Journal of Syifa Sciences and Clinical Research (JSSCR)
Volume 8, Issue 2, 2026
Journal Homepage: http://ejurnal.ung.ac.id/index.php/jsscr, E-ISSN: 2656-9612 P-ISSN: 2656-8187
DOI: https://doi.org/10.37311/jsscr.v8i2.39058

# Rationality of Prophylactic Antibiotic Use and Surgical Site Infection After Cesarean Section at a Jakarta Hospital

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## ABSTRACT

Cesarean section (CS) is an obstetric surgical procedure associated with a risk of surgical site infection (SSI). The administration of prophylactic antibiotics aims to prevent postoperative infections; however, irrational antibiotic use can increase the risk of antimicrobial resistance. This study aims to evaluate the rationality of prophylactic antibiotic use based on the Gyssens method and to analyze the relationship between the rationality of antibiotic use and the incidence of SSI in cesarean section patients at X Regional Hospital in Jakarta in 2025. This study employed an analytical observational design with a retrospective cross-sectional approach. Data were obtained from the medical records of 310 cesarean section patients from January to December 2025, selected using simple random sampling based on the Slovin formula. The observed variables included patient characteristics, type of prophylactic antibiotic, rationality of antibiotic use based on the Gyssens method, and the incidence of SSI. Data analysis was performed descriptively and analytically using Fisher's Exact Test, as well as odds ratio (OR) and 95% confidence interval (CI) analysis. The results showed that the majority of patients underwent emergency cesarean section, totaling 211 patients (68.1%). The most commonly used prophylactic antibiotic was ceftriaxone, administered to 242 patients (78.1%), while cefazolin was used in 68 patients (21.9%). Based on the Gyssens method, rational antibiotic use was found in 68 patients (21.9%), while irrational use was found in 242 patients (78.1%). ILO events were found in 7 patients (2.3%). The analysis results showed no significant association between the rationality of antibiotic use and the occurrence of ILO (p=0.704). Patients with irrational antibiotic use had a 1.70-fold higher risk of ILO compared to the rational group (OR=1.70; 95% CI=0.20–14.44). The study's conclusion indicates that the use of prophylactic antibiotics in cesarean section patients at Hospital X in the Jakarta region in 2025 was still dominated by irrational use based on the Gyssens method, particularly regarding inappropriate antibiotic selection. However, no significant association was found between the rationality of antibiotic use and the incidence of ILO.



**Keywords:**
Cesarean section, Prophylactic antibiotics, Gyssens method, Rationality, Surgical site infection

| *Received:* | *Accepted:* | *Online:* |
|---|---|---|
| *2026-05-30* | *2026-07-25* | *2026-07-31* |

## 1. Introduction

Cesarean section (CS) is a surgical procedure performed through an incision in the abdominal wall (laparotomy) and the uterus (hysterotomy) to deliver a baby when

vaginal delivery is not possible or poses a risk to the mother and fetus. The Indonesian Society of Obstetrics and Gynecology (POGI) states that CS is one of the most frequently performed obstetric procedures, although it carries risks of complications such as infection, bleeding, and a longer postoperative recovery period compared to vaginal delivery [1].

The WHO reported approximately 287,000 maternal deaths globally in 2020, the majority of which occurred in low- and middle-income countries, with postpartum infections being a major contributing factor [2]. In Indonesia, the 2023 National Health Profile recorded 3,572 maternal deaths in 2022, rising to 4,482 cases in 2023 [3].

Surgical site infection (SSI) is one of the most common complications following cesarean section (CS). SSI can lead to delayed wound healing, prolonged hospital stays, the need for additional antibiotics, and increased healthcare costs [1]. The administration of prophylactic antibiotics is the primary strategy for preventing SSI. POGI recommends the use of narrow-spectrum antibiotics such as cefazolin, administered 30–60 minutes before incision and not continued for more than 24 hours [1].

