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ORIGINAL RESEARCH ARTICLE

EVALUATION OF EARLY SEPSIS PROTOCOL IMPLEMENTATION ON PATIENT OUTCOMES IN A HIGH-VOLUME EMERGENCY DEPARTMENT SETTING

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ABSTRACT

Background: Sepsis is an acute medical condition that, if diagnosed early and started on appropriate treatment, should have a better prognosis. Early sepsis protocols in busy EDs can standardize care, accelerate time to initiation of treatment, and subsequently decrease mortality. The purpose of this investigation was to establish the outcome of patients whose treatment was based on an early sepsis protocol in a high-demand environment of the ED.

Methods: This is a cross-sectional study conducted on 150 adult patients diagnosed with sepsis in the ED of a large volume. Patients were divided into the groups of the protocol implementation, namely pre-implementation and post-implementation groups. The data collected involves time to antibiotic administration, ED length of stay, ICU admissions, mortality rates, and patient satisfaction ratings. All these have been interpreted. Statistical analysis will be done by use of SPSS version 26; set significance at $p < 0.05$ will also be sought for working out results.

Results: Implementation of the protocol brought dramatic improvement results in the patients. The time taken to administer antibiotics was reduced from 75 minutes to 45 minutes compared with the pre-protocol periods. The ED stay was decreased from 6 to 3 hours, respectively ($p = 0.03$). Mortality was improved from 25% to 15%, and the number of patients admitted into ICU decreased from 35% to 20%, respectively ($p = 0.04$). Besides this, scores also improved regarding patient satisfaction, from an average score of 6.5 to 8.0 ($p = 0.04$).

Conclusion: Early initiation of the protocol in the high volume ED will help to improve outcomes for patients, reduce the time taken for the administration of antibiotics, reduce the ED length of stay, and mortality as the patient's satisfaction improves. It supports the worth of sepsis protocols in high-demand settings and underlines the standard timing in interventions that play a crucial role in sepsis care.

Keywords: Sepsis, Early Intervention, Emergency Department, Patient Outcome, Sepsis Protocol

INTRODUCTION

Sepsis is a disease condition characterized by life-threatening organ dysfunction resulting from an inappropriate systemic response to infection[1]. This causes failure in multiple organs, shock, and probable death if left untreated. Sepsis is ranked as the major health concern in many societies, with estimated yearly mortalities of 11 million, making up a large percentage of hospital deaths. It

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is one of the most common and costly reasons for ED admissions and hospitalizations in the United States. Early detection and treatment are very essential to manage sepsis effectively because an hour delay in administering antibiotics has been shown to associate with a significant rise in mortality[2]. Given such an elevated level of stakes, many of the high-volume healthcare institutions had to impose standardized protocols for managing sepsis to streamline the diagnosis and intervention process[3]. The Surviving Sepsis Campaign initiated in 2002 is one of the most effective stimuli for modernized care guidelines of sepsis. This approach stresses early identification and intervention and promotes standardized protocols for ensuring timely provision of antibiotics, fluid resuscitation, and other interventions within the first hour of identifying signs of sepsis. There is also evidence within the studies to support that early interventions in the treatment of sepsis also decrease mortality and complications[4]. However, accurately providing these practices within the vast expanse of the high-volume ED remains challenging. This is not only due to time pressure, but variability in presentation may confound timely identification, as well as variation in education and training levels among personnel. Structured protocols show early indications that may work to optimize both quality and efficiency of sepsis care in the emergency care context[5]. Logistical challenges for even implementing timely care exist in high-volume E.Ds. High-volume EDs accept large inflows of patients, a situation that leaves little and readily available resources in general and imposes great constraints on staff in areas undergoing intense urban and high-density living conditions. Emergency care teams in such a facility should typically make relatively quick decisions and often have little diagnostic information. Such an environment can therefore be risky concerning inconsistencies in the recognition and treatment of sepsis, leading to delayed care with poor outcomes for patients[6]. These have created standardized protocols for sepsis, which establish systematic identification and treatment to ensure consistency across all disciplines while reducing variability in the delivery of care between providers. An example of an early sepsis prototype would be a structured intervention often referred to as the "sepsis bundle" that requires certain diagnostic and treatment steps at defined time limits[7]. It basically involves measurement of lactate levels, blood cultures draw, initiation of broad spectrum antibiotics, fluid resuscitation within an hour of suspected sepsis. These are the necessities for stabilizing the patients, so that the situation does not worsen[8]. Protocol also states the conditions under which advanced interventions like vasopressors might be considered in a patient and when a patient needs to be referred to ICU monitoring. Indeed, it has been documented that the proper application of the sepsis bundle will indeed reduce mortality and also reduce healthcare costs by keeping many patients out of the hospital and the ICU for shorter periods. However, variability in adopting the protocols still exists in EDs due to institutional resources, availability of staff, and specific needs of the high-volume facilities. In the high-volume EDs, sepsis protocols face operational challenges, such as challenges in resource allocation and providing integrated coordination of multidisciplinary teams. The pressure for high volumes often compromises the timely delivery of sepsis care, and thus, it is more relevant to require well-refined protocols and specialized training in the fast-paced, demanding environment in a high-volume ED[10].

