

## ORIGINAL PAPER

# A Comparative study of APACHE II and SOFA Scoring Systems in Critically ill Patients with Sepsis

Devee Anjana<sup>1</sup>, Chandraprakash<sup>2</sup>

Received on May 08, 2016; editorial approval on July 09, 2016

### ABSTRACT

There are several well recognized scoring systems for evaluation and prognostication of critically ill patients. While the APACHE II (Acute Physiology and Chronic Health Evaluation II) scoring system uses a point score based on physiologic parameters, age and previous health status, the SOFA (Sequential Organ Failure Assessment) scoring system takes into account the organ failure in critically ill patients. In the assessment of critically ill patients with suspected multi-organ dysfunction admitted in ICU, the role of SOFA in predictive validity for in-hospital mortality is being widely discussed. The present study is undertaken to prognosticate the patients by using two different established and defined scoring systems like SOFA and APACHE II, and to make attempt to establish early diagnosis of sepsis by using SOFA scoring in 50 critically ill patients with suspected multi-organ dysfunction admitted over a period of one year. The results showed that serial measurement of SOFA score during first week is a very useful tool in predicting the outcome especially on the day 3. The APACHE II score on day of admission, though reliable, was not very effective in predicting the mortality rate in our set up.

**Keywords:** APACHE II, SOFA, qSOFA, MODS, Sepsis, Septic shock

---

### Address for correspondence:

<sup>1</sup>Associate Professor

(Corresponding Author)

Department of Medicine

Gauhati Medical College and Hospital

Guwahati, Bhangagarh, Guwahati-781032, Assam, India

**Mobile:** +91 9435040249

**Email:** anjana\_devee@rediffmail.com

<sup>2</sup>Post-graduate Trainee, Department of Emergency Medicine,

Gauhati Medical College and Hospital

Guwahati-781032, Assam, India.

### INTRODUCTION

APACHE II (Acute Physiology and Chronic Health Evaluation II) is one of several ICU scoring systems applied within 24 hours of admission of a patient. It uses a point score based upon initial values of 12 routine physiologic measurements, age, and previous health status to provide a general measure of severity of disease.<sup>1</sup> The SOFA (Sequential Organ Failure Assessment) score is a simple, but effective method to describe organ dysfunction or failure in critically ill patients.<sup>2</sup>

Sepsis should be defined as life-threatening organ dysfunction caused by a deregulated host response to infection. For clinical assessment, organ dysfunction can be represented by an increase in the SOFA score of 2 points or more, which is associated with in-hospital mortality greater than 10%.

Septic shock should be defined as a subset of sepsis in which particularly profound circulatory, cellular, and metabolic abnormalities are associated with a greater risk of mortality than with sepsis alone. Patients with septic shock can be clinically identified by a vasopressor requirement to maintain a mean arterial pressure of 65 mm Hg or greater and serum lactate level greater than 2 mmol/L (>18 mg/dL) after adequate fluid resuscitation.<sup>3</sup> This combination is associated with hospital mortality rates greater than 40%. Adult patients with suspected sepsis can be better identified to be more likely to have poor outcomes by using SOFA Score in comparison to APACHE II score.

A quick method of identifying patients at high risk for poor outcome with sepsis is by utilizing at least 2 of the following clinical criteria that together constitute a new bedside clinical score termed quick SOFA (qSOFA):<sup>4</sup>

- 1) Respiratory rate of 22/min or greater,
- 2) Altered mentation, or
- 3) Systolic blood pressure of 100 mm Hg or less.

As initiation of appropriate effective antimicrobial therapy is essential for a favorable outcome in the patient with sepsis, identification of the risk factors is also helpful in deciding about

the prognosis of the cases. Since the results of laboratory tests like culture & serology are available only after 24 to 48 hours, using scores like APACHE II and SOFA may help in predicting outcome in the crucial initial hours of management.

This study was conducted in patients admitted into the ICU of Emergency Medicine department to assess the comparative efficacy of APACHE II and SOFA scoring system in determining the early diagnosis of sepsis and prognosis of patients with sepsis.

