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A Study on Relation Between the Timing of ICU Admission and Mortality in Patients with Hospital Onset Sepsis at a Teaching Hospital"- A Prospective Cohort Study.

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ABSTRACT

Background: Hospital acquired infection is a life threatening disorder, hence patients who have acquired these infections needs immediate care and treatment in intensive care unit. This study looks at how the timing of ICU admission affects the chances of survival in patients who developed sepsis.

Methods: The study was conducted over six months (September 2024 to February 2025) at a tertiary care hospital, focusing on the data from the patient record in intensive care unit. We looked at adult patients aged 19 and older who got sepsis while staying in the hospital and were moved to ICU. We followed them until they went home or died. Patients who came straight from the emergency room to the ICU were excluded. We used SPSS 29.00 to study the data.

Results: Among patients admitted early (86), 52 (60.5%) survived, whereas 34 (39.5%) died. In contrast, among those with delayed admission (84), only 25 (29.8%) survived, while a significantly higher rate, 59 (70.2%) died. This shows that waiting long to move a patient to ICU can lead to a higher risk of death compared to moving them sooner.

Conclusion: The admission of the patients within six hours of onset drastically benefitted the patients who needed inotropes/vasopressors, mechanical ventilator support and dialysis and with increased lactate levels and septic shock. So, finding sepsis early and quickly admitting patients to ICU can help improve their chances of survival.

Keywords- Sepsis, Septic shock, Prognosis, morbidity.

1. INTRODUCTION

Sepsis, a potentially fatal illness marked by a dysregulated immunological response to infection, continues to be a major global health concern. Even with improvements in clinical care, sepsis remains one of the main causes of death, highlighting the vital need for novel approaches to treating this debilitating illness. Sepsis high death rate puts a significant burden on healthcare systems around the world, making improved early identification and efficient treatment imperative. The intensive care unit (ICU) is vital for treating severe sepsis; prompt admission and vigorous therapy are critical for patient survival. In cases of severe sepsis, early intensive care unit admission and prompt administration of organ support treatments, such as mechanical ventilation and RRT, can greatly enhance patient outcomes and lower fatality rates. Staff members' committed care, which includes specialized monitoring and intervention, is crucial for managing the physiological issues connected to critical illness and improving patient outcomes. ICUs should use evidence-based policies and procedures to guarantee that patients with sepsis receive consistent, high-quality treatment. In order to maximize patient outcomes, a customized approach to care is required for the many clinical manifestations of sepsis, including when to admit patients to the intensive care unit. This study aims to find the best time to move patients with hospital-onset sepsis to the ICU in order to improve survival rates and reduce deaths. It looks at how the timing of ICU admission affects the chances of survival for these patients, to better understand how ICU care impacts their outcomes.[1]

WHO estimates that the global prevalence of healthcare-associated infections (HAI) is between 7% and 12%. In order to identify the frequent causal agents, as well as to comprehend the patterns and types of HAI at a particular healthcare facility, this study was conducted.[2]

The length of hospital and intensive care unit stays was considerably increased by nosocomial infections, especially pneumonia, underscoring the necessity of effective infection prevention and control strategies. Extended intensive care unit stays were found to be major risk factors for nosocomial infections. This highlights the significance of using antibiotics sparingly and avoiding invasive procedures. Even though nosocomial infections did not raise death rates in this study, more investigation is required to determine the long-term effects of these illnesses and to create efficient preventative and control measures.[3]

The results cast doubt on the 6-hour goal set for ICU admission in sepsis, indicating that a quicker transfer would improve patient outcomes. Healthcare professionals may be able to lower mortality and enhance overall patient outcomes by giving priority to early intensive care unit admission for patients with sepsis.[4]

The significant variation in ICU utilization rates across hospitals, ranging from 4.9% to 61.2%, underscores the need for a more nuanced approach to patient triage and resource allocation. While ICU admission can prolong hospital stays, the magnitude of this effect varies widely across hospitals, suggesting that factors such as hospital capacity, staffing levels, and the severity of illness may influence the impact of ICU care on patient outcomes. This will help create better strategies to make the best use of resources and improve patient outcomes.[5]

Patients with HAI had comparable fatality rates regardless of whether they were initially diagnosed with sepsis or not, despite variations in baseline characteristics. This indicates that HAI is a major risk factor for unfavorable outcomes. The big difference in death rates seen in the two groups highlight how crucial it is to implement efficient infection prevention and control strategies in order to lower the frequency and consequences of HAIs in patients who are in critical condition.[6]

