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Use of Sequential Organ Failure Assessment Among Intensive Care Unit Patients with Septic Shock

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Abstract

Purpose: Sepsis is a significant cause of mortality in modern intensive care units (ICUs). At Sharp Grossmont Hospital (SGH), sepsis cases increased the patient mortality rate in comparison to other Sharp facilities. Currently, no tools are utilized to identify septic patients at SGH. The study aimed to find out the impact of early consultation of advanced illness management (AIM) and goals of care conversations (GOCC) on reducing the length of stay (LOS) among septic shock patients.

Methodology: Descriptive data were attained based on Electronic Medical Records (EMR) of 39 septic shock patients form which ICU nurses utilize to calculate Sequential Organ Failure Assessment (SOFA) on admission and daily for 2 days.

Findings: The education increased the ICU staff's awareness of the high occurrence of septic shock among ICU patients. After the deployment of SOFA scores among 39 patients of septic shock, the average LOS was 3 days, compared to more than 5 days before implementing SOFA scores. Post-implementation, 33 % of patients received early AIM or GOCC intervention, with 84% of them receiving intervention from the first day of admission. These percentages are compared to pre-implementation, when early AIM or GOCC intervention was provided to 36.4 % of patients, with 41.3 % of them receiving AIM or GOCC from the first day of admission.

Recommendations: In this study, the leader of change must be aware of standardized Arterial Blood Gas (ABG) orders for SOFA scores and measure the compliance of ICU nurses in documenting SOFA scores. Moreover, raise awareness among healthcare professionals about the high occurrence of septic shock mortality among ICU patients.

Keywords: *Sepsis, Septic Shock, Intensive Care Units, Sequential Organ Failure Assessment, length of Stay, Advanced Illness Management, Goals of Care Conversations*

1.0 INTRODUCTION

Sepsis is the relationship between organ dysfunction and infection that can be life-threatening if it is not detected quickly. Seymour et al. (2016) defined sepsis and *septic shock* (Sepsis-3) as a "life-threatening organ dysfunction caused by a dysregulated host response to infection" (p. 771). It has serious welfare and economic burdens on patients and medical serviceframeworks globally (Vincent, 2019). Sepsis is one of the main causes of death and diseases in theworld, with in-hospital mortality rates in the United States as high as 25%–30% (Vincent et al., 2019). In the United States, there are over 1.5 million individuals afflicted with sepsis yearly, and approximately 250,000 die from it (Centers for Disease Control and Prevention, 2020). Although sepsis is a preventable condition, 1 out of 3 deaths in U.S. hospitals is from sepsis (Centers for Disease Control and Prevention, 2020).

Sepsis is a major cause of morbidity and mortality in modern intensive care units (ICU) (Khwannimit et al., 2019). At Sharp Grossmont Hospital (SGH), sepsis cases increased mortality rate compared with other Sharp healthcare facilities, due to the volume of patients who had a higher documented severity of illness. In a retrospective review of the ICU, among sepsis patients admitted to the ICU, there was an associated mortality rate of 50% ($n = 72$; SGH, 2020). In 2019, the average length of stay for septic patients at SGH was 10.6 days (SGH, 2020). Currently, there is no disease-specific, evidence-based predictive tool used to identify septicpatients at high risk for mortality at SGH. The goals of care conversations (GOCC) and advanced illness management (AIM) consult orders are placed based on physician intuition and clinicalexpertise.

In recent years, the high frequency, high cost, and pace of death of patients with sepsis have become considerations; the critical care scientific community has established clear procedures to improve patients' prognosis with sepsis (Girardis et al., 2009). Early treatment is important because the patient has more time for a rapid and appropriate response and can experience a decreased ICU length of stay (Seymour et al., 2016). Since a modest degree of organ dysfunction isassociated with increased in-hospital mortality. The Sequential Organ Failure Assessment (SOFA) is the best scoring system to determine patients' degree of organ dysfunction, prognosis, and risk of mortality (Seymour et al., 2016).

