Policy Research Journal
ISSN (E): 3006-7030 ISSN (P) : 3006-7022 Volume 3, Issue 12, 2025

INVESTIGATION OF POST CAESAREAN SECTION WOUND INFECTIONS AT KAUSAR HOSPITAL KHAIRPUR MIR'S: RISK FACTORS, INCIDENCE RATES, BACTERIAL PROFILE & ANTIMICROBIAL RESISTANCE PATTERN

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DOI: https://doi.org/10.5281/zenodo.17891605

Keywords
Post-operative patients, Incidence rate, Antimicrobial resistance

Article History
Received: 11 October 2025
Accepted: 21 November 2025
Published: 11 December 2025

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Abstract

Caesarean section, also commonly referred to as C-section, is a medical operation that entails cutting of the abdomen and uterus of a mother. Failure to keep proper care after discharge may result in the development of infected surgical wounds. This study was aimed at determining the prevalence, risk factors, incidence, type of bacteria involved and trend of resistance to antibiotics in C-section wound infections in patients of Kausar Hospital, Khairpur Mir, Sindh, Pakistan.

Sample pus was collected on sterilized swabs of the various hospital units under the use of sterilized Arnie. Furthermore, the information about possible risk variables was obtained with the help of the standardized questionnaire. The gathered samples were cultivated selectively and differentially using the media. Colony morphology and biochemical testing were used to identify the bacteria, and when necessary, a Micro Scan system was used for confirmation. Clinical and laboratory standards Institute (CLSI) guidelines were observed in carrying out antibiotic and antiseptic susceptibility testing.

The most important risk factor was ignored personal hygiene (87%), then there was improper medication adherence (70%), and low socioeconomic status (68%). The rates of the infection were recorded in 97 cases and the maximum number was in the period of June-August during a year.

Six different bacterial species were isolated: Staphylococcus aureus, Escherichia coli, Pseudomonas aeruginosa, Klebsiella pneumoniae, *methicillin-resistant* Staphylococcus aureus *(MRSA), and* Staphylococcus epidermidis. *Findings on the antibiotic sensitivity revealed that the isolates were broadly resistant. It was however found that gram-negative bacteria were susceptible to gentamicin and Augmentin, gram-positive bacteria were susceptible to cefoxitin and Augmentin. Spirit was the second-best antiseptic among the ones tried corresponding to Dettol and Pyodine.*

Based on findings, post C-section wound infection is not uncommon and most of

the agents that cause it are becoming resistant to conventional medicines. These results demonstrate the need of clinicians to use careful antibiotic stewardship and do further studies to identify new therapeutic drugs to curb this problem.

1. INTRODUCTION

A Caesarean section, commonly known as a C-section, is a surgical procedure used to deliver a baby by making incisions in the mother's abdomen and uterus. This approach is frequently used for a number of medical reasons, including issues with the mother's health, numerous births, or health issues with the baby. C-sections might be scheduled beforehand or performed as an emergency technique when unforeseen problems occur during labor. Although some deliveries are done by cesarean section, the rate is far greater in a number of nations, and the World Health Organization cautions against exceeding 10-15%. This study examines the causes of the rise in C-sections, talks about the possible advantages and disadvantages of the procedure, and assesses how it affects the health of expectant mothers and their babies. (Singanayagam *et al.*, 2022).

BACKGROUND INFORMATION ON OBSTETRIC SURGICAL PROCEDURES

In the past, Caesarean sections were usually saved for dire circumstances in which giving birth vaginally would have put the mother and the unborn child in grave danger. Nonetheless, in many nations, including Pakistan, the number of C-sections has gradually increased in recent decades. The World Health Organization (WHO) states that the optimal rate of cesarean sections to attain the greatest results for mothers and newborns is between 20% and 35%; nevertheless, current global rates are higher than this suggestion (Battisti, 2022). This increasing tendency has been caused by a number of variables, including maternal preference, anxiety related to vaginal delivery, maternal age, obesity, and the increasing use of medical interventions during labor. There might also be need to deliver through a surgical procedure due to some medical issues, such as placement of a breech, two or more births, and fetal distress. There are certain risks associated with cesarean sections despite the fact that the procedures might be very crucial in saving the lives of both the mother and the child. These are predisposition to complications like blood clots, infection, and excessive bleeding among others. Also, babies born through cesarean section might have a greater risk of respiratory difficulties as well as a longer recovery time (Obstetricians & Gynecologists, 2021).

