

**Role of Empirical Antibiotic Administration Timing on Mortality in Polytrauma Patients Presenting to the Emergency Department at Rama Medical College Hospital and Research Centre, Kanpur: A Retrospective Observational Study**

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**Abstract**

Polytrauma is a major public health problem and remains one of the leading causes of morbidity and mortality worldwide, particularly among young and economically productive individuals. It is generally defined as the presence of multiple traumatic injuries involving at least two body regions or organ systems, with one or more injuries being life-threatening. The most common causes of polytrauma include road traffic accidents, falls from height, industrial injuries, and interpersonal violence. Advances in prehospital care, emergency medicine, and trauma surgery have improved survival; however, infectious complications continue to contribute significantly to adverse outcomes in these patients. Following severe trauma, patients experience immune deregulation, tissue damage, haemorrhage, and exposure to environmental contaminants, increasing their susceptibility to wound infections, pneumonia, bloodstream infections, and sepsis. Early recognition and management of these complications are essential for improving survival. Empirical antibiotic therapy is frequently initiated in polytrauma patients when infection is suspected or when there is a high risk of contamination. While prompt antibiotic administration has demonstrated benefits in septic patients, the optimal timing of empirical antibiotic therapy in polytrauma remains a subject of ongoing debate. This study aims to evaluate the relationship between the timing of empirical antibiotic administration and mortality among polytrauma patients presenting to the Emergency Department of Rama Medical College Hospital and Research Centre, Kanpur. **Objective** To evaluate the association between timing of empirical antibiotic administration and in-hospital mortality among polytrauma patients presenting to the Emergency Department.

**Methods** A retrospective observational study was conducted at Rama Medical College Hospital and Research Centre, Kanpur. Medical records of 100 polytrauma patients admitted between 1 June 2025 and 1 February 2026 were reviewed. Patients were categorized according to timing of first empirical antibiotic administration: within 1 hour, 1–3 hours, and more than 3 hours after ED presentation. Primary outcome was in-hospital mortality. Secondary outcomes included ICU admission, hospital stay, and development of sepsis. **Results** Among 100 patients, 72 were male and 28 were female (male: female ratio 2.57:1). Mortality was significantly lower in patients receiving antibiotics within 1 hour (8.6%) compared with those receiving antibiotics between 1–3 hours (18.2%) and >3 hours (35.7%) ( $p=0.018$ ). Early antibiotic administration was associated with reduced sepsis rates and shorter hospital stay. **Conclusion** Timely empirical antibiotic administration within the first hour of ED presentation was associated with reduced mortality and infectious complications in polytrauma patients.

**Keywords:** Polytrauma, Emergency Department, Empirical Antibiotics, Mortality, Sepsis, Trauma Care.

## **Introduction**

Trauma remains a leading cause of mortality worldwide, particularly among young adults. Polytrauma patients frequently present with multiple injuries involving different organ systems and are vulnerable to infectious complications due to open wounds, contamination, invasive interventions, prolonged mechanical ventilation, and immunological alterations following trauma. The concept of early empirical antibiotic therapy has been widely accepted in sepsis management. However, the role of antibiotic timing in trauma patients remains controversial. Delayed antibiotic administration may increase the risk of infection, septic complications, prolonged hospitalization, and mortality. This study was undertaken to assess whether the timing of empirical antibiotic administration influences mortality among polytrauma patients presenting to the Emergency Department of Rama Medical College Hospital and Research Centre, Kanpur.

## **Materials and Methods**

### **Study Design**

Retrospective observational study.

### **Study Site**

Emergency Department and Trauma Unit, Rama Medical College Hospital and Research Centre, Kanpur.

### **Study Duration**

1 June 2025 to 1 February 2026.

### **Study Population**

100 polytrauma patients admitted through the Emergency Department.

### **Inclusion Criteria**

- Age  $\geq 18$  years.

- Polytrauma involving two or more body systems.
- Hospital admission for >24 hours.
- Availability of complete medical records.

### Exclusion Criteria

- Death within 1 hour of arrival.
- Transfer from another hospital after receiving antibiotics.
- Incomplete records.
- Immunocompromised patients.

### Sample Size Calculation

Using anticipated mortality rates from previous trauma literature:

#### Sample Size Calculation

$$n = Z^2 P (1 - P) / d^2$$

Where:

$$Z = 1.96$$

$$P = 0.50$$

$$d = 0.10$$

Substituting the values:

$$n = (1.96)^2 \times 0.5 \times (1 - 0.5) / (0.10)^2$$

Calculated sample size  $\approx$  96 patients

Considering possible exclusions, 100 patients were included.

### Data Collection

Variables recorded:

- Age
- Sex
- Mechanism of injury
- Injury Severity Score (ISS)
- Time to antibiotic administration
- ICU admission
- Length of hospital stay
- Development of sepsis
- Mortality

### Statistical Analysis

Analysis performed using SPSS Version 27.