According to the reviewed literature, it was found that the evidence base practice question initiated was, "Among adult ICU patients, doesuse of the SOFA score compared with usual care support early AIM consult or GOCC decrease LOS?" Septic shock is the most critical sort of sepsis in which deep underlying abnormalities in the circulatory system and cell or metabolic parameters lead to a substantial increase in mortality(Vincent et al., 2019). The literature review focused on the use of SOFA scores to predict the mortality and adverse outcomes of ICU patients with septic shock. The prognosis of any patient admitted to the ICU is determined by the function of major vital organ systems, especially the respiratory, cardiovascular, central nervous, renal, and hepatobiliary systems. The occurrence or severity of a specific organ malfunction should be easily detectable, and health organizations should have access to it. A successful prognostic scoring system must be able to account for the passage of time. Lambden et al. (2019) studied the SOFA score as an increasingly important tool indetermining the clinical status of patients and their response to treatment in the context of clinical trials.

The implementation of the SOFA score was supposed to start in January 2021, but becauseof the COVID crisis, it was delayed to March 2021. Based on the evidence used in this project, theSOFA score was deployed at SGH in the electronic medical record-based form, in which ICU nurses use the SOFA score to calculate SOFA on admission and daily for the first two days of ICUlevel of care. Khwannimit et al. (2019) found the SOFA score showed the best predictive power forin-hospital and 30-day mortalities and multiple organ failure of sepsis patients admitted to the ICU. Lambden et al.,

2019 studies found when arterial blood gas monitoring is not used, it may be difficult to detect the SOFA score through respiratory assessment (Lambden et al., 2019). The Arterial Blood Gas (ABG) orders were added for SOFA score to the intensive order note.

Lambden et al. (2019) studied calls for the importance of developing standard protocols to evaluate and manage patients in clinical trials to reduce patient-to-patient variability and ensure alternative assessments are robust.

The high incidence of septic shock among ICU patients supports efforts to increase awareness of healthcare professionals (Vincent et al., 2019). Education was provided to medical intensive care unit (MICU) and surgical intensive care unit (SICU) staff about the high occurrence of septic shock among ICU patients and how to use the SOFA score. The education included a flyer, an in-person ICU nurses' meeting, a multidisciplinary round, and a virtual meeting with MICU and SICU in-charge nurses. The ICU nurses communicated the SOFA score with the ICU intensivist during weekly interdisciplinary rounds. Girardis et al. (2009) found a multidisciplinary approach and a specific team play a key role in education and in providing early and appropriate sepsis management like AIM or GOCC consultation.

Evidence-Based Practice Benchmark and Target

This project was aimed at adult septic shock patients entering MICU and SICU. The benchmark was based on the SOFA score at admission and q 24 hours x two days compared with current practice. That detects the advice of AIM or GOCC as soon as possible and reduces the LOS to less than five days of patients with septic shock in the ICU with a mortality rate of 50% or higher by the end of March 2021.

2.0 METHODOLOGY

The principal investigators of this project first obtained approval from the ICU leadership and sepsis committee, SGH, and the University of San Diego Institutional Review Board. The prospective study was conducted in the MICU and SICU of SGH in San Diego. The project included 39 adult patients over 18 years old who were admitted from the emergency department to MICU and SICU with septic shock in March 2021.

The data were collected through electronic medical records and included admitting diagnosis of septic shock, the date and time of AIM or GOCC consultation, and SOFA score on admission and daily for two days. The LOS was calculated from the time a patient was admitted to the ICU to the time of discharge or death. Based on SOFA score components include patients should have an ABG test to successfully measure SOFA score. I excluded (a) patients without an ABG test on admission and daily for two days, (b) ICU patients who developed septic shock diagnosis after 24 hours of admission, and (c) septic shock patients who transferred to another unit within the first three days of ICU admission.