However, various studies in Indonesia indicate that the use of prophylactic antibiotics in clinical practice does not always adhere to guidelines. Arief et al. (2024) [4] reported that only 15.52% of subcutaneous (SC) prophylactic antibiotic use was rational, with the greatest discrepancies observed in the timing and duration of administration. Latief & Destian (2024) [5] found that 68% of patients received antibiotics for too long (Gyssens Category IIIA), while 22% were classified as Category IVC. Fajriyah et al. (2023) [6] reported that ceftriaxone was used in 99% of SC patients, even though national and international guidelines recommend cefazolin as the first-line treatment. Shafira Putri & Harlianti (2025) [7] found that only 42.91% of prophylactic antibiotic use was rational according to the Gyssens method, and no significant association was found between antibiotic rationality and the incidence of ILO.

The Gyssens method is a systematic evaluation algorithm used to assess the rationality of antibiotic use, encompassing an evaluation of indications, drug selection, dosage, dosing intervals, route of administration, timing of administration, and duration of therapy [8]. This method is recommended by the Indonesian Ministry of Health and has been widely used in the evaluation of antibiotic use in Indonesian hospitals [9].

To date, no study has simultaneously evaluated patterns of prophylactic antibiotic use, the rationality of antibiotic use based on the Gyssens method, and their association with the incidence of Surgical Site Infections (SSIs) in cesarean section patients at X Regional Hospital in Jakarta. Most previous studies have focused only on evaluating the rationality of antibiotic use or the incidence of SSI separately. Therefore, this study is novel in integrating the evaluation of the rationality of prophylactic antibiotics with an analysis of SSI incidence in a population of cesarean section patients at a regional hospital in Jakarta.

In addition, this study was conducted at a regional hospital in Jakarta that has different patterns of prophylactic antibiotic use compared to previous studies, thereby providing a local perspective that supports the evaluation of antibiotic use policies in hospitals.

## 2. Methods

### Study Design

This study is an analytical observational study using a retrospective cross-sectional approach. Data were obtained from the medical records of cesarean section

(CS) patients from January to December 2025 at a regional hospital in Jakarta, which is referred to in this study as Regional Hospital X in Jakarta.

### Population and Sample

The study population consisted of all patients who underwent cesarean section (CS) at X Regional Hospital in Jakarta in 2025. Based on a total population of 1,374 patients and using the Slovin formula with a 5% margin of error, a sample of 310 patients was obtained. Sampling was conducted using probability sampling with the simple random sampling technique.

### Inclusion and Exclusion Criteria

Inclusion criteria: female patients who underwent a cesarean section (elective or emergency) in 2025, received preoperative prophylactic antibiotics, had complete medical records (including type of antibiotic, dose, time of administration, route, and duration), underwent surgery at X Regional Hospital in Jakarta, and had no infection prior to the procedure. Exclusion criteria: incomplete medical records; patients who did not receive prophylactic antibiotics; patients who received antibiotics to treat pre-existing infections prior to surgery; and patients with a history of antibiotic allergy requiring a regimen outside of guidelines.

### Study Variables

Independent variables: type of prophylactic antibiotic and rationality of antibiotic use based on the Gyssens method (including appropriateness of indication, type of drug, dose, timing of administration, interval, route, and duration). Dependent variable: incidence of Surgical Site Infection (SSI), defined as infection at the surgical incision site within 30 days post-surgery based on medical records.

### Gyssens Assessment Categories

An assessment of rationality was conducted for all aspects of the Gyssens algorithm, including the appropriateness of indications, choice of antibiotic type, dosage, dosing interval, route of administration, timing of administration, and duration of therapy. The evaluation was conducted by comparing the practice of prophylactic antibiotic use with current national and international guidelines for cesarean section procedures.

The rationality of antibiotic use was evaluated using the Gyssens algorithm [8]: Category 0 (rational/appropriate use); Category I (inappropriate timing); Category IIA (inappropriate dose); Category IIB (inappropriate interval); Category IIC (inappropriate route); Category IIIA (duration too long); Category IIIB (duration too short); Category IVA (more effective alternatives available); Category IVB (less toxic alternatives available); Category IVC (cheaper alternatives available); Category IVD (alternatives with a narrower spectrum are available); Category V (no indication for antibiotics); Category VI (incomplete data).