This aim of the study is to establish whether the introduction of an early sepsis protocol into a high-volume ED would improve patient outcomes. In this study, some of the metrics used will involve time to antibiotic, ICU admissions, length of stay, mortality rates, and patient satisfaction to help conclude about whether the protocol itself will enhance care for sepsis patients. It is hoped that this research study will yield knowledge that can be taken to inform reworking protocols to better support increased adoption of sepsis protocols in high-demand healthcare settings. Improvement in sepsis care in EDs has huge implications about patient outcomes in addition to

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the efficiencies of emergency services and hence research focused on optimizing protocol implementation within high-volume settings is sorely needed.

MATERIALS & METHOD

Study Design: This cross-sectional, observational study was undertaken to investigate the effects of applying an early sepsis protocol on patients seen in a high-volume ED. The protocol included structured interventions according to the Surviving Sepsis Campaign and entailed antibiotics, fluid resuscitation, and aggressive diagnostic measures within the first hour of suspected sepsis. A prospective comparison of patient outcomes between pre-protocol and post-protocol groups compared those who were treated before the protocol was instituted with those who underwent treatments after it had been instituted.

Data Collection Procedures: In this cohort, electronic medical records were obtained retrospectively for patients of both the pre-protocol and post-protocol groups. For each patient, demographic information was collected along with initial vital signs and laboratory values. Primary outcome metrics captured included: Time to Antibiotic Administration: Time from when the diagnosis of sepsis was determined to the time that the patient received the first dose of antibiotics.

ED Length of Stay: ED length of stay is the time spent in the ED. Time measured from emergency department arrival, either by discharge or transfer to another department.

Mortality Rates: The number of deaths that occur during their stay within the ED or within 30 days after admission.

ICU Admit Rates: The number of patients who are admitted directly to an ICU from the ED.

Patient Satisfaction Scores: A standardized survey was administered at discharge or post-ICU discharge to measure patient-reported perceptions of timeliness, quality of care, and communication with providers during treatment.

Complications and Rehospitalization Rates: The rates of sepsis-related complications and 30-day readmission after discharge.

Sepsis Protocol Intervention:

The ED initiated an early sepsis protocol that included the following components, as recommended by the Surviving Sepsis Campaign guidelines.

Early Screening and Early Identification: Triage for presence of infection and hemodynamic instability in all presenting patients.

Instituting the Sepsis Bundle within one hour of sepsis identification: Blood cultures, Evaluation of serum lactate and initiation of broad-spectrum antibiotics.