Descriptive data were attained based on an EMR by using the SOFA score on admission and daily for two days. The result of the SOFA score was communicated to the attending intensivist during interdisciplinary rounds. ICU physicians identified patients who may benefit from early AIM or GOCC consultation based on prognostication from the SOFA score among septic shock patients. Potential to decrease the ICU length of stay to less than five days to meet the project goal. For comparing pre-and post-implementation data, a clustered column chart and line chart was used to display in clustered vertical columns AIM or GOCC consultation and tracked LOS changes over the project period.

3.0 FINDINGS

Among 39 septic shock patients, the SOFA score was used March 1–31 at MICU and SICU. The predicted mortality rate was calculated by SOFA score on admission and daily for two days. The highest SOFA score correlated well with high mortality; the highest score of 10 correlated with a mortality rate of 45%–50%. Based on the result of the SOFA score on admission, the mortality rate was greater than 50% for 35.8% ($n = 14$) of the patients. Trends in SOFA scores during the 24 and 48 hours were also analyzed; 15%–25% ($n = 6$–10) of patients had a mortality rate greater than 50%.

Analysis was done between survivors and nonsurvivors of a total of 39 septic shock patients who were admitted in March 2021. The nonsurvivor patients were 17.9% ($n = 7$), with a mortality rate greater than 50% on admission. The survivor patients were transferred to other units (e.g., post-acute care, home health, hospice care, and skilled nursing facility). During this period, the average LOS was three days compared with the pre-implementation SOFA score of more than 5 days (see Figure 1). In this project, the SOFA score on admission was a good predictor of mortality compared with 24 and 48 hours. [Table 1]

Table 1: Average Length of Stay for Septic Shock Patients (Days) in MICU and SICU

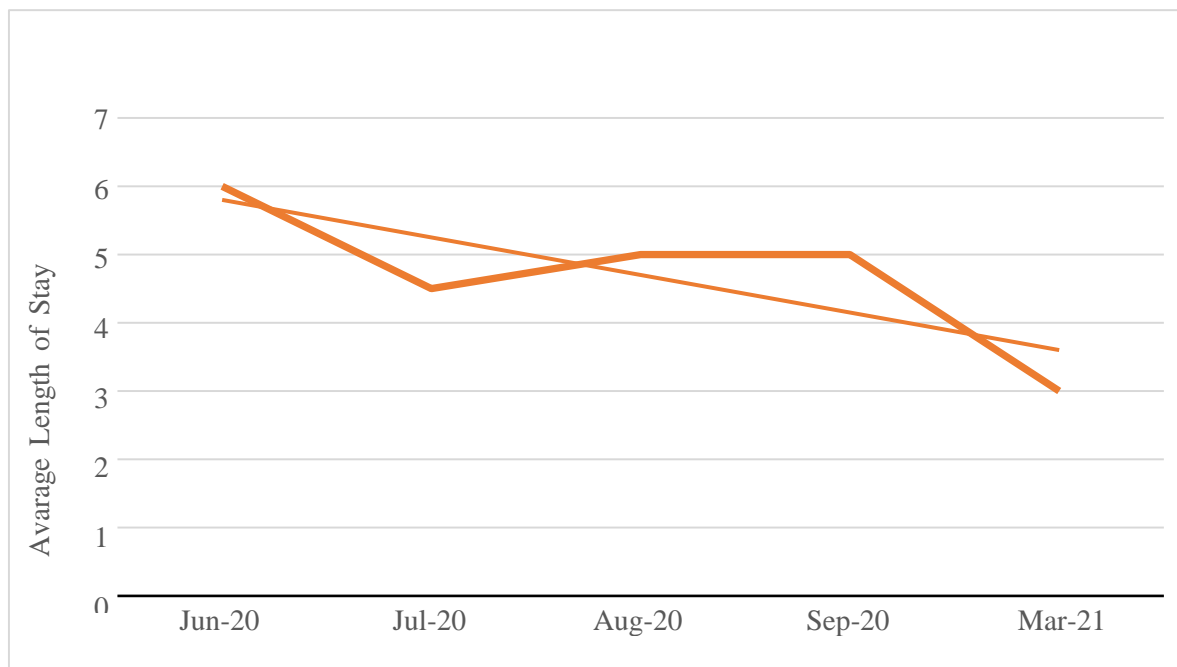| Month	LOS
Jun-20	6
Jul-20	4.5
Aug-20	5
Sep-20	5
Mar-21	3