RISKS AND BENEFITS OF C-SECTION

The cesarean section (C-section) is a serious operation that may endanger both the mother and the unborn child. The possible outcome on the mother is infections, excessive bleeding, injuries to internal organs, and the prolonged recovery period compared to a vaginal birth. Infants might suffer such issues as low birth weight, respiration issues, and a lactation problem. These dangers are not without some benefits of C-sections. They are able to reduce the chances of maternal incontinence, fetal discomfort and complications during birth. Cesarean section may prove to be a better option under the circumstances of high-risk pregnancies like multiple pregnancy as well as in cases where the mother has underlying health complications (Wender *et al.*, 2022).

COMPLICATIONS OF OBSTETRIC SURGICAL PROCEDURES

As it has been mentioned above, obstetric surgical interventions are characterized by certain threats, and complications might develop in some cases. Blood clots can increase the risk of bleeding, which is highly detrimental, as a result of long immobilization before and after surgery (Programme, 2015). Postoperative pain can be treated with medication and this is usually common after surgery. Surgery obstetrics can occasionally be slow to heal and new mothers can be tired or have newborn care problems. The specific type of surgery, the specific health condition of the patient and the competence of the medical team involved are among the factors that may influence the likelihood and the severity of the specified outcomes. Patients must engage in

deep discussions with their medical practitioners about the potential risks and benefits of any surgical operation in order to get the knowledge that they need to make informed decisions about their care (Miller *et al.*, 2020).

IMPACT ON MATERNAL AND NEONATAL OUTCOMES

Cesarean section (C-section) effects on maternal and neonatal health outcomes have been put into question. Although it has been reported that C-sections could correlate with higher risks of maternal mortality, maternal complications, and health complications among the newborn compared to vaginal births, other studies show that there could be few differences in the consequences of the two delivery modes. The long-term effects of C-sections on such variables as future fertility, breastfeeding, and child development need to be researched. Although C-section is a common and at times medically necessitated delivery mode, the increased C-section cases around the globe create the risk that most of the C-section surgeries are done unnecessarily or unrelated to the medical conditions. To optimize the maternal and neonatal health outcomes, additional research and the approaches toward mitigating the unwarranted C-sections are necessary due to the risks they pose to both mother and child (Vogel *et al.*, 2023).

REASONS BEHIND THE HIGH RATE OF C-SECTIONS

The increasing number of caesarean section (C-section) delivery is caused by a set of factors such as the development of the healthcare system, cultural factors, and the valid medical reasons. Patient and medical personnel convenience, expectant mothers request, and fear of vaginal birth are also cited as factors that contributed to the surge in the application of C-sections. C-sections have medical grounds in case of a breech, fetal distress, or pregnancy or labor complications. Despite such justifications, research indicates that a large percentage of C-sections are arguably unnecessary and not medically warranted although with valid reasons behind it. C-sections are sometimes advised because of the concerns over the health of the mother or the baby, although a vaginal birth can still be an option, is necessary, or can still put the mother at risk of complications (Kibe *et al.*, 2022).

FACTORS CONTRIBUTING TO THE OVERUSE OF CAESAREAN SECTION

There has been a debate on whether cesarean is more common and therefore, problems that cause its excessive application in obstetric practice ought to be resolved to improve the wellbeing of the mother and the child. Establish the reasons behind the high rates of cesarean section.

1. To find out the causes of Caesarean section high rates of obstetric care.
2. To investigate the health consequences of Caesarean sections, especially those that are performed needlessly.
3. To understand the effectiveness of the patient education, physician training and policy changes among others in reducing the rates of Caesarean sections.
4. To make suggestions for reducing the overuse of Caesarean sections in obstetric care and enhancing the health of both the mother and the fetus.

