

# A Prospective Study on Wound Infection Rates in Elective Vs Emergency Abdominal Surgeries

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## Abstract

**Background:** Surgical site infections (SSIs) remain one of the most frequent postoperative complications, contributing to prolonged hospital stays, increased morbidity, and higher healthcare costs. SSI incidence varies significantly between elective and emergency abdominal surgeries due to differences in preoperative preparation, surgical environment, and patient-related risk factors. Understanding these patterns is critical to developing effective infection prevention protocols. This study aimed to compare the incidence and determinants of wound infections in elective versus emergency abdominal surgeries in a tertiary care hospital setting. **Material and Methods:** A prospective observational study was conducted over 12 months in the Department of General Surgery at a tertiary care hospital. Two hundred patients undergoing abdominal surgeries were included, comprising 100 elective and 100 emergency cases. Patients were monitored for postoperative wound infection using CDC criteria. Data on age, sex, comorbidities, wound class, duration of surgery, antibiotic prophylaxis, and hospital stay were collected. Wound swabs were taken for microbiological culture and sensitivity in suspected cases. Statistical analysis was performed using Chi-square and Student's t-tests, and  $p < 0.05$  was considered statistically significant. **Results:** The overall wound infection rate was 18%, with a higher incidence in emergency surgeries (28%) compared to elective procedures (8%). *Staphylococcus aureus* and *Escherichia coli* were the predominant organisms isolated. Factors significantly associated with infection included contaminated or dirty wound class, prolonged operative duration ( $>2$  hours), diabetes mellitus, and emergency status ( $p < 0.05$ ). The mean postoperative hospital stay was significantly longer in infected patients ( $12.8 \pm 4.2$  days) compared to non-infected patients ( $7.1 \pm 2.9$  days). **Conclusion:** Emergency abdominal surgeries have a substantially higher risk of wound infection than elective procedures, primarily due to a lack of preoperative optimisation and higher wound contamination. Strict adherence to aseptic technique, rational use of antibiotics, and early identification of risk factors can effectively reduce postoperative morbidity. Institutional infection control protocols must emphasise perioperative risk stratification to minimise SSI rates.

**Keywords:** Surgical site infection, Elective surgery, Emergency surgery, Abdominal operations, Wound infection rate, Postoperative complications, Infection control, Risk factors.

Received: 09 August 2025

Revised: 27 September 2025

Accepted: 16 October 2025

Published: 29 October 2025

## INTRODUCTION

Surgical site infections (SSIs) are among the most prevalent postoperative complications, which negatively impact surgical outcomes and healthcare resources globally. They make up nearly 20% of all hospital-acquired infections, and they lead to major postoperative morbidity, longer hospitalisation, delayed recovery, and increased costs of treatment.<sup>[1]</sup> SSIs are defined as infections that occur within 30 days of surgery at the incision site or deeper tissues, and are a critical marker of surgical quality and aseptic technique in hospitals.<sup>[2]</sup> The wound infection rate varies depending on the type of surgery, the patient's overall condition, comorbidities, wound classification, and the surgical field intra-operatively. Abdominal surgical procedures, in particular, have higher infection rates due to the inherent presence of endogenous microorganisms and the risk of faecal contamination from the gastrointestinal tract.<sup>[3]</sup> Several patient-related risk factors include diabetes mellitus, anaemia, malnutrition, obesity, and immunosuppressed status, and procedural factors such as lengthy operative time, status of emergency surgery, and inadequate sterilisation technique that can increase the risk of infection.<sup>[4]</sup> Elective

abdominal surgeries are generally performed orderly after adequate preoperative preparations, medical optimisation of comorbidities, bowel preparation when required, and timely surgical antibiotic prophylaxis.<sup>[5]</sup> Emergency abdominal surgeries are generally performed without adequate time to optimise the patient's medical status, in less-than-ideal circumstances, and often in the presence of contaminated or dirty wounds. Collectively, these factors will lead to increased infection rates in emergency surgery versus elective.<sup>[6]</sup> Surgical site infections contribute to both a clinical burden and a reflection of perioperative care at an institution. Modern antibiotics, more effective sterilisation techniques, and stringent infection control

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**DOI:**  
10.21276/amt.2025.v12.i3.150