Figure 1: Average Length of Stay for Septic Shock Patients (Days) in MICU and SICU

Note: This figure shows the average length of stay among MICU and SICU septic shock patients for pre-and post-SOFA score implementation. The pre-implementation period was June– September

2020. The average LOS was 4.5–6 days. Postimplementation began March 1 to March 31 of 2021. The average LOS was three days compared with the pre-implementation SOFAscore of more than five days.

In the postimplementation period, 33% ($n = 13$) of patients received early AIM or GOCC intervention, and 84% ($n = 11$) of them from the first day of admission. Compared with pre-implementation, was provided to 36.4% ($n = 58$) of patients, with 41.3% ($n = 24$) having receivedAIM or GOCC from the first day of admission (see Figure 2). There were significant improvements in AIM or GOCC consultant timing from the first day of admission compared with the pre-implementation periods. The use of SOFA score too early AIM or GOCC consultation from the first day of admission was successfully increasing hospice use through targeted intervention. [Table 2]

Table 2: The Early Advanced Illness Management (AIM) or Goals of Care Conversations (GOCC)Consultation

Month	AIM or GOCC	1st Day of Admission
Jun-20	40%	57%
Jul-20	32%	33%
Aug-20	30%	31%
Sep-20	46%	44%
Mar-21	33%	84%

Figure 2: The Early Advanced Illness Management (AIM) or Goals of Care Conversations (GOCC) Consultation
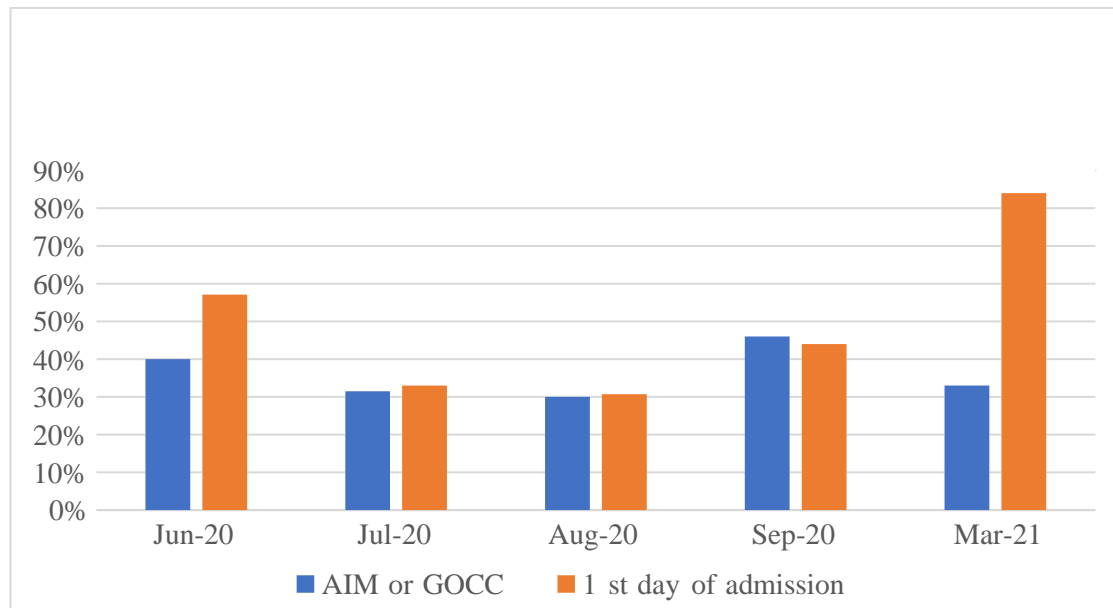
Note: This figure illustrates the early AIM or GOCC consultation among septic shock patients. Inthe post-implementing of the SOFA score, there were significant improvements in AIM or GOCC consultant timing from the first day of admission compared with the pre-implementing period. There were 30%–45% of patients with AIM or GOCC consultation of pre-and post-implementedSOFA

scores.