CONTROVERSY SURROUNDING CAESAREAN SECTION RATES

Caesarian section is one of the most debatable procedures in obstetric operating room. Despite the fact that cesarean section may be necessary and life-saving in some medical cases, it is often abused leading to more complications to newborns and mothers (Ana P. Betran *et al.*, 2016). The World Health Organization (WHO) recommends that C-section rates should ideally remain between 10% and 15% because higher rates are not associated with better health outcomes. Many countries, however, report far higher rates; in 2019, the United States had a 31.9% cesarean delivery rate (Martin *et al.*, 2021).

METHODS

AREA OF STUDY

From January to December 2022, the study was conducted at the Obstetrics and Gynecology Department of Kausar Hospital in Khairpur Mir, Sindh, Pakistan.

INCLUSION CRITERIA AND EXCLUSION CRITERIA

This study included patients exhibiting symptoms of a wound infection from a cesarean section. Patients who did not exhibit any of the symptoms or signs were not included in this study, nor were those who had taken antibiotics in the previous 72 hours.

RESEARCH STRATEGY

The pus Samples were aseptically collected from the Postnatal Care (PNC) wards using sterile Amie's transport swabs. Each sample was properly labeled and transported to the Microbiology Laboratory at Kausar Hospital, Khairpur Mir's, Sindh, Pakistan, in a cold chain thermal box maintained at 5°C, for the isolation and identification of bacterial pathogens responsible for post-cesarean wound infections. Clinical and demographic data were also documented, such as patient age, parity, residential address, type of cesarean section (emergency or elective), and literacy-based education level. Additionally noted were the patient's address, the type of cesarean section (emergency or elective), and their literacy-based educational attainment.

ANTIBIOTIC SENSITIVITY PROFILE

Antimicrobial susceptibility testing was done to identify the optimal clinical care plan. The antibiotic sensitivity of the isolates was assessed using the Kirby-Bauer disk diffusion method. A bacterial suspension was prepared and adjusted to meet the 0.5 McFarland turbidity standard (roughly 0.5×105cfu/mL) after the bacteria had grown on an agar plate for the entire night. The standardized bacterial suspension was poured into Mueller-Hinton agar plates that were 150 mm in diameter. After incubating the plates with antibiotic discs on the plate surface with sterile forceps, the plates were incubated over a period of one day. The measurement and classification of the inhibitory zone were determined the next day and classifying it as sensitive, moderate, or resistant in accordance with the guidelines provided by the Clinical and Laboratory Standards Institute (CLSI) (Zakosek Pipan *et al.*, 2019). The results of the antibiotic panel are presented in (Table 1).

Tabled 1. Panel of Antibiotics

S. No.	Abb:	Antibiotic:	Potency:
1	AK	Amikacin	(30pg)
2	AUG	Amoxycillin / Clavulanic acid	(30pg)
3	SCF	Sulbactam / Cefoperazone	(105pg)
4	GN/CN	Gentamicin	(lOmcg)
5	TGC	Tigecycline	(15pg)
6	FC	Fusidic acid	(lOfig)
7	FOX	Cefoxitin	(30pg)
8	VA	Vancomycin	(30pg)
9	CAZ	Ceftazidime	(30mcg)
10	CRO	Ceftriaxone	(30pg)
11	C1P	Ciprofloxacin	(5jig)
12	NA	Nalidixic Acid	(30pg)
13	IM1	Imipenem	(10pg)
14	LEV	Levofloxacin	(5jig)
15	TZP	Piperacillin / Tazobactam	(HOpg)

16	DA	Clindamycin	(lOftg)

ANTISEPTIC SENSITIVITY PROFILE

Agar well diffusion method was used to determine the antibacterial activity of different antiseptics on Muller Hinton agar with small changes. Each of the bacterial isolates was tested using commercial antiseptics, such as Spirit, Pyodine, and Dettol. The same procedure that was carried out to determine the susceptibility to antibiotics was used to prepare bacterial suspensions. When the suspension was well spread on the agar surface, 6 mm diameter wells were cored into the agar surface with a sterile subject. Wells were made in the inoculated plates by an agar well-puncher.