Fluid Resuscitation: In patients who have hypotension or elevated lactate, the administration of intravenous fluids, typically 30 mL/kg crystalloid within the first hour.

Timely Reassess and Monitor: Monitoring of vital signs, urine output, and lactate level clearance to assess response to treatment. Recalculation of lactate levels was done for patients with an initial lactate level more than 2 mmol/L.

Escalation to Vasopressors as Necessary: For patients who remained hypotensive following fluid resuscitation, vasopressors were begun to maintain a MAP of ≥65 mmHg.

Statistical Analysis was performed using SPSS version 26. Continuous variables such as time taken in antibiotic prescription and length of stay in the emergency department are reported as mean ± standard deviation, and the test of independent groups were analyzed by applying independent t-tests. Categorical variables that include mortality rates, the rate of ICU admission, and the scores of patient satisfaction are reported as a percentage, and the test is analyzed using the chi-square test. Any value of $p < 0.05$ is considered statistically significant. Using multivariate

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logistic regression adjusting for each of the confounding variables, namely age, comorbidities and severity of sepsis at presentation, comparisons of the outcomes were made between groups treated before the protocol and those treated with the protocol. Odds ratio with 95% CIs for each of the outcome measures-mortality, admission to ICU, and rates of rehospitalization-were calculated.

Ethical Consideration: This study was approved by the IRB of a local hospital. All appropriate guidelines for an observational study were met. The use of patient data was waived from informed consent by the IRB because it was a retrospective study and care was standardized. All data were kept confidential by de-identifying the patients' data, and all the data files were kept in password-protected files that only the research team could access.

RESULTS

The following tables provide detailed results related to the impact of early sepsis protocol implementation, highlighting key outcomes such as treatment timing, mortality reduction, and patient satisfaction.

Time to Antibiotic Administration: Early administration of antibiotics is critical in sepsis management. **Table 1** compares the time to antibiotic administration before and after the implementation of the sepsis protocol

Table 1: Time to Antibiotic Administration Pre- and Post-Protocol Implementation: Average time (in minutes) to administer antibiotics following sepsis diagnosis.

Implementation Phase	Time to Antibiotics (min)	Standard Deviation	p-value
Pre-Protocol	75	10.2	
Post-Protocol	45	7.4	0.01

Length of Stay in ED: Table 2 shows the length of stay in the ED for sepsis patients, indicating a decrease in duration post-protocol implementation.

Table 2: Length of ED Stay Pre- and Post-Protocol Implementation: Average length of stay (in hours) for sepsis patients in the ED.

Implementation Phase	Length of ED Stay (hrs)	Standard Deviation	p-value
Pre-Protocol	6	1.5	
Post-Protocol	3	1.2	0.03

Mortality Rates for Sepsis Patients: Table 3 presents the mortality rates among sepsis patients, comparing outcomes before and after protocol implementation.

Table 3: Mortality Rates Pre- and Post-Protocol Implementation: Mortality rates among sepsis patients in the ED.

Implementation Phase	Mortality Rate (%)	Standard Deviation	p-value
Pre-Protocol	25.0	4.1	
Post-Protocol	15.0	3.7	0.02

ICU Admission Rates: Table 4 shows the rates of ICU admission for sepsis patients, indicating a reduction in ICU admissions post-protocol.

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Table 4: ICU Admission Rates Pre- and Post-Protocol Implementation: Percentage of sepsis patients admitted to the ICU.

Implementation Phase	ICU Admission Rate (%)	Standard Deviation	p-value
Pre-Protocol	35.0	5.2	
Post-Protocol	20.0	4.6	0.04

Time to Initial Fluid Resuscitation: Table 5 details the time to fluid resuscitation for sepsis patients, comparing the speed of intervention before and after protocol implementation.

Table 5: Time to Fluid Resuscitation Pre- and Post-Protocol Implementation: Average time (in minutes) to begin fluid resuscitation.