### Data Analysis

Univariate analysis was used to describe the frequency distribution of all study variables. Bivariate analysis was conducted to examine the association between the rationality of prophylactic antibiotic use and the incidence of Surgical Site Infections (SSIs). Fisher's Exact Test was used because some cells had an expected count of less than 5, thereby violating the assumptions required for the Chi-square test. Additionally, odds ratio (OR) and 95% confidence interval (CI) analyses were performed to measure the risk of SSI occurrence in the group with irrational antibiotic use compared to the rational group. The significance level was set at $\alpha = 0.05$. Data were analyzed using IBM SPSS Statistics.

## Ethical Approval

This study received ethical approval from the Health Research Ethics Committee of the University of 17 Agustus 1945 Jakarta, under number: 207/KEPK-UTA45JKT/EC/EXP/4/2026, prior to the study's implementation.

## 3. Results and Discussion

### Demographic and Clinical Characteristics of Patients

A total of 310 cesarean section patients met the study's inclusion criteria. The patients' demographic and clinical characteristics included age, body weight, parity, and type of cesarean section.

**Table 1.** Demographic and clinical characteristics of cesarean section patient

| Characteristic | Category or statistic | Value |
|---|---|---|
| Age, years | 14–20 | 42 (13.5%) |
| | 21–30 | 186 (60.0%) |
| | 31–40 | 73 (23.5%) |
| | 41–45 | 9 (2.9%) |
| | Median (range) | 28 (14–45) |
| Body weight, kg | Median (range) | 63 (40–163) |
| Parity | Median (range) | 2 (1–9) |
| Type of cesarean section | Emergency | 211 (68.1%) |
| | Elective | 99 (31.9%) |

***Note:*** *Categorical data are presented as n (%), while continuous data are presented as median (range*)

The majority of patients were in the 21–30 age group, totaling 186 patients (60.0%). The median age of patients was 28 years, ranging from 14 to 45 years. The median body weight was 63 kg, ranging from 40 to 163 kg, and the median parity was 2, ranging from 1 to 9. Based on the type of procedure, emergency cesarean sections were more common than elective cesarean sections, accounting for 68.1% and 31.9%, respectively.

The predominance of patients of reproductive age indicates that cesarean sections are most frequently performed in the age group with the highest pregnancy rates. The high proportion of emergency procedures is likely related to the presence of specific obstetric conditions such as fetal distress, preterm rupture of membranes, or prolonged labor requiring immediate termination. These findings are consistent with national reports indicating that cesarean sections are still frequently performed in obstetric emergencies.

### Patterns of Prophylactic Antibiotic Use

The use of prophylactic antibiotics in cesarean section patients in this study consisted of cefazolin and ceftriaxone. Based on **Table 2**, ceftriaxone was the most commonly used prophylactic antibiotic, administered to 242 patients (78.1%), while cefazolin was used in 68 patients (21.9%). The high use of ceftriaxone indicates that broad-spectrum antibiotics are still more frequently used for CS procedures at the study hospital.

**Table 2.** Distribution of Types of Prophylactic Antibiotics in *Cesarean Section* Patients

| Antibiotic Type | Frequency (n) | Percentage (%) |
|---|---|---|
| Cefazolin | 68 | 21.9 |
| Ceftriaxone | 242 | 78.1 |
| Total | 310 | 100.0 |

These findings do not yet fully align with national or international guidelines. POGI and the WHO recommend cefazolin as the first-line prophylactic antibiotic for cesarean section because it is effective against bacteria that cause surgical site infections ( ), has a narrower spectrum of activity, and carries a lower risk of resistance. Conversely, the use of ceftriaxone—a third-generation cephalosporin—can increase the risk of antimicrobial resistance if used extensively and irrationally.

The results of this study are consistent with the findings of Fajriyah et al. (2023) [6], who reported the predominant use of ceftriaxone in patients undergoing cesarean section. Additionally, Latief and Destian [5] also found that the majority of prophylactic antibiotic use fell under Gyssens Category IV D, meaning there were alternative antibiotics with a narrower spectrum of activity.

## Rationality of Prophylactic Antibiotic Use Based on the Gyssens Method

The rationality of prophylactic antibiotic use in cesarean section patients was evaluated using the Gyssens method.