A separate Petri dish was designated for each antiseptic, and the wells were filled individually using a sterile pipette. Each well received 50 microliters of the respective antiseptic. The plates were then incubated in an upright position at 37°C for 24 hours. After incubation, the diameter of the zones of inhibition was measured in millimeters (mm). Inhibition was categorized based on the radius from the edge of the well to the edge of the clear zone: a radius of 10–14 mm was considered strong inhibition, while a radius of 6–9 mm indicated moderate inhibition (Wanja *et al.*, 2020).

RESULTS

RISK FACTORS ANALYSIS

During this study multiple risk factors for C-section wound infections **Several high-risk factors contributing to infections were identified in the population, including age, obesity, anemia, history of multiple surgeries, diabetes, poor personal hygiene, improper medication use, low socioeconomic status, and poor adherence to postoperative care instructions.** The poor personal hygiene was found higher risk factors (87%) followed by improper medication (70%) and socioeconomic status (68%) are shown in (Figure 1).

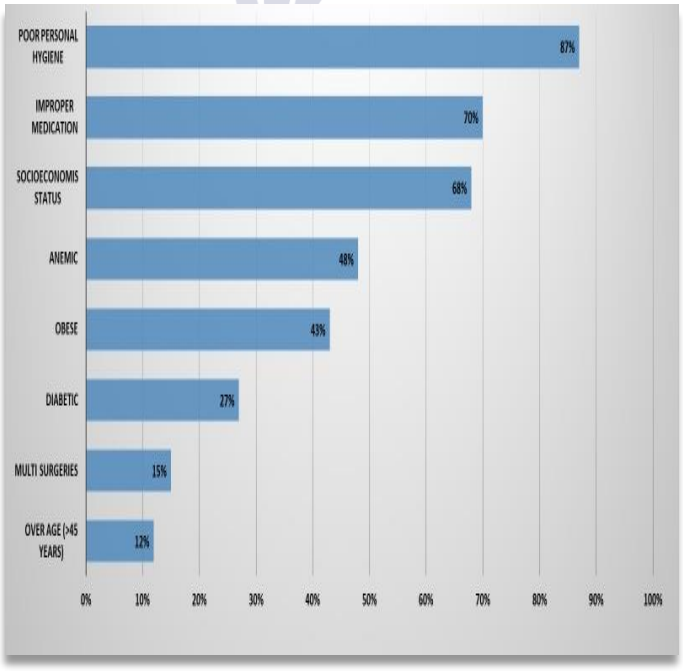

Figure 1. Risk Factors

INCIDENCE RATES

Over the course of a one-year study, a total of 97 cases of cesarean section wound infections were recorded. The highest number of cases occurred between June and August. Monthly incidence rates are illustrated in (Figure 2).

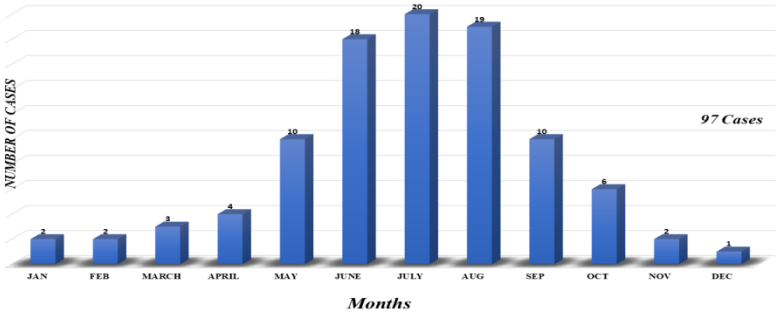

Figure 2. Incidence Rates

Out of 97 collected samples, bacterial growth was observed in 78 on different culture media. The isolates were identified based on their cultural, microscopic, and biochemical properties (Figure 3).

