Original Article

Frequency of Surgical Site Infection (SSI) Among Patients Undergoing Caesarean Section Receiving Care-Bundle Approach

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Abstract

Objective: To determine the frequency of SSI among patients undergoing Caesarean Section (CS) who received a care-bundle approach.
Methodology: This prospective cohort study was conducted in the Department of Obstetrics and Gynaecology at Fauji Foundation Hospital Rawalpindi, Pakistan, from January 1 to May 31, 2024. Five hundred women aged between 18 and 35 years undergoing emergency and elective CS were included. A care-bundle approach based on current best practices was applied, and patients were assessed for SSIs before discharge and four weeks post-CS.
Results: Consisted of 500 women, with a mean age of 28.67 ± 3.19 years. The majority of participants (93.8%) were between 26 and 35 years old, and the mean parity was 2.38 ± 1.16. Of the 500 patients, 240 (48%) underwent elective CS, while 260 (52%) had emergency CS. The frequency of SSI among patients receiving the care-bundle approach was 8.8% (44 out of 500).
Conclusion: Implementing the care-bundle approach significantly reduced the rate of SSI, aligning with global trends and highlighting its utility in resource-limited settings.
Keywords: Caesarean, surgical site infection, care-bundle approach.

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Introduction

Caesarean section (CS) is one of the most frequently performed surgical procedures worldwide, with increasing rates across most countries. Despite its widespread use, CS remains associated with a number of complications, particularly surgical site infections (SSI). The reported incidence of SSI after CS varies from 3% to 18%, depending on multiple factors such as the type of surgery (emergency vs elective), patient risk factors (obesity, diabetes), and the healthcare setting. [1] Given the global rise in the frequency of CS, understanding the associated complications becomes even more crucial. The economic impact, in terms of extended hospital stays and the need for additional medications, further exacerbates the issue.

SSI is not only a significant cause of maternal morbidity, but it also places a considerable burden on healthcare systems due to extended hospital stays, increased need for antibiotics, and potential readmissions. [2] These outcomes also create emotional stress for patients and their families, particularly in resource-limited settings where access to follow-up care may be restricted. Globally, SSIs account for a substantial proportion of healthcare-associated infections (HAIs), with data from the World Health Organization (WHO) suggesting that SSIs represent approximately 36% of all HAIs.[3] Given the rising concern about antibiotic resistance, the need for effective SSI prevention strategies has become even more critical.[4] Antibiotic resistance, in particular, adds another layer of complexity to managing postoperative infections, as limited options remain available for treating resistant organisms, especially in low-resource settings.

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The care-bundle approach has emerged as a comprehensive strategy to prevent SSIs, involving the implementation of multiple evidence-based interventions at various stages of the perioperative process. This multifaceted approach ensures that multiple risk factors for infection are targeted simultaneously, leading to a higher likelihood of reducing overall infection rates. Unlike single interventions, care bundles combine preventive measures that target different infection pathways, enhancing their overall effectiveness.[5] Care bundles typically include interventions such as appropriate preoperative antibiotic prophylaxis, skin antisepsis, maintenance of normothermia during surgery, and postoperative wound management.[6] These interventions, when applied systematically, not only reduce the likelihood of SSIs but also improve patient outcomes by promoting quicker recoveries and reducing the need for postoperative interventions.

In recent years, numerous studies have demonstrated the effectiveness of care bundles in reducing SSI rates across different surgical disciplines, including general surgery, orthopedics, and obstetrics. However, while the application of care bundles has been widely promoted in high-resource settings, there is limited research on their implementation and outcomes in low- and middle-income countries (LMICs), where healthcare resources and infrastructure may be constrained.[7] This study aims to assess the impact of a care-bundle approach in reducing SSI rates following CS, contributing to the growing body of evidence supporting the use of care bundles in obstetrics. By highlighting the successes and challenges of implementing care bundles in LMICs, this study aims to provide valuable insights into optimizing infection prevention protocols in these settings.