Discussion

The health of the main vital organ systems determines the prognosis of each patient admitted to the intensive care unit primarily the respiratory, cardiovascular, neurological, renal, and hepatobiliary systems. Every institution should have access to and be able to measure any organ dysfunction, regardless of its severity. Organ dysfunction in any patient is a dynamic process that evolves. For a good prognostic score, the system needs to be able to take the time factor into account. The purpose of the project is to utilize the SOFA score among septic shock medical/surgical ICU patients at SGH and detect early consultation of AIM or GOCC and reduce the length of stay among septic shock patients in ICU with a mortality rate of 50% or greater. With prognosis ratings like SOFA, it is simple to evaluate the patient's clinical condition and detect early AIM or GOCC consultation because the necessary variables can be assessed frequently at set time intervals, better capturing the evolving nature of the illness. There are 30%–45% of patients with AIM or GOCC consultation of pre-and post-implementedSOFA scores (Figure 2).

Understanding the incidence of sepsis and related mortality is critical to help guide asset allocation and recommend medical service assets. The high incidence of septic shock among ICU patients supports current efforts to increase awareness of healthcare professionals'(Vincent et al, 2019). The facilitator for the project is a sepsis senior specialist for the ICU of SGH. He does passionate about providing guidance and sharing his clinical experiences to reach this project's goal. His responsibility was setting up meetings to communicate and collaborate with health information nurses, respiratory therapists, and clinical nurse specialists to use the SOFA score in ICU. They were looking for clinical trial methods to provide the best results and solutions to adopt the SOFA score. These relationships among the practitioners facilitate work and positively influence all parties to share their opinions and experiences and cooperate to reach this project's goal.

The short-term outcomes of the SOFA score result for each septic shock patient were communicated with the attending intensivist during daily rounds by ICU nurses. ICU physicians can detect AIM consultation and/or GOCC early on the first day of admission to the ICU for septic shock patients. And decreases the length of stay of ICU septic shock patients to less than 5 days. The researcher achieved the short-term outcomes at the end of March 2021. The average LOS was three days compared with the pre-implementation SOFAscore of more than five days. The researcher's long-term outcome was to maintain the improvement and progress of the positive short-term outcomes of using SOFA score among ICU septic shock patients. And monitor the effectiveness of the SOFA score after the completion of this project.

Besides, compare the cost analysis before and after using the SOFA score in patients with septic shock in ICU. The SOFA tool will be applied to Cerner of ICU Sharp HealthCare hospitals after successfully using the SOFA score at SGH and measuring ICU nurses' and physicians' compliance among SOFA scores. Seymour et al. (2016) found that SOFA has higher predictive validity and higher consistency in ICU because more variables may measure abnormal and independent ongoing interventions.

There are potential barriers to implementing SOFA scores in the ICU, such as a lack of understanding of SOFA scores and a lack of documentation on sepsis prognosis based on EMR nursing screening tools. The clinical nurse specialist intensively trains ICU nurses who can overcome this problem to improve their understanding of the SOFA score and the higher incidence of septic shock in ICU patients. Another barrier is an Arterial Blood Gas (ABG) test not available or measured routinely for sepsis patients within 24 hours after admission. The researcher's observation found when arterial

blood gas monitoring is not used; it may be difficult to detect the SOFA score through respiratory assessment (Lambden et al, 2019). We planned to work with respiratory therapists to standardize the ABG test time for ICU patients.