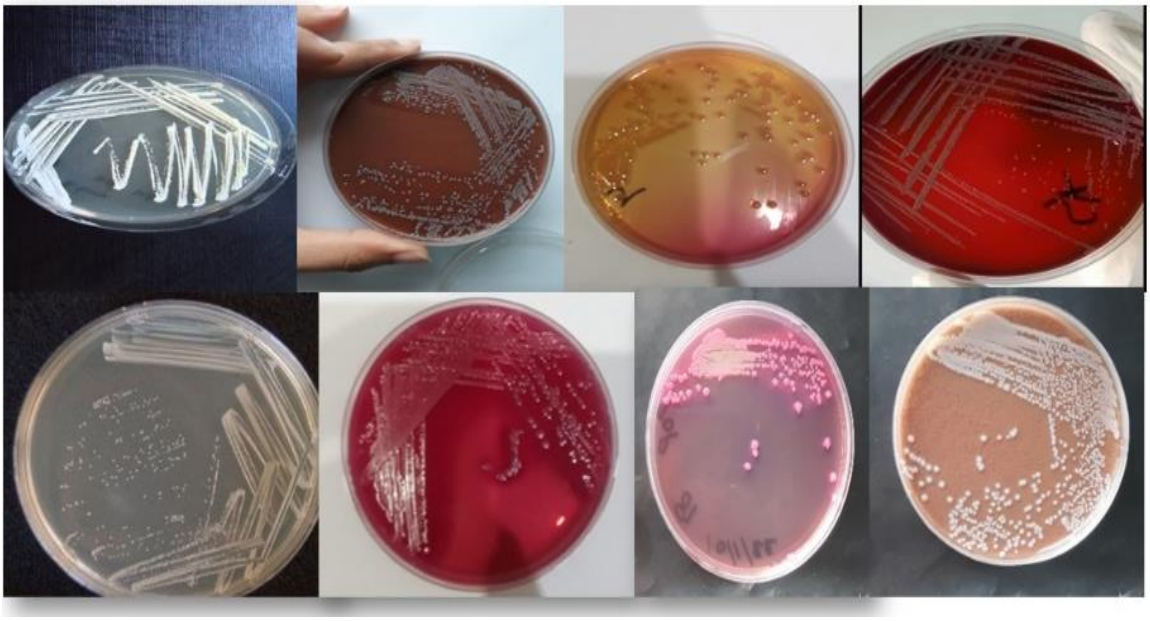

Figure 3. Isolated Bacteria

Cultural characteristics of the bacterial isolates were assessed based on colony morphology, including shape, color, size, and edge appearance. There were 42 isolates all of which had round, convex colonies measuring approximately 1 to 4 mm in diameter, smooth and shiny surface, and golden to yellow pigmentation. The colonies of fifteen isolates were round, elevated, and 1 to 2 mm in diameter. They were white-edged and also had similar smooth and glossy surfaces. Nine isolates formed pinpoint colonies, which were either small (1 mm to 2 mm in diameter) or large, bright pink in color and had a rough or smooth texture. Six isolates showed flat

colonies, measuring about 2–3 mm, dark gray in color, and exhibiting a metallic sheen. Another six isolates produced circular colonies, about 2–4 mm in diameter, ranging from pink to red in color, with a mucoid and sticky appearance.

Gram staining revealed that the isolates included both Gram-positive and Gram-negative bacteria. Among them, 57 isolates were Gram-positive cocci arranged in clusters, while 21 were Gram-negative rods typically occurring singly.

Biochemical testing further aided in identification. Forty-two isolates showed beta-haemolysis on blood agar and tested positive for catalase, coagulase, and DNase, indicating *Staphylococcus aureus*. Fifteen isolates were non-haemolytic, catalase-positive, coagulase-negative, and DNase-negative, suggesting they were coagulase-negative *staphylococci*.

negative that were identified *S. epidermidis.* Out of 42 *S. aureus* isolates, 33 were found MSSA and 9 were found MRSA on the basis of zone of inhibition around cefoxitin on antibiotic disc. On the basis of biochemical tests, the *P. aeruginosa, Escherichia coli, Klebsiella pneumoniae* were found. The biochemical tests results and bacterial identity. Higher number of bacteria among wound samples were found an S. *aureus* (33%) followed by S. *epidermidis* (15%). Percentage of each organism is mentioned in (Figure.4).