**How to cite this article:** Balsingh D, Veena G, Kumar MR. A Prospective Study on Wound Infection Rates in Elective Vs Emergency Abdominal Surgeries. *Acta Med Int.* 2025;12(3):639-645.

have often decreased the overall infection rates from surgical site infections, but this remains a problem, especially in emergency surgery.<sup>[7]</sup> The emergence of antibiotic-resistant organisms such as methicillin-resistant *Staphylococcus aureus* and extended-spectrum beta-lactamase *E. coli* adds further challenges to prevention and management.<sup>[8]</sup>

Investigating the wound infection rates of elective and emergency surgery will provide valuable information about the modifiable risk factors and assist in the surgeons' development of infection prevention strategies tailored for their unique patient population. Knowing the modifiable risk factors that will be unique to elective surgery compared to emergency surgery (e.g., wound class, duration of surgery, comorbidities, etc.) will help the surgeon design interventions that can be utilised to reduce postoperative complications.

As such, it is important to assess and compare the incidence, causative organisms, and contributory risk factors of postoperative wound infections following elective and emergency abdominal procedures in a tertiary care institution as part of a strategy for improving surgical outcomes and strengthening infection control procedures.

#### **Aim and Objectives**

**Aim:** To compare the incidence and determinants of postoperative wound infection in elective versus emergency abdominal surgeries in a tertiary care hospital.

#### **Objectives:**

1. To determine the overall incidence of wound infection following abdominal surgeries.
2. To compare the wound infection rates between elective and emergency abdominal surgeries.
3. To identify the common causative organisms responsible for surgical site infections and assess their antibiotic sensitivity patterns.
4. To analyse the association of risk factors such as age, sex, diabetes mellitus, anaemia, duration of surgery, wound classification, and type of surgery with postoperative wound infection.
5. To evaluate the impact of wound infection on postoperative hospital stay and patient recovery outcomes.

## **MATERIALS AND METHODS**

**Study Design:** This was a prospective, observational, comparative study conducted in the Department of General Surgery at Government General Hospital, Nagarkurnool, over 12 months from September 2024 to September 2025. The study evaluated and compared the wound infection rates between elective and emergency abdominal surgeries.

**Study Population:** The study included 200 patients undergoing abdominal surgery. Of these, 100 underwent elective surgeries, and 100 underwent emergency procedures. All patients were followed from the day of surgery until discharge or until 30 days postoperatively for any evidence of wound infection.

#### **Inclusion Criteria:**

1. Patients aged 18 years and above undergoing abdominal surgery (both elective and emergency).

2. Patients willing to provide informed consent for participation and follow-up.

#### **Exclusion Criteria:**

1. Patients with pre-existing local skin infections or systemic sepsis before surgery.
2. Patients on long-term immunosuppressive therapy or chemotherapy.
3. Re-operated cases for previously infected wounds.

**Preoperative Preparation:** Patients scheduled for elective surgeries underwent thorough clinical evaluation, optimisation of comorbidities, and bowel preparation when indicated. Prophylactic antibiotics (third-generation cephalosporins) were administered 30–60 minutes before incision. In emergency surgeries, antibiotics were given immediately upon diagnosis and continued postoperatively based on clinical judgment.

**Operative Procedure:** All procedures were performed under aseptic precautions in the operating theatre. According to the CDC wound classification, the surgeries were categorised as clean, clean-contaminated, contaminated, or dirty. Operative time, type of surgery, and intraoperative contamination (if any) were recorded. In emergency cases, appropriate debridement and lavage were performed when indicated.

**Postoperative Monitoring:** All patients were observed daily for signs of wound infection such as erythema, oedema, discharge, pain, or wound gaping. Wound swabs were collected from patients showing any clinical evidence of disease and sent for microbiological examination (Gram staining, culture, and antibiotic sensitivity). Postoperative antibiotic therapy was modified according to culture sensitivity reports.

**Criteria for Wound Infection Diagnosis:** Surgical site infection (SSI) was defined according to the Centres for Disease Control and Prevention (CDC) criteria as an infection occurring within 30 days after surgery involving the incision or deeper tissues.

