66.67%)	30 (41.10%)	0.10
	Vaginal	2 (16.67%)	18 (24.66%)	
	Laparoscopic	2 (16.67%)	25 (34.25%)	
Elective vs. Emergency	Elective	6 (50.00%)	54 (73.97%)	0.07
	Emergency	6 (50.00%)	19 (26.03%)	
Wound Class	Clean	3 (25.00%)	32 (43.84%)	0.04*
	Clean-contaminated	7 (58.33%)	34 (46.58%)	
	Contaminated	2 (16.67%)	7 (9.59%)	
Duration of Surgery	<90 min	4 (33.33%)	48 (65.75%)	<b>0.03*</b>
	≥90 min	8 (66.67%)	25 (34.25%)	

\*Significant at  $p < 0.05$

**Table 4. Perioperative Factors Associated with SSI**

Factor	Category	SSI (n=12)	No SSI (n=73)	p-value
Prophylactic Antibiotic Timing	Within 60 min	8 (66.67%)	63 (86.30%)	0.08
	>60 min	4 (33.33%)	10 (13.70%)	
Use of Drains	Yes	7 (58.33%)	18 (24.66%)	<b>0.01*</b>
	No	5 (41.67%)	55 (75.34%)	
Blood Loss	<500 ml	5 (41.67%)	50 (68.49%)	0.06
	≥500 ml	7 (58.33%)	23 (31.51%)	
Blood Transfusion	Required	4 (33.33%)	9 (12.33%)	<b>0.04*</b>
	Not required	8 (66.67%)	64 (87.67%)	

\*Significant at  $p < 0.05$

**Table 5. Microbiological Profile of SSI Cases**

Organism Isolated	Number (n=12)	Percentage (%)
<i>Staphylococcus aureus</i>	5	41.67%
<i>Escherichia coli</i>	3	25.00%
<i>Pseudomonas aeruginosa</i>	2	16.67%
Mixed growth	1	8.33%
No growth	1	8.33%

**DISCUSSION**

The overall incidence of SSI in the present study was 14.12% (12/85), which lies toward the higher end of the range reported in abdominal surgery series from similar resource settings. Razavi et al. reported an abdominal SSI rate of 17.4% in 220 patients at an Iranian teaching hospital, with most infections occurring after clean-contaminated and contaminated procedures.<sup>8</sup> Our incidence is slightly lower than theirs but still higher than many Western hospital reports, suggesting that patient mix, emergency load, and resource constraints in tertiary centres may contribute to the observed burden of SSI.

In this cohort, abdominal procedures accounted for 66.67% of all SSIs, whereas vaginal and laparoscopic surgeries each contributed 16.67%, indicating a clear predominance of infection after open surgery. Taylor et al. described 763 hysterectomy patients and found an overall post-hysterectomy wound infection rate of about 7%, with higher infection rates following abdominal hysterectomy compared with vaginal procedures, reinforcing that larger incisions and more extensive tissue handling increase risk.<sup>9</sup> Our abdominal SSI proportion is therefore consistent with the pattern of higher risk in open gynecologic surgery, although the absolute rate in our series is higher, likely reflecting a larger proportion of high-risk and emergency cases.

Age  $\geq 40$  years and elevated BMI ( $\geq 25$  kg/m<sup>2</sup>) together accounted for the majority of SSIs in the current study, with 66.67% of infections in older women and 75.00% in overweight/obese patients. Waisbren et al., in a prospective cohort of 591 elective surgical patients, showed an overall SSI rate of 12%, but when obesity was defined by percent body fat, infection occurred in 15.2% of obese versus only 5.0% of non-obese patients, and obesity by body fat carried a five-fold higher SSI risk (OR 5.3).<sup>10</sup> The trend in our data toward more infections in overweight women, even though not statistically significant, mirrors this strong association between adiposity and SSI and underscores the need for pre-operative optimization of weight and nutritional status in gynecologic surgery.

Diabetes mellitus was a significant predictor of SSI in our population: 41.67% of women with diabetes developed SSI compared with only 12.33% of non-diabetic patients ( $p = 0.01$ ), suggesting roughly a three-fold increase in risk. Chen et al., in a series of 195 patients undergoing posterior lumbar arthrodesis, confirmed diabetes as a major risk factor for postoperative SSI, with diabetic patients experiencing a significantly higher rate of wound infection than

non-diabetics and concluding that diabetes independently predisposed to deep SSI in spinal surgery.<sup>11</sup> Although their work was in orthopaedic rather than gynecologic procedures, the pattern closely parallels our findings and supports rigorous perioperative glycemic control as a key component of SSI prevention.