## MATERIALS AND METHODS

This prospective hospital based observational study was undertaken in the department of Emergency Medicine ICU of Gauhati Medical College & Hospital, over a period of one year from August 2014 to July 2015. Prior approval from Institutional Ethical Committee was obtained. A total of 87 critically ill patients were included in the study. The detailed history, clinical examination and all the relevant laboratory investigations were done. The clinical conditions were defined according to standard practice and based on relevant investigation reports. The patients of sepsis admitted to ICU of Emergency Medicine department were prognosticated on the basis of APACHE II score and SOFA score.

The objectives of the study were defined as:

1. To assess morbidity and mortality of patients with multi-organ dysfunction syndrome (MODS) in sepsis.
2. To prognosticate the patients by using two different established and defined scoring systems like SOFA and APACHE II.
3. To make attempt to establish early diagnosis of sepsis by using SOFA Scoring.

Various profiles between survivor group and non-survivor group were analyzed. Out of the 87 patients with sepsis admitted to the ICU, 50 patients with sepsis developed multi-organ dysfunction syndrome (MODS). The rest 37 patients did not qualify to be labeled as having multi-organ dysfunction syndrome, and hence these patients were not included in the final analysis of results in this study.

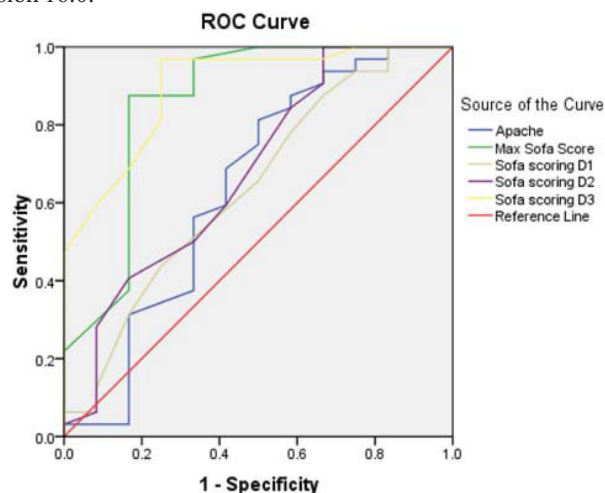
## RESULTS

The clinical profile of 50 patients with sepsis with MODS was studied. There were 28 males and 22 females in this cohort. During the study period, 18 patients died and 32 patients survived with mortality rate of 36%. For all patients, APACHE II scoring was done on day of admission. Although reliable, it was not very effective in predicting the mortality rate in our patients. Though mean APACHE II score was high among non-survivors than survivors (23.28 v/s 18.75), APACHE II score was found to be of no statistical significance ( $p=0.068+$ ).

For all patients, SOFA scoring was done from day 1 to the last day. The SOFA score on day 1 was high among non survivors and survivors which was statistically significant (10.17 v/s 7.94,  $p=0.014$ ). However, the most significant difference was observed on day 3. The SOFA score was very high among non-survivors as compared to survivors which was statistically significant. (13.42 v/s 6.84,  $p<0.001$ ).

Receiver operating characteristic (ROC) curves were plotted to

define discriminative value of scores as a prognosis of mortality. Figure one shows the comparison of the SOFA score of the day one (D1), day two (D2), day three (D3), max SOFA score and APACHE II score was done using SPSS statistical software version 16.0.



Diagonal segments are produced by ties.

**Figure 1** Comparison of APACHE II and SOFA scores by ROC curves

The “Areas under curves” (AUC) values observed are shown in **Table 1**.

**Table 1** Showing AUC values of all scoring systems

Scoring system	Day	AUC values
SOFA Score	D1	0.641
SOFA Score	D2	0.680
SOFA Score	D3	0.896
Max SOFA Score		0.859
APACHE II Score		0.639

From the above observation, it was apparent that D3 SOFA score and Max SOFA score are more discriminative value than D1, D2 SOFA score and APACHE II score.

## DISCUSSION

Sepsis is the primary cause of death from infection, especially if not recognized and treated promptly. Its recognition mandates urgent attention. Sepsis is a life-threatening condition that arises when the body’s response to an infection injures its own tissues and organs.

Sepsis is a syndrome shaped by pathogen factors and host factors (eg, sex, race and other genetic determinants, age, comorbidities, environment) with characteristics that evolve over time. What differentiate sepsis from infection are aberrant or deregulated host response and the presence of organ dysfunction. Sepsis induced organ dysfunction may be occult; therefore, its presence should be considered in any patient presenting with infection. Conversely, unrecognized infection may be the cause of new onset organ dysfunction. Any unexplained organ dysfunction should thus raise the possibility of underlying infection.