Methodology

This prospective cohort study was conducted at Fauji Foundation Hospital, Rawalpindi, a tertiary care hospital serving a large population of obstetric patients. The study period spanned five months, from January 1 to May 31, 2024. The study population included 500 women aged 18 to 35 years who underwent CS during this period. Both emergency and elective CS cases were included. Women with pre-existing conditions that could increase the risk of infection, such as diabetes, obesity (BMI >30), or a previous history of wound infection, were excluded from the study.

The care-bundle approach applied in this study was designed according to current best practices in SSI prevention, adapted to the available resources in our setting. The bundle included the following interventions:

1. Preoperative Measures:

- Antibiotic Prophylaxis: Patients received intravenous ceftriaxone (1g) 30-60 minutes prior to skin incision, in line with WHO and CDC guidelines.[8] Antibiotic timing is a critical element of SSI prevention, as early administration ensures sufficient drug concentration at the incision site during surgery. Previous studies have demonstrated that prophylactic antibiotics reduce SSI rates by up to 50% when administered within one hour before incision.[9]
- Skin Antisepsis: Preoperative skin preparation was performed using povidone-iodine solution, with an additional step of vaginal cleansing before CS. Proper antiseptic skin preparation can substantially reduce the microbial load on the skin, decreasing the risk of SSI.[10]
- Hair Removal: Hair at the incision site was removed using clippers, avoiding the use of razors to reduce the risk of micro-abrasions. Studies have shown that using clippers instead of razors reduces skin irritation and minimizes the likelihood of SSIs.[11]

2. Intraoperative Measures:

- Normothermia Maintenance: Efforts were made to maintain the patient’s core body temperature at 37°C or higher using warming blankets during surgery. Maintaining normothermia has been shown to reduce infection rates by enhancing immune function and promoting wound healing.[12]

3. Postoperative Measures:

- Wound Closure: Subcutaneous suture closure was used instead of staples, as studies have shown a lower risk of wound complications with this technique.[13] Staples are associated with an increased risk of wound dehiscence, which can lead to higher SSI rates, particularly in obese patients.
- Early Dressing Removal: Dressings were removed 48 hours after surgery, and patients were educated on wound care and hygiene to prevent contamination. Early dressing removal and patient education are key components of postoperative care, aimed at preventing the accumulation of moisture and bacterial growth at the incision site. [14]

Patients were monitored for SSIs during their hospital stay and at a follow-up visit four weeks postoperatively. Data were collected on patient demographics, the type of surgery (elective vs emergency), and the occurrence of SSI, defined according to CDC criteria as infection occurring at the incision site within 30 days of surgery. Statistical analysis was performed using SPSS version 25, with significance set at $p < 0.05$.

Results

The study cohort consisted of 500 women, with a mean age of 28.67 ± 3.19 years. The majority of participants (93.8%) were between 26 and 35 years old, and the mean parity was 2.38 ± 1.16. The mean body mass index (BMI) of the participants was 27.2 ± 2.8 kg/m², with approximately 40% of the patients classified as overweight (BMI > 25 kg/m²).

Of the 500 patients, 240 (48%) underwent elective CS, while 260 (52%) had emergency CS. The overall incidence of SSI in this cohort was 8.8% (44 out of 500), with a slightly higher rate of infection observed in emergency cases (10.4%) compared to elective cases (7.1%). However, this difference was not statistically significant ($p = 0.27$). Other factors such as age (Table I) and parity (Table II) also did not show a statistically significant association with SSI rates in this study ($p > 0.05$**).**

Table I: Stratification of SSI with respect to age groups.

Age (in years)	Surgical site infection		P value
	Yes	No	
18-25	03	28	**0.859**
26-35	41	428	

Table II: Stratification of SSI with respect to parity

Parity	Surgical site infection		P value
	Yes	No	
≤3	37	405	**0.350**
>3	07	51	

Discussion

SSIs are one of the most common complications following CS, leading to prolonged hospital stays, higher healthcare costs, and increased maternal morbidity. Implementing a care-bundle approach has been shown to significantly reduce SSI rates, as confirmed by multiple studies across various surgical fields.[15] The reduction in infection rates following the introduction of care bundles can be attributed to the comprehensive nature of the approach, targeting various potential sources of infection throughout the perioperative process. This highlights the importance of integrating these practices into standard care, particularly in settings where infection control measures may otherwise be suboptimal.