Anemia (Hb  $< 10$  g/dL) was present in 50.00% of patients with SSI versus 19.18% of those without infection ( $p = 0.02$ ), indicating that oxygen-carrying capacity and tissue perfusion may critically influence wound healing. Dunne et al., analyzing 6,301 non-cardiac surgical patients in the Veterans Affairs system, showed that pre-operative anemia (hematocrit  $< 36\%$ ) was common (33.9%) and that increasing severity of anemia was associated with higher postoperative infection and mortality, with infection (for example, pneumonia) rising from 2.6% to 5% as hematocrit fell, and with anemia and transfusion both independently predicting worse outcomes.<sup>12</sup> Our finding that half of infected women were anemic is compatible with this larger dataset and reinforces the value of correcting anemia preoperatively where feasible.

Wound class showed a significant association with SSI in this study: 25.00% of infections occurred in clean wounds, 58.33% in clean-contaminated, and 16.67% in contaminated wounds ( $p = 0.04$ ), with clean-contaminated procedures contributing the largest share. Culver et al., in the classic National Nosocomial Infections Surveillance analysis of over 44 hospitals, reported pooled mean surgical wound infection rates of 2.1%, 3.3%, 6.4%, and 7.1% for clean, clean-contaminated, contaminated, and dirty procedures, respectively, clearly demonstrating escalation of risk with increasing wound contamination.<sup>13</sup> The relative distribution of infections in our clean versus clean-contaminated and contaminated gynecologic procedures reflects this graded pattern, although absolute rates are higher, likely due to case mix and local infection control constraints.

Prolonged duration of surgery was another important determinant: 66.67% of SSIs followed procedures lasting  $\geq 90$  minutes compared with 33.33% after shorter operations ( $p = 0.03$ ). Leong et al., comparing English and US surveillance data, demonstrated that procedures exceeding the 75th percentile of procedure-specific operative time had significantly higher SSI rates across multiple operation types, confirming operative duration as a robust predictor of infection.<sup>14</sup> Our finding that longer gynecologic

operations were more than twice as likely to be complicated by SSI is therefore in keeping with international surveillance data and suggests that meticulous planning, efficient operative technique, and avoidance of unnecessary delays are critical in high-risk cases.

Perioperative factors in this series also influenced SSI risk. Use of drains was associated with infection in 58.33% of SSI cases versus 24.66% of non-SSI patients ( $p = 0.01$ ), and blood transfusion showed a significant association with SSI (33.33% vs 12.33%,  $p = 0.04$ ); in addition, infections were more frequent when prophylactic antibiotics were given more than 60 minutes before incision. These observations align with the CDC guideline for prevention of SSI by Mangram et al., which emphasizes minimizing foreign bodies (including drains), avoiding unnecessary transfusions, and timing prophylactic antibiotics within the hour before incision to reduce wound contamination and infection risk.<sup>15</sup> Our data therefore support strict adherence to guideline-based perioperative practices in gynecologic theatres.

The microbiological profile in the present study was dominated by *Staphylococcus aureus* (41.67%), followed by *Escherichia coli* (25.00%) and *Pseudomonas aeruginosa* (16.67%), with mixed growth and culture-negative infections each accounting for 8.33%. In a cross-sectional study of postoperative nosocomial infections at Felege Hiwot Referral Hospital in Ethiopia, Mulu et al. reported an overall nosocomial infection rate of 10.9% after clean and clean-contaminated operations, with SSI accounting for 10.2% and *S. aureus* being the leading pathogen (26.2%), followed by *E. coli* and coagulase-negative staphylococci (each 21.4%).<sup>16</sup> The higher proportion of *S. aureus* in our cohort, alongside a substantial contribution from *E. coli*, is thus consistent with this pattern of mixed gram-positive and gram-negative flora in postoperative wounds, while the occasional culture-negative cases may reflect prior antibiotic exposure or sampling limitations.

Taken together, the present study demonstrates that SSI after gynecologic surgery in a tertiary care setting is a multifactorial problem, with contributions from patient-related factors (age, obesity, diabetes, anemia), procedure-related variables (abdominal or open approach, higher wound class, longer duration), and perioperative practices (drain use, transfusion, antibiotic timing). Molina-Cabrillana et al., in a surveillance study of hysterectomy in the Canary Islands, reported an overall wound infection rate of 5.2% (6.0% for abdominal and 3.1% for vaginal hysterectomy) and highlighted obesity, diabetes, and longer procedures as key determinants of infection risk.<sup>17</sup>

## CONCLUSION

The present observational study demonstrated a relatively high incidence of surgical site infection (14.12%) following gynecologic procedures in a

tertiary care hospital. SSIs were more frequent in women with diabetes, anemia, higher BMI and in those undergoing abdominal, clean-contaminated and longer ( $\geq 90$  minutes) surgeries, as well as in patients requiring drains and blood transfusions. *Staphylococcus aureus* was the most commonly isolated pathogen, followed by gram-negative bacilli. These findings highlight the need for targeted preoperative optimization, strict adherence to perioperative infection-prevention bundles and continual surveillance to reduce SSI-related morbidity in gynecologic practice.

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