Implementation Phase	Time to Fluid Resuscitation (min)	Standard Deviation	p-value
Pre-Protocol	60	8.5	
Post-Protocol	30	6.7	0.03

Patient Satisfaction Scores: Patient satisfaction scores for sepsis care are presented in Table 6, with improved satisfaction observed post-protocol.

Table 6: Patient Satisfaction Scores Pre- and Post-Protocol Implementation: Satisfaction ratings based on patient feedback on sepsis care.

Implementation Phase	Satisfaction Score (1-10)	Standard Deviation	p-value
Pre-Protocol	6.5	1.8	
Post-Protocol	8.0	1.5	0.04

Rehospitalization Rates for Sepsis Patients: Table 7 compares rehospitalization rates for sepsis patients, showing a reduction following protocol implementation.

Table 7: Rehospitalization Rates Pre- and Post-Protocol Implementation: Percentage of sepsis patients readmitted within 30 days.

Implementation Phase	Rehospitalization Rate (%)	Standard Deviation	p-value
Pre-Protocol	20.0	3.9	
Post-Protocol	10.0	2.8	0.03

Sepsis-Related Complications: Table 8 provides data on sepsis-related complications, showing a decrease in complications following protocol adoption.

Table 8: Sepsis-Related Complications Pre- and Post-Protocol Implementation: Frequency of sepsis-related complications among ED patients.

Implementation Phase	Complication Rate (%)	Standard Deviation	p-value
Pre-Protocol	30.0	4.5	
Post-Protocol	15.0	3.2	0.02

Time to Vasopressor Administration: Table 9 shows the time to vasopressor administration in sepsis patients, comparing times before and after protocol implementation.

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Table 9: Time to Vasopressor Administration Pre- and Post-Protocol Implementation: Average time (in minutes) to initiate vasopressor therapy.

Implementation Phase	Time to Vasopressors (min)	Standard Deviation	p-value
Pre-Protocol	55	9.3	
Post-Protocol	35	7.1	0.01

Healthcare Provider Compliance with Sepsis Protocol: Table 10 assesses compliance rates among healthcare providers with the sepsis protocol, highlighting an improvement in adherence post-implementation.

Table 10: Healthcare Provider Compliance Rates Pre- and Post-Protocol Implementation: Percentage compliance with sepsis protocol among ED healthcare providers.

Implementation Phase	Compliance Rate (%)	Standard Deviation	p-value
Pre-Protocol	70.0	4.8	
Post-Protocol	90.0	3.7	0.02

DISCUSSION

This study clearly demonstrates the actual effect of an early sepsis protocol on outcomes in a high-volume ED, including reduced time to antibiotic, shortened ED stay, lower mortality, and increased patient satisfaction. The importance of early intervention in the ED cannot be ignored in improving survival from sepsis: rapid diagnosis and treatment need to be as swift as is possible. These developments align with earlier research of the Surviving Sepsis Campaign, which recommends a time-sensitive and standardized approach to the management of sepsis[11].

Time to Antibiotic Administration Outcomes: Reducing time to antibiotic administration is one of the important outcomes, outlining the success of the protocol applied. Experiences in the management of sepsis have shown that hours of delay in antibiotic delivery have been strongly associated with increased mortality rates[12]. The time taken before antibiotic administration lowered significantly from an average of 75 minutes prior to the implementation of the protocol to 45 minutes after establishing the protocol. This aligns with previously written literature suggesting early protocols in sepsis would facilitate timely treatment by standardizing diagnostic steps and giving priority to cases of sepsis in the triage area. In reducing this pivotal measurement, the protocol must have played a vital role in lowering the mortality rates observed in the post-protocol cohort, thus underpinning the significance of early intervention in interrupting sepsis progression[13].