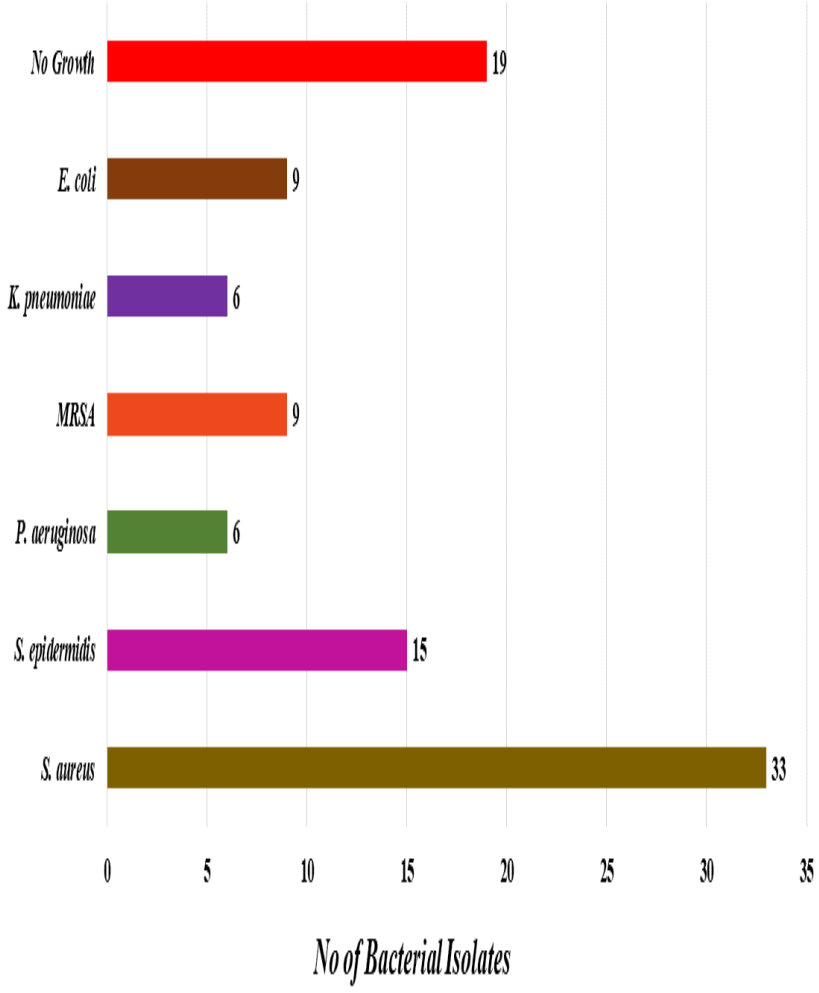

Figure 4. Bacterial Profile Based on this Study

A total of six pathogenic bacterial species were isolated from wound infection samples. The most commonly identified organism in pus samples was *Staphylococcus aureus*, accounting for 33 isolates (34.0%), followed by *Staphylococcus epidermidis* with 15 isolates (15.46%). Methicillin-resistant *Staphylococcus aureus* (MRSA) was detected in 9 samples (9.27%), while *Pseudomonas aeruginosa* and *Klebsiella pneumoniae* were each found in 6 samples (6.18%). *Escherichia coli* was also identified in 9 samples (9.27%).

Antibiotic susceptibility test results showing that most of the bacteria exhibited resistance to several antibiotics. However, **Augmentin and cefoxitin** were found to be effective against Gram-positive bacteria, while **Augmentin and gentamicin** showed efficacy against Gram-negative bacteria. The **zone of inhibition** results is presented in **Figure 5**, In the figure, **red boxes** indicate resistant bacteria, **green boxes** indicate sensitivity, and **blue boxes** represent intermediate responses to the respective antibiotics.