**Data Collection Parameters:** Data were recorded using a structured proforma, including:

- Patient demographics (age, sex)
- Type of surgery (elective or emergency)
- Presence of comorbidities (diabetes, anaemia, obesity)
- Duration of surgery
- Wound class (clean, clean-contaminated, contaminated, dirty)
- Postoperative infection status
- Microbial isolates and antibiotic sensitivity
- Duration of hospital stay

**Statistical Analysis:** Data were entered and analysed using SPSS version 25.0. Descriptive statistics were used to express categorical variables as frequencies and percentages, and continuous variables as mean  $\pm$  standard deviation. The Chi-square test assessed associations between categorical variables, and the Student's t-test was applied to compare the means. A p-value  $< 0.05$  was considered statistically significant.

## **RESULTS**

A total of 200 patients undergoing abdominal surgeries were included in this prospective study, comprising 100 elective and 100 emergency procedures. The study population consisted predominantly of males (61%) with an average age of 45.5 years. All patients were closely monitored postoperatively for clinical

evidence of surgical site infection (SSI) for 30 days. The overall incidence of wound infection was 18%, with a significantly higher rate in emergency surgeries (28%) than in elective procedures (8%). A greater proportion of emergency cases presented with contaminated and dirty wounds, whereas elective cases were primarily clean or clean-contaminated. Multiple factors, including wound class, duration of surgery, and comorbidities such as diabetes mellitus and anaemia, influenced the occurrence of SSI. Longer surgical duration, especially procedures exceeding two hours, was associated with a markedly higher infection rate. Wound cultures from infected cases predominantly

grew *Staphylococcus aureus* and *Escherichia coli*, with notable resistance to commonly used beta-lactam antibiotics. The mean postoperative hospital stay was significantly prolonged in patients who developed wound infections compared to those without infection. Statistical analysis confirmed that emergency status, contaminated or dirty wound class, prolonged duration, and diabetes were significant predictors of postoperative wound infection ( $p < 0.05$ ). The following tables present a detailed breakdown of demographic profiles, infection distribution, microbiological isolates, and associated risk factors observed during the study period.

**Table 1: Distribution of Patients According to Type of Surgery**

Type of Surgery	No. of Cases	Percentage (%)
Elective	100	50.0
Emergency	100	50.0
Total	200	100.0

[Table 1] shows the division of the study population based on the type of abdominal surgery performed.

**Table 2: Age and Gender Distribution of Patients**

Demographic Variable	Elective (n=100)	Emergency (n=100)	Total (n=200)
Age (Mean ± SD)	44.8 ± 12.5	46.3 ± 14.1	45.5 ± 13.2
Male	58 (58%)	64 (64%)	122 (61%)
Female	42 (42%)	36 (36%)	78 (39%)

[Table 2] represents the demographic characteristics of the study population.

**Table 3: Distribution of Patients According to Comorbid Conditions**

Comorbidity	Elective (n=100)	Emergency (n=100)	Total (%)
Diabetes Mellitus	18 (18%)	26 (26%)	22.0
Anemia	14 (14%)	20 (20%)	17.0
Obesity	9 (9%)	12 (12%)	10.5
Smoking/Alcohol	12 (12%)	18 (18%)	15.0
Total with ≥1 comorbidity	32 (32%)	43 (43%)	37.5

[Table 3] demonstrates the prevalence of common comorbidities among patients undergoing elective and emergency surgeries.

**Table 4: Distribution of Wound Class According to CDC Criteria**

Wound Class	Elective (n=100)	Emergency (n=100)	Total (%)
Clean	42 (42%)	10 (10%)	26.0
Clean-contaminated	48 (48%)	44 (44%)	46.0
Contaminated	8 (8%)	26 (26%)	17.0
Dirty	2 (2%)	20 (20%)	11.0

[Table 4] categorizes wounds as per CDC classification across both groups.

**Table 5: Incidence of Wound Infection in Elective vs Emergency Surgeries**

Type of Surgery	Total Cases	Infected Cases	Infection Rate (%)
Elective	100	8	8.0
Emergency	100	28	28.0
Total	200	36	18.0

[Table 5] compares the wound infection rates between elective and emergency abdominal surgeries.

**Table 6: Distribution of Wound Infection According to Wound Class**

Wound Class	Total Cases	Infected Cases	Infection Rate (%)
Clean	52	1	1.9
Clean-contaminated	92	8	8.7
Contaminated	34	12	35.3
Dirty	22	15	68.1

[Table 6] shows that contaminated and dirty wounds had significantly higher infection rates.