#### Continuous variables:

- Mean  $\pm$  SD
- Independent t-test
- ANOVA

#### Categorical variables:

- Frequency and percentages
- Chi-square test

#### Significance:

- $p < 0.05$

### Results

#### Demographic Characteristics

**Table 1. Age Distribution**

Age Group (Years)	Number (%)
18-30	34 (34%)
31-45	29 (29%)
46-60	24 (24%)
>60	13 (13%)
Mean Age = 38.7 $\pm$ 14.2 years	

Table 1.1 : table depicting age distribution.

### Gender Distribution

Gender	Number	Percentage
Male	72	72%
Female	28	28%

**Male : Female Ratio 72 : 28**

**= 2.57 : 1**

Table 1.2 : table depicting Gender distribution & male to female ratio.

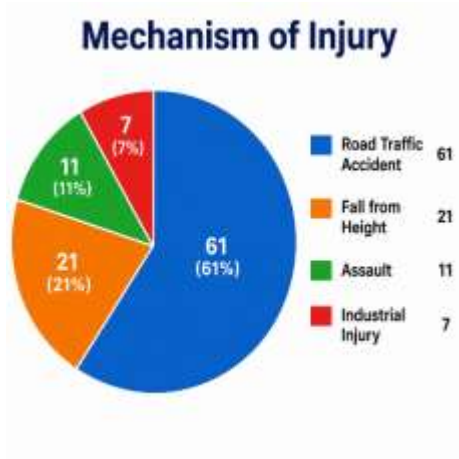


Image 1.3 : Pie chart showing mechanism of injury.

Timing of Antibiotic Administration		
Group	Time	Number
Group A	<1 Hour	35
Group B	1-3 Hours	33
Group C	>3 Hours	32

Mortality According to Antibiotic Timing		
Group	Deaths	Mortality (%)
<1 Hour	3	8.6
1-3 Hours	6	18.2
>3 Hours	11	34.4

Table 1.4 : showing timing of antibiotic administration

Table 1.5 : showing mortality according to antibiotic timing

**Sepsis Development**

Group	Sepsis Cases
<1 Hour	5
1-3 Hours	9
>3 Hours	15
<b>p = 0.011</b>	

**Mean Hospital Stay**

Group	Mean Stay (Days)
<1 Hour	8.2 ± 2.4
1-3 Hours	10.6 ± 3.1
>3 Hours	13.4 ± 4.6
<b>p &lt; 0.001</b>	

Table 1.6 : showing timing of sepsis development & mean hospital stay.

**Comparative Analysis**

Variable	<1 Hour	1-3 Hours	>3 Hours	p Value
Mortality (%)	8.6	18.2	34.4	0.018
Sepsis (%)	14.3	27.3	46.9	0.011
ICU Admission (%)	34.3	45.5	56.3	0.039
Mean Stay (days)	8.2	10.6	13.4	<0.001

Table 1.7 : showing comparison of various outcomes.

## Discussion

This study demonstrated a significant association between early empirical antibiotic administration and reduced mortality among polytrauma patients.

The majority of patients were young males, consistent with global trauma epidemiology. Road traffic accidents constituted the most common mechanism of injury.

Patients receiving antibiotics within one hour exhibited the lowest mortality rate (8.6%), whereas delayed administration beyond three hours resulted in substantially higher mortality (34.4%).

These findings support the hypothesis that early antimicrobial therapy may prevent progression to systemic infection and sepsis.

Similarly, rates of sepsis and ICU admission increased with delayed antibiotic administration. Early therapy was also associated with shorter hospitalization, suggesting reduced healthcare burden.

The findings are consistent with previous studies highlighting the benefits of prompt antimicrobial intervention in critically ill trauma patients.

## Limitations

- Retrospective design.
- Single-center study.
- Potential confounding by injury severity.
- Limited sample size.

Future multicenter prospective studies are required to establish causality and define optimal antibiotic timing protocols in trauma care.

## Conclusion

Early empirical antibiotic administration within the first hour of emergency department presentation was associated with:

- Reduced in-hospital mortality.
- Lower incidence of sepsis.
- Reduced ICU admissions.
- Shorter hospital stay.

Prompt initiation of empirical antibiotics should be considered an important component of comprehensive polytrauma management, particularly in patients at high risk of infectious complications.

### Future scope of the study

- Conduct multicenter prospective studies to validate current study findings.
- Evaluate optimal antibiotic regimens for different polytrauma injury patterns.
- Assess long-term survival and functional outcomes after trauma management.
- Investigate biomarker-guided antibiotic initiation strategies in trauma patients.
- Develop standardized protocols for empirical antibiotic administration timing.

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