Standardizing the ABG test may indicate the importance of developing standard practices for patient evaluation; ABG monitoring in the initial clinical phase is essential to reduce instability between patients and ensure selective SOFA scores. This study calls for the importance of developing standard protocols to evaluate and manage patients in clinical trials to reduce patient-to-patient variability and ensure that alternative assessments are robust. For future research, we recommend standardized ABG orders to be on admission and daily x 2 days for all new admission septic shock ICU patients. Moreover, raise awareness among healthcare professionals about the high occurrence of septic shock mortality among ICU patients. And measure the compliance of ICU nurse SOFA score documentation among the target population.

4.0 CONCLUSION AND RECOMMENDATIONS

The SOFA score was developed to assess the acute morbidity of septic patients in the ICU. Among patients with septic shock admitted to the ICU, the use of the SOFA score on admission was a good predictor of mortality compared with 24 and 48 hours of SOFA score results. The use of SOFA score improvement at admission resulted in the early AIM or GOCC consultation time exceeding 84.6% from the first day of admission and reduced ICU length of stay of below five days among patients with a poor predicted outcome of septic shocks. The SOFA score is an increasingly important tool in defining the response to therapies in the context of clinical trials.

Sustainability and Implications for Practice

This project focused on using the SOFA score on admission and MICU/SICU to decrease LOS and early AIM or GOCC consultation. The implication of the project measures the compliance of ICU nurses in documentation SOFA score among the target population. Besides, it the essential to raise awareness among healthcare professionals about the high occurrence of septic shock mortality among ICU patients. The crucial development of standard protocols for the assessment and management of patients in clinical trials is essential to minimize inter-patient variability and ensure results of surrogate assessments like SOFA are robust. Moreover, focus on measuring the volume of patients with early AIM consult or GOCC with a high SOFA score. It is critical to maintain standardized ABG order to be on admission and daily for two days for all new admission septic shock ICU patients.

REFERENCES

Centers for Disease Control and Prevention. (2020). *Clinical resources*. https://www.cdc.gov/sepsis/clinicaltools/index.html

Girardis, M., Rinaldi, L., Donno, L., Marietta, M., Codeluppi, M., Marchegiano, P., & Venturelli,C. (2009). Effects on management and outcome of severe sepsis and septic shock patientsadmitted to the intensive care unit after implementation of a sepsis program: A pilot study. *Critical Care*, *13*(5), R143. http://doi.org/10.1186/cc8029

Khwannimit, B., Bhurayanontachai, R., & Vattanavanit, V. (2019). Comparison of the accuracy of three early warning scores with SOFA score for predicting mortality in adult sepsis and septic shock patients admitted to the intensive care unit. *Heart & Lung*, *48*(3), 240–244. https://doi.org/10.1016/j.hrtlng.2019.02.005

Lambden, S., Laterre, P. F., Levy, M. M., & Francois, B. (2019). The SOFA score – Development, utility, and challenges of accurate assessment in clinical trials. *Critical Care*, *23*(1), 1–9. https://doi.org/10.1186/s13054-019-2663-7

Seymour, C. W., Liu, V. X., Iwashyna, T. J., Brunkhorst, F. M., Rea, T. D., Scherag, A., & Deutschman, C. S. (2016). Assessment of clinical criteria for sepsis for the third international consensus definitions for sepsis and septic shock (Sepsis-3). *The Journal of the American Medical Association*, *315*(8), 762–774. https://doi.org/10.1001/jama.2016.0288

Sharp Grossmont Hospital. (2020). https://www.sharp.com/hospitals/grossmont/

Vincent, J. L., Jones, G., David, S., Olariu, E., & Cadwell, K. K. (2019). Frequency and mortalityof septic shock in Europe and North America: A systematic review and meta-analysis. *Critical Care*, *23*(1), 1–11. https://doi.org/10.1186/s13054-019-2478-6