**Table 7: Relationship Between Duration of Surgery and Wound Infection**

Duration of Surgery	Total Cases	Infected Cases	Infection Rate (%)
< 1 hour	56	2	3.6
1–2 hours	82	10	12.2
> 2 hours	62	24	38.7

[Table 7] indicates a higher infection rate in surgeries lasting more than 2 hours.

**Table 8: Correlation Between Comorbidities and Infection Rate**

Comorbidity	No. of Cases	Infected Cases	Infection Rate (%)
Diabetes Mellitus	44	14	31.8
Anemia	34	9	26.5
Obesity	21	5	23.8
Smoking/Alcohol	30	6	20.0
No Comorbidity	125	7	5.6

[Table 8] highlights the relationship between underlying diseases and wound infection.

**Table 9: Bacteriological Profile of Wound Infections**

Isolated Organism	Elective (n=8)	Emergency (n=28)	Total (%)
Staphylococcus aureus	3	8	30.5
Escherichia coli	2	9	30.5
Klebsiella pneumoniae	1	4	13.8
Pseudomonas aeruginosa	1	4	13.8
Mixed flora	1	3	11.4

[Table 9] reveals the distribution of organisms isolated from infected wounds.

**Table 10: Antibiotic Sensitivity Pattern of Isolates**

Organism	Sensitive Antibiotics	Resistance Observed
S. aureus	Linezolid, Vancomycin	Amoxicillin, Erythromycin
E. coli	Amikacin, Piperacillin-Tazobactam	Ampicillin, Cephalosporins
Klebsiella	Meropenem, Amikacin	Ceftriaxone, Ciprofloxacin
Pseudomonas	Piperacillin-Tazobactam, Meropenem	Cefotaxime

[Table 10] demonstrates the most effective antibiotics against isolated organisms.

**Table 11: Comparison of Mean Postoperative Hospital Stay**

Infection Status	Mean Hospital Stay (days) ± SD
Infected	12.8 ± 4.2
Non-infected	7.1 ± 2.9

[Table 11] compares hospital stay durations in infected and non-infected patients.

**Table 12: Statistical Summary of Significant Risk Factors**

Variable	Statistical Test	p-value	Significance
Emergency Surgery	Chi-square	0.001	Significant
Contaminated/Dirty Wound	Chi-square	0.002	Significant
Duration > 2 hours	Chi-square	0.001	Significant
Diabetes Mellitus	Chi-square	0.011	Significant
Age/Sex	Chi-square	0.465	Not Significant

[Table 12] consolidates significant predictors of wound infection identified in the study.

[Table 1] confirmed an equal distribution of elective and emergency surgeries, ensuring comparability. [Table 2] established that the study population was predominantly middle-aged and male, reflecting the general demographic undergoing abdominal surgeries. [Table 3] indicates a higher prevalence of comorbidities such as diabetes and anaemia among emergency cases. [Table 4] showed that most elective cases were clean or clean-contaminated, while emergency cases frequently involved contaminated or dirty wounds. [Table 5] revealed that wound infection was significantly higher in emergency surgeries (28%) than in elective ones (8%), confirming the hypothesis that emergency procedures carry a greater risk of infection. [Tables 6 and 7] highlighted that infection rates increased with wound contamination and longer surgical duration (>2 hours). [Table 8] identified diabetes mellitus as a major independent risk factor. [Table 9 and 10] demonstrated that Staphylococcus aureus and E. coli were the predominant pathogens, showing resistance to commonly used beta-lactam antibiotics but good sensitivity to amikacin and carbapenems. [Table 11] confirmed that wound infection was associated with significantly longer

hospital stays. [Table 12] summarises that emergency surgery, contaminated wounds, prolonged operative time, and diabetes mellitus were statistically significant predictors of postoperative wound infection.