Evidence-based recommendations regarding the acute

management of sepsis and septic shock are the foundation of improved outcomes for the critically ill patients.<sup>5</sup> The clinical and biological phenotype of sepsis can be modified by preexisting acute illness, long-standing co-morbidities, medication, and interventions.<sup>6</sup> Specific infections may result in local organ dysfunction with a receptor-mediated deregulated systemic host response following pathogen invasion.<sup>7</sup> SIRS criteria are present in many hospitalized patients, including those who never develop infection and never incur adverse outcomes (poor discriminate validity). The SIRS criteria do not necessarily indicate a deregulated, life-threatening response. The predictive validity for in-hospital mortality using SOFA score was statistically found to be greater than SIRS and qSOFA, supporting its use in clinical criteria for sepsis in large multi-centric study.<sup>8</sup> Organ dysfunction can be identified as an acute change in total SOFA score  $\geq 2$  points consequent to the infection.

The baseline SOFA score can be assumed to be zero in patients not known to have preexisting organ dysfunction. A SOFA score  $\geq 2$  reflects an overall mortality risk of approximately 10% in a general hospital population with suspected infection. Even patients presenting with modest dysfunction can deteriorate further, emphasizing the seriousness of this condition and the need for prompt and appropriate intervention, if not already being instituted.

The SOFA score is not intended to be used as a tool for patient management but as a means to clinically characterize a septic patient. Components of SOFA (such as creatinine or bilirubin level) require laboratory testing and thus may not promptly capture dysfunction in individual organ systems. Other elements, such as the cardiovascular score, can be affected by iatrogenic interventions. However, SOFA has widespread familiarity within the critical care community and a well-validated relationship to mortality risk.

## CONCLUSION

Serial measurement of SOFA score during first week is a very useful tool in predicting the outcome especially on the day 3. The trend of SOFA score was progressively declining in survivors while non-survivors had a stable higher score during the first week.

The APACHE II score on day of admission, though reliable, was not very effective in predicting the mortality rate in our set up.

**Conflict of interest:** None declared.

**Ethical clearance:** Taken.

**Source of funding:** None declared.

**Contribution of Authors:** We declare that this work was done by the authors named in this article and all liabilities pertaining to claims relating to the content of this article will be borne by the authors.

## REFERENCES

1. Knaus WA, Draper EA, Wagner DP, Zimmerman JE. *APACHE II: a severity of disease classification system. Critical Care Medicine* 1985;13(10):818–29.
2. Vincent JL, de Mendonça A, Cantraine F, Moreno R, Takala J, Suter PM et al. Use of the SOFA scores to assess the incidence of organ dysfunction/failure in intensive care units: results of a multicenter, prospective study. Working group on “sepsis-related problems” of the European Society of Intensive Care Medicine. *Crit Care Med* 1998;26(11):793–800.
3. Shankar-Hari M, Phillips GS, Levy ML, Seymour CW, Liu VX, Deutschman CS et al. Developing a New Definition and Assessing New Clinical Criteria for Septic Shock. *JAMA* 2016;315(8):775–787.
4. Singer M, Deutschman CS, Seymour CW, Shankar-Hari M, Annane D, Bauer M et al. The Third International Consensus Definitions for Sepsis and Septic Shock (Sepsis-3). *JAMA* 2016;315(8):801–810.
5. Dellinger RP, Levy MM, Rhodes A, Annane D, Gerlach H, Opal SM et al. Surviving Sepsis Campaign: International guidelines for management of severe sepsis and septic shock. *Crit Care Med* 2013; 41(2):580–637.
6. Angus DC, van der Poll T. Severe sepsis and septic shock. *N Engl J Med* 2013;369(9):840–851.
7. Wiersinga WJ, Leopold SJ, Cranendonk DR, van der Poll T. Host innate immune responses to sepsis. *Virulence* 2014;5(1):36–44.
8. Seymour CW, Liu VX, Iwashyna TJ, Brunkhorst FM, Rea TD, Scherag A et al. Assessment of Clinical Criteria for Sepsis for the Third International Consensus Definitions for Sepsis and Septic Shock (Sepsis-3). *JAMA* 2016;315(8):762–774.