ANTIBIOTIC SUSCEPTIBILITY TEST RESULTS

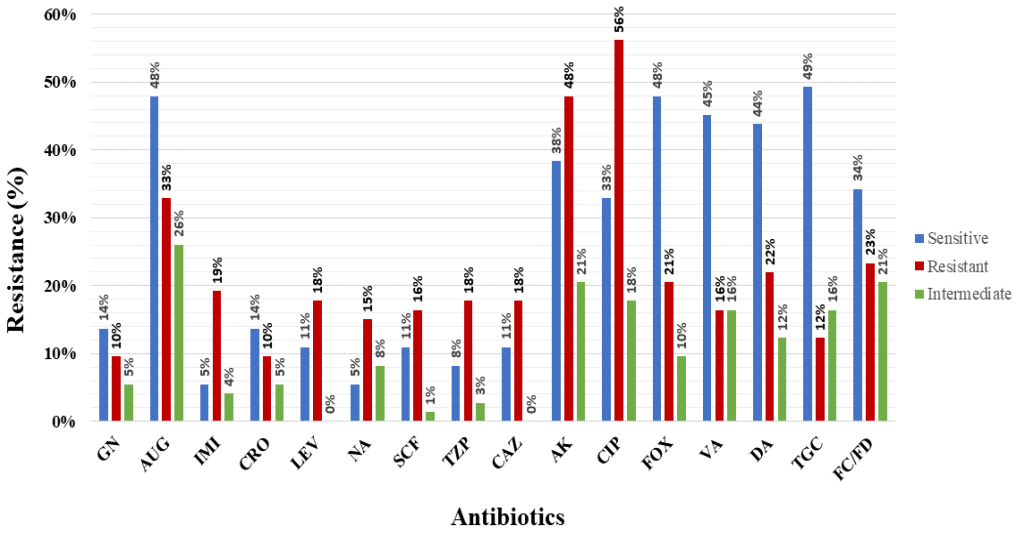

Figure 5. Drug Resistance Among Bacterial Isolates

ANTISEPTICS SUSCEPTIBILITY TEST RESULTS

The results of the antiseptic susceptibility test showed that **Dettol was effective against** *Escherichia coli*, *Staphylococcus aureus*, *Staphylococcus epidermidis*, **and methicillin-resistant** *Staphylococcus aureus*. *Staphylococcus aureus*, *Escherichia coli*, and *Pseudomonas aeruginosa* exhibited either moderate or strong zones of inhibition when exposed to spirit. Similarly, *Staphylococcus aureus*, *Escherichia coli*, methicillin-resistant *Staphylococcus aureus* (MRSA), and *Staphylococcus epidermidis* also showed moderate to strong inhibitory responses to pyodine. The **zone of inhibition** measurements (in mm) is provided in **Table 2**, where the boxes represent levels of inhibition — moderate or severe.

Table 2. Antiseptic Test Results

BACTERIAL ISOLATES	ZONEDETOL Mean ± Std	ZONE PYODINE Meant Std	ZONE SPIRIT Meant Std
S. aureus	28.00 mm ± 0.00 mm	20.00 mm ±9.90 mm	13.75 mm ±15.20 mm
E. coli	12.50 mm ±0.00 mm	11.50 mm ±0.00 mm	10.00 mm ±0.00 mm
K. pneumoniae	1.00 mm ±1.41 mm	2.50 mm ±0.00 mm	6.00 mm ±0.00 mm
MRSA	19.00 mm ±0.00 mm	16.00 mm ±0.00 mm	2.00 mm ±0.00 mm
S. epidermidis	20.00 mm ±0.00 mm	24.00 mm ±0.00 mm	4.00 mm ±0.00 mm
P. aeruginosa	5.75 mm ±6.01 mm	12.00 mm ±0.71 mm	14.50 mm ±7.07 mm

Severe inhibition (10-14mm) **Moderate inhibition (6-9 mm)**

DISCUSSION

The incidence, risk factors, bacterial profiles, and patterns of antibiotic resistance of surgical site infections (SSIs) after caesarean sections were investigated in this study from January to December 2022 at Kausar Hospital in Khairpur Mir, Sindh. The results show a high SSI incidence of 20 per 100 caesarean sections, with 97 recorded instances over the course of the study, peaking in July, August, and June. This is probably because seasonal temperature rises potentially jeopardize surgical sterility. The detected infection rate is in line with earlier research carried out in comparable clinical and socioeconomic contexts. However, it is higher than the prevalence found in tertiary care facilities in Brazil (23.3%), Tanzania (48.2%), and Karachi (24.3%), possibly because of variations in patient demographics, postoperative care procedures, and healthcare infrastructure (Panwar *et al.*, 2021), (Shimano *et al.*, 2020).