## DISCUSSION

Surgical site infections (SSIs) continue to be a major concern in abdominal surgeries despite the advent of modern aseptic techniques, prophylactic antibiotics, and improved perioperative care. The present prospective study was undertaken to compare wound infection rates between elective and emergency abdominal surgeries and to identify associated risk factors influencing postoperative infection.<sup>[9]</sup> The overall wound infection rate observed in this study was 18%, which aligns with the commonly reported incidence range of 10–20% for abdominal surgeries in developing countries. A significant difference in infection rates was noted between elective and emergency surgeries, 8% and 28%, respectively, highlighting the critical influence of surgical urgency on infection outcomes.<sup>[10]</sup> Emergency procedures are often performed without adequate preoperative preparation, optimisation of comorbidities, or bowel

cleansing, which increases the risk of contamination and bacterial proliferation.

In contrast, elective surgeries are conducted under planned, sterile conditions, reducing microbial load and tissue trauma.<sup>[11]</sup> The demographic analysis revealed that most patients were males between 30 and 60 years, reflecting the typical demographic undergoing abdominal procedures in tertiary hospitals. Although age and sex did not show statistical significance with wound infection, these parameters may indirectly influence infection rates due to comorbidities, delayed wound healing, and hormonal variations.<sup>[12]</sup> Comorbid conditions, particularly diabetes mellitus, emerged as a significant independent predictor of SSI ( $p < 0.05$ ). Diabetic patients are predisposed to infections due to impaired neutrophil function, reduced tissue perfusion, and delayed collagen synthesis, all of which impede wound healing.<sup>[13]</sup> Other comorbidities, such as anaemia, obesity, and chronic smoking or alcohol consumption, also showed an increased infection trend, although not all reached statistical significance. These findings emphasise the need for preoperative identification and optimisation of modifiable risk factors to minimise postoperative complications.<sup>[14]</sup>

Based on CDC criteria, wound class demonstrated a strong association with infection. Wounds were classified as contaminated with an infection rate of 35.3% and dirty wounds with 68.1%. This linear progression suggests the significance of bacterial count and contamination, causing infection. Emergency surgery had more contaminated and dirty wounds, leading to these patients having greater infection.<sup>[15]</sup> Operating time was another critical factor, with operations that took longer than two hours showing an infection rate of 38.7% while wound infection rates were 3.6% for operations taking less than one hour. Timed operations confer greater tissue exposure, desiccation, and risk for subsequent bacterial contamination. At the same time, an operative length may infer the procedure's complexity or the technical aspects of the operation. Ultimately, this reinforces the need for sound surgical planning, appropriate staffing and addressing to minimise operative time, while maintaining an adequate level of quality.<sup>[16]</sup> *Staphylococcus aureus* and *Escherichia coli* were identified as the most common isolates of infected wounds, each accounting for approximately 30% of the infected wounds. The isolation of *S. aureus* primarily from clean and clean-contaminated wounds suggests potential exogenous contamination from commensal flora or surgical instruments. *E. coli* and *Klebsiella pneumoniae* were isolated from both contaminated and dirty wounds and, thus, can be associated with endogenous contamination from the gastrointestinal tract. *Pseudomonas aeruginosa* was isolated in a smaller proportion, consistent with its opportunistic environmental nature in the hospital setting.<sup>[17]</sup>

Antibiotic sensitivity testing demonstrated high susceptibility of isolates to amikacin, piperacillin-tazobactam, meropenem, and vancomycin, whereas resistance to ampicillin, cephalosporins, and erythromycin was frequently observed. This pattern reflects the growing concern of antimicrobial resistance in hospital-acquired

infections and underscores the importance of institution-specific antibiograms for rational empirical therapy. Strict antibiotic stewardship and regular surveillance are essential to curb the emergence of resistant strains.<sup>[18]</sup> Postoperative hospital stay was significantly prolonged in patients with SSIs, averaging 12.8 days, compared to 7.1 days in non-infected patients. This extended hospitalisation increases the economic burden on patients and institutions and contributes to bed occupancy and risk of nosocomial infections. Preventing SSIs, therefore, is both a clinical and administrative priority.<sup>[19]</sup> The present study confirms that emergency surgery, contaminated or dirty wounds, prolonged operative time, and diabetes mellitus are major determinants of postoperative wound infection. These findings reinforce the multifactorial nature of SSIs, where both patient-related and procedural factors interact to influence outcomes. Preventive strategies should include meticulous preoperative evaluation, glycemic control, strict aseptic technique, intraoperative discipline to minimise tissue trauma and duration, and judicious use of antibiotics.<sup>[20]</sup>

Comparatively, the infection rates observed in this study are consistent with previous reports from tertiary centres in India and other developing countries, where emergency surgeries consistently demonstrate higher SSI rates. The persistence of this trend despite improved surgical standards emphasises the ongoing need for early patient presentation, proper preoperative preparation, and adherence to surgical protocols even during emergencies.