The authors aimed to find out if patients with severe sepsis and septic shock could benefit from early ICU placement because of the potential for better outcomes with earlier ICU admission. The authors wanted to explore how early ICU treatment affects the survival of patients with severe sepsis and septic shock, knowing that delayed ICU admission is linked to higher death rates.[7]

Each year, healthcare-associated infections (HAIs) impact millions of hospitalized patients, leading to more illness and death, which makes them a major public health issue. In addition to lengthening hospital stays and raising medical expenses, HAIs seriously jeopardize patient safety by causing serious consequences and frequent fatalities. Effective infection prevention and control measures are desperately needed to reduce the risk of these avoidable infections, as seen by the high prevalence of HAIs.[8]

A Rapid Response System (RRS) is a safety tool used in hospitals to quickly help patients who suddenly get much sicker. If care is delayed or not done correctly, the patient's risk of serious harm or death goes up. [9]

Early goal-directed therapy (EGDT) was shown to reduce mortality in patients with severe sepsis and septic shock compared to the then-standard therapy.[10]

Lack of ICU bed, delays in the radiological examination, and laboratory investigation services were the most important factors which lead to delayed transfer to ICU.[11]

Doctors and researchers still don't fully understand why some people with sepsis die in the hospital. Knowing the exact reasons could help improve treatment and design better studies.[12]

Intensive care unit (ICU) beds, a scarce resource, may require prioritization of admissions when demand exceeds supply.[14]

Severe sepsis is common in Indian ICUs and is mostly caused by Gram-negative bacteria. It often leads to high death rates and needs a lot of resources because patients usually stay in the ICU for a long time.[15]

The demand for ICU beds and staff often exceeds what's available, and these shortages are likely to continue. Triage decisions must carefully balance the risks and benefits of ICU admission while aiming to use resources fairly. It's important to make sure that ICU beds go to patients who are most likely to benefit from the specialized care the ICU provides.[21]

To apply this in clinical practice, organ dysfunction can be identified by the SOFA score, which is linked to a hospital death rate of over 10% Septic shock.[22]

Frailty is a real and important condition that doctors can recognize. Their clinical judgment about frailty can help predict how patients are likely to do.[23]

Norepinephrine is the first-choice medicine to raise blood pressure in septic shock, but vasopressin might be better for some patients.[25]

2. METHODS

2.1 STUDY AREA

Intensive care unit of a tertiary care teaching hospital in Belagavi, from September 2024-Febuary 2025

2.2 STUDY DESIGN

Prospective Cohort study

2.3 STUDY POPULATION

The study was carried out in patients diagnosed with hospital onset sepsis within 6 hours and after 6 hours of diagnosis, who were admitted to ICU.

2.4 DATA COLLECTING

TECHNIQUE - Primary data will be taken from patient record in intensive care unit of a tertiary care teaching hospital in Belagavi.

2.4 STATISTICAL ANALYSIS

The data for this study were analyzed using SPSS 29.00 Software to evaluate the relationship between ICU admission timing and patient mortality. Descriptive statistics was utilized to summarize categorical variables, which were expressed as frequencies and percentages. These descriptive analyses provided an overview of patient characteristics, including demographic factors, comorbidities, and clinical severity scores, in both earlier and later admitted patients. To assess how the timing of ICU admission affected death Rates, a Chi-square test (χ^2) was performed. This test was used to find out if the timing of ICU admission had a meaningful effect on patient survival. To understand how the timing of ICU admission affects the risk of death, a binary logistic regression model was used. The study calculated both unadjusted and adjusted odds ratios with 95% CIs to measure the strength of this link. The adjusted model accounted for key confounding factors such as age and initial SOFA scores to provide a more precise estimation of the relationship between admission timing and patient outcomes. In addition to numerical statistical outputs, various graphs and visualizations were used to illustrate key findings. Bar charts and pie charts were employed to depict the distribution of categorical variables such as gender, comorbidities, frailty levels, and septic shock incidence across early and delayed admission groups. All data were analyzed using SPSS software, and results were considered statistically significant if the p-value was less than 0.05. This threshold ensured that the findings were robust and reliable in assessing the influence of ICU admission timing on patient prognosis. The combination of statistical tests and graphical representations provided a comprehensive analysis, enhancing the clarity and interpretability of the results.

2.5 ETHICAL CLEARANCE: An institutional ethics committee at Jawaharlal Nehru Medical College in Belagavi, Karnataka, approved the study.

2.6 INCLUSION CRITERIA

The study included adult patients aged 19 and older who were diagnosed with hospital-onset sepsis and admitted to the ICU during the study period. Patients were followed up until they were either discharged or passed away.