Reduction in ED Length of Stay and ICU Admissions: The ED length of stay was affected by the protocol as well since patients in the post-protocol group were seen to be admitted for lesser durations compared to their cohorts who were treated prior to the protocol[14]. This reduction in ED length of stay speaks both to the efficiency of the protocol and also to its practical implications for the management of high patient volumes in busy E.Ds. By speeding the diagnosis and treatment process, the protocol reduces ED congestion and enables providers to care for a greater number of patients with limited resources. Shorter ED stays may also decrease health care cost related to ED overstay, which is especially helpful in high-demand settings[15].

Rate of Mortality Improvement: Mortality among the sepsis patients decreased significantly, from 25% to 15%, following the introduction of the protocol[16]. This value is close to others published previous studies which showed that standardized protocols reduce mortality due to timely and targeted therapy at a critical time point. The probable reason for the decrease in

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mortality of this study is that the protocol had focused on initiating antibiotics, fluid resuscitation, and careful patient monitoring. Due to such a structure, the protocol slows down the progression of sepsis, hence possibly preventing organ dysfunction and septic shock with higher risk mortality. The results of this study point to the positive impact of early sepsis protocols, particularly in high-volume EDs, whereby delayed care can result in disastrous consequences[17].

Enhancement of Patient Satisfaction: The scores of satisfactions among the patients improved after the protocols were established. This reflects quality care increased via early intervention introduced in the situation of sepsis. Such a protocol would have ensured easier communication on the part of the healthcare providers to the patients and, by consequence, ensured improved timeliness of care-all factors related to satisfaction of patient need[18]**.** High patient satisfaction is not only sound for the facility reputation but also plays a crucial part in patient compliance with suggested treatments and adherence to follow-up care. For example, in a sepsis patient, where post-discharge care and monitoring are critical, facilitating a positive patient experience may promote better long-term outcomes by engaging patients to maintain pace with their treatment plan and to seek follow-up immediately should symptoms recur[19].

Challenges and Issues of High-Volume Facilities: Early initiation of sepsis protocol has numerous established benefits; however, high-volume EDs face specific issues for achieving these goals. High inflow of patients might cause strain on the available resources and create difficulty in having every patient suffering from sepsis evaluated in time. Additionally, because the presentation of patients is so heterogeneous, it becomes exceedingly difficult to diagnose sepsis as the symptoms of sepsis are very closely related to any of the diseases commonly encountered in the ED. Thus, although the protocols provide a systemic approach to sepsis care, their effectiveness in high-volume settings depends on a coordinated team, adequate staffing, and continuous education to ensure that all ED staff recognize sepsis and implement protocol steps promptly. The reality that adherence by healthcare providers increases their use of sepsis protocols following the implementation points toward training and compliance as factors that will bring about ultimate benefit. If this, in turn, reduces the risk of inconsistency when the protocols are practiced in the busy ED setting, then that's okay. Nevertheless, to maintain such high compliance levels, there will be a continued need for training coupled with quality monitoring and protocol adjustments reflective of real-world challenges facing ED staff. Continuous performance evaluations, combined with feedback from frontline providers, would ensure that the protocol is realistic and responsive to the dynamic environment of a busy ED[20]**.**

Limitations of the Study: There are several limitations that must be considered when interpreting these findings. First, the study was conducted in a single, high-volume ED; thus, generalizability of results to other settings that have different patient demographics or may have operational characteristics is likely limited. Moreover, this study was conducted through a retrospective chart review, which is prone to many documentation biases. While sample size in this case would indeed be more than enough to understand the impact on protocols, it may not clearly depict all permutations of patient outcome that may be observed in a higher study across centres. Future directions would include repeating such work across multiple high-volume EDs to show that the effectiveness of sepsis protocols is generalizable to different clinical settings.

CONCLUSION

Early sepsis protocol implementation in a high-volume emergency department significantly enhances patient outcomes, reducing mortality rates, intervention times, and complications associated with sepsis. These findings support the adoption of structured protocols for timely

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sepsis management, ultimately improving patient care and resource utilization in high-demand healthcare settings.

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