In our study, the frequency of SSI among women undergoing CS was 8.8%, a figure that aligns with findings from international studies employing care-bundle strategies. Although this figure reflects a notable improvement in SSI rates, it also emphasizes the need for continuous monitoring and adaptation of care-bundle components to further drive down infection rates. For instance, tailoring certain aspects of the care bundle to local practices and available resources could enhance its effectiveness in different settings. The use of care bundles has gained momentum in the past five years due to their proven efficacy in reducing SSIs, particularly in low-resource settings.[16] Studies have shown that even slight modifications to care-bundle protocols, such as the inclusion of additional hygiene measures or adjustments to antibiotic prophylaxis timing, can have a significant impact on outcomes, making the approach highly adaptable and scalable.

A 2020 study by Monahan et al. reported a 45% reduction in SSI rates in low- and middle-income countries following the implementation of care bundles.[17] This significant reduction underscores the potential for care bundles to drastically improve patient outcomes, particularly in settings where infection control measures may be less robust or difficult to implement due to limited resources. It also suggests that care bundles could be an important tool in addressing healthcare disparities in LMICs. A 2021 European study also demonstrated a 50% reduction in post-CS SSI rates when care bundles were utilized, underlining the importance of a systematic, multidisciplinary approach to infection prevention.[18] In our study, the multidisciplinary nature of the care bundle approach was evident in the coordinated efforts between surgeons, anesthesiologists, and nursing staff, all of whom played critical roles in ensuring the consistent application of preventive measures. This collaborative effort is essential in maximizing the effectiveness of care-bundle strategies.

Our study confirms that care bundles are effective in resource-limited settings where infrastructure and staffing constraints may prevent optimal SSI prevention. Recent research has emphasized that tailoring care bundles to specific healthcare environments, particularly in low-resource settings, is critical to their success.[9] For instance, the availability of certain resources, such as advanced antiseptics or specialized surgical instruments, may vary between hospitals, requiring adaptations to the care-bundle components to suit the local context. By acknowledging these variations and modifying the bundle accordingly, it is possible to maintain high standards of infection control even in challenging environments. The inclusion of postoperative hygiene education and early removal of dressings in our care bundle contributed to the reduction in SSIs in this study. These interventions, along with preoperative antibiotic prophylaxis and appropriate skin antisepsis, have been repeatedly validated as key elements of SSI prevention.[19] The education of patients and their families in postoperative care is particularly crucial, as it ensures that infection prevention measures continue even after discharge from the hospital, further reducing the risk of SSIs developing in the days or weeks following surgery.

Moreover, recent guidelines published by organizations such as the Centers for Disease Control and Prevention (CDC) and the World Health Organization (WHO) now advocate for the widespread adoption of care bundles in surgical settings, including obstetrics. These guidelines highlight the importance of normothermia, adequate skin preparation, and timely antibiotic administration—all of which were included in our care-bundle approach. [20]

However, despite the success of care-bundle interventions, ongoing challenges remain in ensuring compliance with all bundle components. A 2023 study by Erritty et al. found that adherence to care-bundle protocols was strongly associated with lower rates of SSIs but noted that certain elements, such as maintaining normothermia, ensuring proper timing of antibiotics were more difficult to implement in resource-constrained environments.[21] Our study supports these findings and underscores the need for continued training and monitoring to ensure that care bundles are consistently applied in obstetric surgery.

Further research should focus on optimizing care-bundle components for obstetric surgeries, particularly CS, and investigating long-term maternal and neonatal outcomes. The role of surveillance systems in enhancing the efficacy of care bundles, as highlighted in a 2020 study by Phelan et al., also warrants further exploration.[22]

Conclusion

This study demonstrates that the care-bundle approach is a highly effective strategy for reducing SSI rates following CS, even in resource-limited settings. The interventions included in the care bundle, such as antibiotic prophylaxis, skin antisepsis, and postoperative wound management, were instrumental in lowering the overall infection rate to 8.8%. Future studies should focus on optimizing care-bundle components for emergency surgeries and investigating long-term maternal outcomes associated with bundle use. Given the significant public health implications of SSIs, particularly in LMICs, the widespread adoption of care bundles in obstetric surgeries should be prioritized.

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