In summary, this study highlights the clear disparity in wound infection rates between elective and emergency abdominal surgeries and identifies modifiable risk factors that can be targeted for intervention. Focused preventive measures, evidence-based antibiotic policies, and surgical team awareness can substantially reduce postoperative infection rates, improving patient recovery and overall hospital efficiency.

#### **Summary**

This prospective study was conducted on 200 patients undergoing abdominal surgeries, equally divided between elective and emergency procedures, to evaluate and compare postoperative wound infection rates and identify contributing risk factors. The overall wound infection rate was 18%, with a significantly higher incidence in emergency surgeries (28%) than in elective procedures (8%). Male patients comprised most of the study population, with a mean age of 45.5 years. The study established that wound infection was more common in contaminated and dirty wounds, longer operative durations, and in patients with diabetes mellitus. Microbiological cultures of infected wounds predominantly yielded *Staphylococcus aureus* and *Escherichia coli*, showing high sensitivity to amikacin, piperacillin-tazobactam, and meropenem, but notable resistance to cephalosporins and ampicillin. Infected patients had a prolonged hospital stay, increasing morbidity and treatment costs. Statistical analysis confirmed that emergency surgery, contaminated wounds, diabetes, and prolonged operative duration were significant predictors of infection ( $p < 0.05$ ).

#### **Limitations**

1. The study was conducted in a single tertiary care hospital with a limited sample size of 200 patients, which may restrict the generalizability of the findings.
2. Postoperative follow-up was restricted to 30 days; late-onset

infections may not have been captured.

3. The study did not evaluate intraoperative antibiotic irrigation's impact or specific surgical techniques' role on infection rates.
4. Microbiological analysis was confined to aerobic bacterial cultures; anaerobic organisms were not studied.
5. Antibiotic sensitivity patterns may vary across regions, and institutional antibiotic policies may influence microbial trends.

#### Recommendations

1. To reduce infection risk, preoperative optimisation of comorbidities, especially diabetes and anaemia, should be prioritised.
2. Due to their higher contamination risk, emergency surgeries should employ enhanced aseptic protocols and targeted antibiotic prophylaxis.
3. Efforts should be made to minimise operative duration by ensuring surgical preparedness and efficient teamwork.
4. Regular microbiological surveillance and antibiogram updates should guide empirical antibiotic selection.
5. A multidisciplinary infection control team should monitor compliance with surgical safety checklists and aseptic protocols.
6. To validate the observed findings and trends, future multicentric studies with larger sample sizes and longer follow-up durations are recommended.

#### CONCLUSION

This prospective comparative study clearly established that postoperative wound infections are still a substantial problem in abdominal surgeries, especially in emergencies. The overall infection rate was much higher in emergency surgeries than in elective ones because of things such as insufficient preoperative preparation, higher contamination levels, and increased burden of comorbid disease in patients. Identifying diabetes mellitus, contaminated or dirty wound class, and longer operative time as significant risk factors is very important. The most frequently isolated organisms were *Staphylococcus aureus* and *Escherichia coli*, which showed increasing resistance patterns to commonly used antibiotics, indicating a growing threat of antimicrobial resistance. The other significant observation was that surgical site infections prolong hospital stays, increase morbidity, and raise treatment costs, which we all know are common to infections. The study indicates the importance of using aseptic techniques, following infection control practices, optimising patients preoperatively (where possible), and trying to do all three things as soon as possible, especially in the emergency operation. Rational use of antibiotics should be based on sensitivities to combat resistance. A more proactive perioperative monitoring process, regular surgical team training, and compulsory use of standardised procedural protocols should reduce postoperative wound infections. At the same time, this study reinforces the need for early identification of risk factors and disciplined surgical practices to improve outcomes and reduce the impact of postoperative infections on abdominal surgery patients.

#### Financial support and sponsorship

Nil.

#### Conflicts of interest

There are no conflicts of interest.

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