2.7 EXCLUSION CRITERIA

Patients with sepsis who were admitted to the ICU directly from the emergency department were not eligible to participate

3. RESULTS-

This study showed that the Demographic distribution of early and delayed admission groups had more Males in delayed admissions (69%) compared to early admissions (59.3%). The Younger individuals (18-30 years) were more commonly found in the delayed admission group (9.5%), whereas those over 40 years had higher early admissions (59.3%). The baseline characteristics of ICU patients based on the timing of admission (early vs. delayed), includes demographic variables, comorbidities, frailty levels, SOFA scores, and septic shock status and this suggested that the majority of patients in both groups were above 45 years (68.6% early, 69% delayed). Diabetes mellitus was the most common comorbidity, followed by COPD. Patients who were admitted late had moderate to severe frailty (23.8% vs. 9.3%), while the patients who were admitted within six hours had a higher proportion of mildly frail patients (31.4% vs. 20.2%). The SOFA score was higher in the delayed group, with 50% having a score above 15 compared to 34.9% in early admissions. No patients were classified as "Very Fit" or "Well" in either group. The differences in SOFA scores and frailty levels suggest that patients with delayed admissions may have had a more severe condition at ICU entry. The primary outcomes between early and delayed ICU admissions across various clinical parameters showed that many individuals in the delayed admission required mechanical ventilation (MV) on ICU Day-1 (53.6% vs. 40.7%), which suggests greater respiratory distress. The need for vasopressors was slightly higher in the early admission group (73.3% vs. 63.1%), indicating hemodynamic instability. The Lactate levels were elevated (>0) in most patients across both groups, though slightly more in early admissions (96.5% vs. 92.9%), possibly reflecting tissue hypoxia. Malignancy was rare but slightly more prevalent in delayed admissions (6% vs. 1.2%). Renal replacement therapy (RRT) was required more in delayed admissions (13.1% vs. 9.3%), suggesting higher kidney dysfunction. Septic shock was more common in delayed admissions (88.1%) than early admissions (81.4%), indicating that delayed ICU entry might be associated with worsening sepsis-related complications. These findings highlights the potential impact of ICU admission timing on critical care interventions and patient outcomes.

The impact of timing of ICU admission on death through an odds ratio (OR) analysis was done to compare the mortality rates between early and delayed admissions and it evaluates the statistical significance of this association. Among patients admitted early, 34 out of 86 (39.5%) died, while for those with delayed admission, 59 out of 84 (70.2%) died, indicating a substantially higher mortality rate in the delayed group. The unadjusted odds ratio (OR = 0.273, 95% CI: 0.137–0.544, p = 0.000) suggests that patients who were admitted early had low death rate compared to those admitted late. This means that early ICU admission reduced the odds of death by approximately 73% before accounting for other factors. However, after adjusting for patient's age and initial SOFA scores, the adjusted odds ratio increased to 3.609 (95% CI: 1.909–6.824). This adjustment suggests that even after considering these critical factors, delayed admission to ICU was still related to risk of high death rate.

4 Discussion

This research which was conducted in the tertiary care hospital, Belagavi, to know the relationship between early and delayed admissions to ICU in patients with hospital acquired sepsis. The sample size was 170 in which 86 were of early admission and 84 were admitted late to the ICU. Among patients admitted early, 34 out of 86 (39.5%) died, while for those with delayed admission, 59 out of 84 (70.2%) died, indicating a substantially higher mortality rate in the delayed group. The results showed that patients admitted within 6 hours to ICU, significantly lowered the risk of mortality compared to delayed admission. The subgroup analysis in this study showed that early ICU admission was linked to a lower risk of death in patients with septic

shock, high lactate levels, or those who needed vasopressors or a ventilator on their first day in the ICU. The primary outcome of this study, revealed that delayed admission was related to increase death rates. However, this study included the cases such as cerebrovascular accidents, trauma, post cardiac arrest, liver diseases, lung diseases etc. The management of such critical cases requires a high dependency effort, such as availability of support resources in ICU. On the other side, the correct use of antibacterial medicines to prevent or control the infection and to lower the effect on organ dysfunction is the foundation of management of hospital acquired infection.[1]

In another study, the WHO states that the risk of getting a healthcare-associated infection (HAI) is much higher in intensive care units (ICUs), where around 30% of patient's experience at least one HAI. All HAIs were linked to the use of invasive devices, and the majority of patients (92%) were admitted to ICUs. VAP accounted for the majority of infections (69%) and was followed by CAUTI (21%) and CLABSI (20%).[2]