**Table 3.** Rationality of Prophylactic Antibiotic Use Based on the Gyssens Method

| Gyssens Category | Frequency (n) | Percentage (%) |
|---|---|---|
| Category 0 (Rational) | 68 | 21.9 |
| Category IVD (There are alternatives with a narrower spectrum) | 242 | 78.1 |
| Total | 310 | 100.0 |

The results of the study indicate that the majority of prophylactic antibiotic use is not yet rational based on the Gyssens method (**Table 3**). A total of 242 cases (78.1%) fell into the IVD category, meaning there were alternative antibiotics with a narrower spectrum, while only 68 cases (21.9%) fell into the rational category (Category 0).

Although the evaluation covered all components of the Gyssens algorithm, this study found no discrepancies regarding indications, dosage, dosing intervals, route of administration, timing of administration, or duration of therapy. All cases of irrational antibiotic use were found in the IVD category, meaning that there were alternative antibiotics with a narrower spectrum of activity, as recommended by the guidelines. This finding is consistent with the study by Sari et al., which showed that the Gyssens method is an effective tool for identifying irrational antibiotic use and supports efforts to improve the quality of antibiotic use in healthcare facilities [18].

The high proportion of Category IVD cases in this study is associated with the predominant use of ceftriaxone as a prophylactic antibiotic compared to cefazolin, which is recommended in the guidelines. Cefazolin, as a first-generation cephalosporin, has a narrower spectrum but remains effective against bacteria causing infections during CS procedures, making it more recommended for surgical prophylaxis. Conversely, the use of ceftriaxone, a third-generation cephalosporin , is considered inappropriate because it has a broader spectrum and the potential to increase antimicrobial resistance.

The findings of this study are consistent with the research by Arief et al. (2024) [4], which reported low rates of rational prophylactic antibiotic use among cesarean

section patients at Dr. Kariadi General Hospital in Semarang. A study by Wibowo et al. (2020) [11] also showed that the use of antibiotics not in accordance with guidelines during obstetric surgical procedures remains high. Additionally, Shafira Putri and Harlianti (2025) [7] reported that the majority of prophylactic antibiotic use in cesarean section patients is still considered irrational based on the Gyssens method.

These findings suggest that periodic evaluation of antibiotic use through the Antimicrobial Resistance Control Program (PPRA) has the potential to improve the rational use of prophylactic antibiotics. Educating healthcare workers on the selection of prophylactic antibiotics in accordance with guidelines is also necessary to improve the rational use of antibiotics and reduce the risk of antimicrobial resistance in hospitals.

## Incidence of Surgical Site Infections (SSI)

The incidence of surgical site infections in cesarean section patients during the study period was analyzed based on the presence or absence of postoperative signs of infection.

**Table 4.** Incidence of Surgical Site Infections (SSI)

| Incidence of SSI | Frequency (n) | Percentage (%) |
|---|---|---|
| No ILO | 303 | 97.7 |
| With ILO | 7 | 2.3 |
| Total | 310 | 100.0 |

Based on **Table 4** the majority of patients did not experience surgical site infections following cesarean section. SSI was found in only 7 patients (2.3%), while 303 patients (97.7%) did not experience SSI. These figures indicate that the incidence of SSI in this study was relatively low.

Low rates of surgical site infections may be influenced by various factors other than the use of prophylactic antibiotics, such as proper surgical techniques, operating room sterility, healthcare workers' adherence to infection prevention procedures, patients' clinical conditions, and the quality of postoperative wound care. The use of prophylactic antibiotics also plays a role in reducing the risk of surgical site infections.

Although the ILO rate in this study was low, it is still important to evaluate the rationality of antibiotic use to ensure the effectiveness of treatment and prevent antimicrobial resistance resulting from the use of antibiotics that does not follow guidelines.

## Relationship Between Rational Antibiotic Use and Incidence of SSI

The relationship between the rationality of prophylactic antibiotic use and the incidence of surgical site infections was analyzed using Fisher's Exact Test.

**Table 5.** Relationship between Antibiotic Rationality and SSI Incidence

| Rationality | SSI | | Total | |
|---|---|---|---|---|
| | No SSI | ILO Present | N | % |
| Rational (Cat. 0) | 67 | 1 | 68 | 21.9 |
| Irrational (Cat. IVD) | 236 | 6 | 242 | 78.1 |
| Total | **303** | **7** | **310** | **100.0** |
| ***Fisher's Exact Test: p = 0.704*** | | | | |
| **Odds Ratio (95% CI) = 1.70 (0.20–14.44)** | | | | |

**Table 5** shows that the majority of patients, in both the rational and irrational antibiotic use groups, did not experience surgical site infections. In the rational antibiotic

use group (Category 0), 67 patients (98.5%) did not experience SSI and 1 patient (1.5%) did. Meanwhile, in the irrational antibiotic use group (Category IVD), 236 patients (97.5%) did not experience SSI and 6 patients (2.5%) experienced SSI.