Risk Factors and Contributing Condition. A number of predisposing factors were significantly associated with SSIs in this study. These include:

1. Age >45 years (12%)
2. Multiple surgeries (15%)
3. Anemia (48%)
4. Diabetes (27%)
5. Obesity (43%)
6. Poor personal hygiene (87%)
7. Inappropriate medication (70%)
8. Low socioeconomic status (68%)

These results are consistent with those of (Molla *et al.*, 2019), who found that anemia, diabetes, obesity, age, and poor hygiene all raise the risk of postoperative infections. Additionally, research from Saudi Arabia, Jimma (Ethiopia), and Tigray has shown that moms in rural locations were 2.3 times more likely to acquire SSIs than mothers in urban areas (Amenu *et al.*, 2011; Wendmagegn *et al.*, 2018; Tran *et al.*, 2000). The process connected to SSI is also highlighted in the paper. An infection was 3.5 times more likely to occur in women who went into labor more than 24 hours before a cesarean operation. This validates previous research conducted in Ethiopia and Nigeria (Ojiyi *et al.*, 2013; Wodajo *et al.*, 2017; Abebe *et al.*, 2021; Gelaw and Abdela, 2018).

The risk of chorioamnionitis and subsequent SSI is increased when membranes rupture prior to surgery, increasing exposure to microorganisms through non-sterile amniotic fluid. According to studies

conducted in Tanzania and Israel, patients with pregnancy-induced anemia had a two to three times higher risk of developing SSI (Schneid-Kofman *et al.,* 2005; Mpogoro *et al.,* 2014). The suggestions made by (Gong *et al.,* 2012), (Dacho and Angelo 2018), and (Gordillo and Sen 2003) for dietary treatments and anemia management during prenatal care were reinforced by the fact that a hematocrit (HCT) level below 30% elevated SSI risk by 3.2 times. Microbial Profile and Antimicrobial Resistance. Among the 97 wound swabs analyzed, 80% showed bacterial growth. The most frequently isolated organisms were:

1. *Staphylococcus aureus (33%)*
2. *Staphylococcus epidermidis (15%)*
3. *MRSA (9%)*
4. *E. coli (9%)*
5. *Klebsiella pneumoniae (6%>)*
6. *Pseudomonas aeruginosa (6%)*

These results are similar to those of (Shimano *et al.,* 2020) and (Njoku *et al.,* 2019), who similarly identified *S. aureus* as the most common SSI pathogen. Given that *E. Coli* and *Klebsiella spp.* are considered normal vaginal flora, their presence is not surprising. Their participation in SSIs, however, suggests that surgical asepsis is impaired.

Gram-positive cocci (*Staphylococcus aureus* and CONS) responded favorably to Augmentin and Cefoxitin in terms of antibiotic susceptibility, while gram-negative organisms responded favorably to Augmentin and Gentamycin. Concerns about antimicrobial resistance around the world were echoed by CONS's resistance to cephalosporins, amoxicillin/clavulanate, gentamicin, meropenem, and fluoroquinolones (FEHMIDA *et al.,* 2019). All SSI patients stayed in the hospital for more than 10 days, a sign of longer recovery times and higher health care costs.

This conforms to the past research conducted by (Leboffe and Pierce 2005) who indicated that patients who are discharged before 72 hours can still develop SSIs upon release. Another major limitation of this study which could have caused underreporting is the fact that, post-discharge surveillance was not included. The current study has found that there is a higher incidence of SSI, compared to the previous studies that were done in Khairpur and other rural regions of Pakistan

This is because Kausar Hospital is mostly targeted to a rural population that do not access high quality surgical care and lack the proper infrastructure and the specialized surgeons. These macro problems align with the research of (Panwar *et al.,* 2021) and (Bonnans and Shapiro 2013) who concluded that emergency procedures, lack of aseptic practices and long surgical hours increase the risk of infection.

RECOMMENDATIONS

The findings underscore the urgent need for:

1. Better preoperative screening and treatment of anemia, diabetes, among other comorbidities.
2. Prophylactic antibiotic usage on a regular basis and stringent aseptic procedures.
3. Enhanced education and hygiene standards amongst the rural people.
4. Post-discharge surveillance to allow more precise tracking of SSI
5. Constant tracking of the trends in antibiotic resistance to guide the empirical treatment guidelines.

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