In a contrast study, the patients above 18 years of age required intensive care unit for the treatment of sepsis must be shifted to the ICU within six hours of casualty visit and their aim was to explore the relationship between death rates and duration of stay in the ED, with the goal of knowing the ideal length of stay for sepsis patients and their findings.[4]

Taking longer to move patients from the emergency room to the ICU didn't lead to longer ICU stays or more deaths.[13]

A minimum duration from door to ICU was linked to a lower likelihood of dying in the hospital and this association persisted even after adjusting for multiple variables.[7]

In a similar study which considered hospital acquired infection and mortality associated with it, it was found that out of 110 patients 10 reported healthcare acquired infection patients had two infection each. Each HAI was associated with a device.[2]

The SOFA score at the time of admission was a better way to predict which patients might have worse outcomes. Patients who got sepsis from infections they caught in the hospital had the poorest outcomes.[16]

This study had some limitations which includes

1. **Single Centre Study**- the results might not apply to all the hospitals particularly those that are resource constrained, non-teaching or rural.
2. **Limited sample size and duration**- over the course of 6 months and 171 patients participated in the study. More solid and broadly applicable data may have been obtained with a larger sample size and longer study period.
3. **Exclusion of ED patients-** the study might have overlooked information about early sepsis therapies that start before an inpatient diagnosis, if patients admitted straight from the ED had been excluded. The comparison with community onset and ED managed sepsis is thus limited.
4. **Variation in clinical judgment and ICU bed availability**- clinician discretion and ICU resource availability were taken into consideration while decisions on ICU transfers which may have resulted in selection bias.
5. **Lack of long term outcome assessment**- the study only examined in hospital mortality, it did not assess readmission rates and post discharge quality of life.
6. **Absence of biomarker or severity scoring correlation-** although the study employed SOFA criteria to diagnose sepsis, it did not establish a correlation between the timing of ICU admission with validated severity scoring systems such as APACHE II or Procalcitonin levels.

With observational data, we can never be completely sure that the way we handle missing data or the model we use for the full dataset is entirely correct.[17]

In a similar study it showed that delay in ICU admission were linked to a higher risk of death in seriously ill adults and highlights how important it is to give timely critical care, even outside the ICU. [18]

In a different study it was shown that Patients on mechanical ventilation who meet the Sepsis-3 criteria have worse outcomes than those not on ventilation, with higher death rates and longer stays in the hospital and ICU.[19]

In a retrospective study, the results gave insight into the outcomes of patients with refractory septic shock, suggesting that using high doses of vasopressors might actually help in cases of septic shock.[20]

Patients were more likely to die in the hospital if they had a higher APACHE score, were older, needed mechanical ventilation when they arrived in the ICU, or had to wait longer to be seen by a doctor.[24]

There may be significant variance in ICU admission rates among institutions, even though the patient's clinical presentation were identical, so it may be one of the most striking finding, can be due to staffing, culture of care, available resources and individual physician judgment may have significant impact on whether a patient with sepsis needs to be admitted in ICU.[5] Hence the aim of this study was to know the relationship between the timing of ICU admission and deaths in patients with hospital acquired sepsis.

5 Conclusion

Among the patients with healthcare acquired infections leading to sepsis and in-hospital death significantly differed between the earlier and late ICU admissions. The transfer to the ICU within six hours of onset drastically benefitted the patients especially to those patients who needed

inotropes/vasopressors, mechanical ventilator support and dialysis and with increased lactate levels and septic shock. Thus early detection of sepsis and timely admission/transfer to the intensive care unit is considered for these subsets of patients.

6 Clinical Significance

This study shows that getting a patient with hospital-acquired sepsis into the ICU quickly—within 6 hours—can save lives. Patients who were admitted to the ICU sooner had a much better chance of surviving than those who were admitted later. Early ICU care helps doctors start important treatments faster, like giving medicines to support blood pressure, using breathing machines, or doing dialysis. This means that spotting sepsis early and not delaying ICU admission can make a big difference in whether a patient recovers or not. Hospitals should make sure there are systems in place to move these patients to the ICU as soon as possible.

ABBREVIATIONS

Sl.no	Abbreviation	Expansion
1	ICU	Intensive care unit
2	RRT	Renal replacement therapy
3	HAI	Hospital acquired infection
4	WHO	World health organization
5	VAP	Ventilator associated pneumonia
6	CLABSI	Central line associated bloodstream infection
7	CAUTI	Catheter associated urinary tract infection
8	ED	Emergency department
9	CDC	Centres for disease control
10	HCA	Healthcare associated infection
11	SSCG	Surviving sepsis campaign guidelines
12	SPSS	Statistical package for the social sciences

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