The results of the analysis using Fisher's Exact Test showed a p-value of 0.704 ($p > 0.05$), indicating that there was no statistically significant association between the rational use of prophylactic antibiotics and the incidence of surgical site infections among cesarean section patients at the study hospital. The lack of a significant association in this study was likely due to various factors that also influence the incidence of surgical site infections. The incidence of SSI is a multifactorial condition influenced not only by the use of prophylactic antibiotics but also by patient factors such as obesity, diabetes mellitus, anemia, nutritional status, and premature rupture of membranes, as well as surgical factors such as aseptic technique, duration of surgery, instrument sterility, and postoperative wound care.

The risk analysis indicates that patients receiving irrational prophylactic antibiotics are 1.70 times more likely to experience ILO than patients receiving rational antibiotics (OR = 1.70; 95% CI = 0.20–14.44). However, the extremely wide confidence interval, which spans the value of 1, suggests that this risk estimate is unstable and not statistically significant.

In addition, the low number of ILO cases in this study—only 7 cases (2.3%)—may affect the statistical power in detecting an association between the two variables. The implementation of good infection control procedures in hospitals may also have played a role in reducing the incidence of ILO, even though the use of prophylactic antibiotics remains largely irrational.

The results of this study are consistent with the research by Shafira Putri and Harlianti (2025) [7], who also reported no significant association between the rational use of prophylactic antibiotics and the incidence of ILO in patients undergoing cesarean section. Nevertheless, the high rate of irrational antibiotic use remains a major concern because it can increase the risk of antimicrobial resistance, treatment costs, and potential drug side effects. Therefore, periodic evaluation and monitoring of antibiotic use remain necessary to improve the quality of healthcare services and support more rational antibiotic use.

### Study Limitations

This study has several limitations. First, the number of ILO cases identified was relatively low only 7 cases (2.3%) limiting the statistical power to detect an association between rational antibiotic use and the incidence of ILO. Second, the retrospective study design relies on the completeness and accuracy of medical record data. Third, several potential risk factors that may influence the incidence of ILO, such as obesity, diabetes mellitus, anemia, nutritional status, duration of surgery, preterm rupture of membranes, and adherence to aseptic procedures, have not been analyzed multivariately. Therefore, future studies are recommended to use a more comprehensive design that takes these confounding factors into account.

## 4. Conclusion

A study of 310 cesarean section (CS) patients at X Regional Hospital in Jakarta in 2025 showed that the majority of patients were in the 21–30 age group, with a median age of 28 years, a median body weight of 63 kg, a median parity of 2, and a predominance of emergency CS procedures (68.1%). The most commonly used prophylactic antibiotic was ceftriaxone (78.1%), although national and international

guidelines recommend cefazolin as the first-line treatment. Based on the Gyssens method, only 21.9% of antibiotic use was rational (Category 0), while 78.1% was irrational (Category IVD—alternatives with a narrower spectrum exist). The incidence of ILO was relatively low at 2.3%. Fisher's Exact Test showed no significant association between antibiotic rationality and ILO incidence ($p = 0.704$). Although the group with irrational antibiotic use had a 1.70-fold higher risk of ILO compared to the rational group, this association was not statistically significant. These findings underscore the need for an Antimicrobial Stewardship Program (ASP) and periodic evaluation of prophylactic antibiotic policies at X Regional Hospital in Jakarta to promote rational antibiotic use and prevent antimicrobial resistance.

**Acknowledgments:**
The authors would like to express their deepest gratitude to X Regional Hospital in Jakarta for granting permission to conduct this study and providing access to medical records, as well as to the Faculty of Pharmacy at the University of 17 Agustus 1945 Jakarta for the institutional support provided throughout this study.

**Conflict of Interest:**
The authors declare that there are no conflicts of interest regarding the publication of this manuscript.

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