

Is Sequential Organ Failure Assessment (SOFA) Score the Real Predictor of Mortality in Resource Constrained Critical Care?

SOFA Score the
Real Predictor of
Mortality

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ABSTRACT

Objective: To determine whether predicted mortality through SOFA score would correctly reflect actual mortality in resource limited setups.

Study Design: Retrospective cross-sectional observational study

Place and Duration of Study: This study was conducted at the Jinnah Postgraduate Medical Center, Karachi from 1st August 2022 to 31st October 2022.

Materials and Methods: SOFA score was calculated at the time of admission for all included patients and percentages of predicted mortalities were documented. Actual mortalities were compared with SOFA score predicted mortality for accuracy of the mortality prediction tool.

Results: A total of 229 patients were enrolled in the study. The mean SOFA score of all patients included in the study was calculated to be 8.310 ± 4.599 pertaining to a predicted mortality of $\leq 33\%$. The actual mortality was calculated to be 46.95%. Amongst medical, surgical and gynecology subgroups of patient the expected mortality was $\leq 33\%$ for each group while the actual mortalities were 51.91%, 25% and 33% respectively.

Conclusion: The SOFA score proved to be over all inaccurate at predicting actual mortality in our study. Accurate prediction was only seen amongst surgical and Gynecology sub groups of patients and also in patients admitted with diagnoses of Organophosphate Poisoning, Diabetic ketoacidosis with Multi-Organ Dysfunction, Guillain Barre Syndrome (GBS), and Tetanus, eclampsia and pre / post-exploratory laparotomy.

Key Words: Critical illness; mortality; organ dysfunction scores; resource allocation; SOFA score

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INTRODUCTION

Sequential Organ Failure Assessment (SOFA) score formerly called Sepsis related Organ Failure Assessment score has been used widely to predict the mortality of patients with organ failure admitted in critical care. This is the only tool so far in which severity of major organ dysfunction and dependency on vasopressor are also taken into account which may be a major contributor to patient outcome.¹ It has been advocated in literature that this tool was originally developed as a mortality score but may be better for determination of worsening or improvement in multiple organ dysfunction rather predicting mortality.² SOFA score includes scoring of worst parameters based on six major organ assessments.

This includes scores of respiratory, cardiovascular, renal, hepatic, neurological and hematological parameters.³ Determination of predicted mortality is an important aspect of management of ICU patients to define the resource allocation in Low & Middle income countries (LMIC) as well as the best treatment strategy of such patients.⁴ Moreover, this score may enable doctors to efficiently prognosticate patients⁵ which further would help in developing effective counselling strategies for patients' families and aid in understanding of the disease and cost burden of treatment.

Medical ICUs of resource constrained set up mostly deals patients with no previous medical records and an already established multiorgan dysfunction requiring level of care III.⁶ The calculation of SOFA score of first 24 hours of ICU admissions based on clinical parameters and the laboratory investigations is part of Medical ICU patient management protocol since it does not require any special investigations and hence, does not burden the patient financially. This study was conducted to determine whether predicted mortality through SOFA score would correctly reflect actual mortality in resource limited setups.

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MATERIALS AND METHODS

We conducted a retrospective cross-sectional observational study in the Medical Intensive Care Unit of Ward 23 at Jinnah Postgraduate Medical Centre, Karachi, Pakistan. The study was conducted on patients admitted in MICU from 1st August 2022 to 31st October 2022, after Institutional Review Board (IRB) approval dated 20th March 2023, with reference no F.2-18/2023-GENL/50/JPMC.

All the patients admitted during the study period were enrolled except for the patients with incomplete data for the calculations of first day’s SOFA score and the patients who were admitted with a code status of Do Not Intubate (DNI). The SOFA score of the first 24 hours was calculated with the worst parameters of the day for the enrolled patients. The mean SOFA score was recorded for all included patients and predicted mortality of the study was determined by taking expected percentages of mortality for that SOFA score described in the table No. 1.

Table No. 1: SOFA score and associated mortality.

SOFA SCORE	PREDICTED MORTALITY
≤9	≤33%
10-11	50%
≥12	≥95%

Actual mortality was considered as patients who expired during their stay in Medical ICU. Survival was considered as patients who were stepped down or discharged from Medical ICU, regardless of the later outcome. Accurate prediction of mortality was defined as matching results of actual mortality within the predicted range of mortality as per SOFA score. Results of actual mortality outside the range of predicted SOFA mortality were considered as inaccurate prediction of mortality by SOFA score. Actual and predicted mortalities of department subgroups: medical; patients admitted with primarily medical diagnosis, Surgical; patients admitted for pre-op to surgical emergencies or post-op, Gynecology patients admitted with pre and post obstetric complications requiring surgery or medical intervention group were further determined separately. Patients were also categorized as per diagnosis determined by relevant investigations, examination and clinical judgment and data was analyzed as stated above.

To collect relevant data, patients’ files were accessed retrospectively and working diagnoses with results of supporting Clinical, laboratory investigations, and expected mortality as per SOFA score and actual mortalities were recorded using a proforma and entered into MS Excel for analysis.

RESULTS

During study period, 309 patients were screened, out of them 6 patients were excluded for their DNI code

status. Data could not be retrieved about 74 patients for the calculation of first day SOFA score. After initial screening, 229 patients were enrolled in the study and were analyzed for the results. The mean SOFA score of all admitted patients included in the study was calculated to be 8.310 ± 4.599 pertaining to a predicted mortality of ≤33%. The actual mortality was calculated to be 46.95%.

Data was grouped into 3 categories, according to predicted mortality by SOFA score in the first 24 hours, ≤33%, 50% and ≥95%. The mortality percentages of each groups are shown in Figure No. 1.

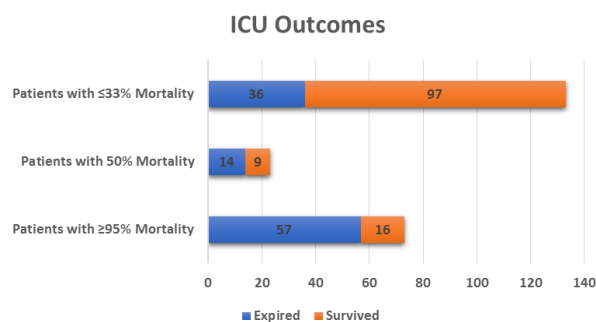


Figure No. 1: Outcome of patients according to subgroups as per predicted mortality.

Amongst medical patients (n=182) mean SOFA score was 8.285 ± 4.604 (mortality ≤33%) whereas actual mortality amongst these patients was 51.91%, Gynecological (n=32) and surgical (n=15) patients had a predicted mortality of ≤33% (mean SOFA 8.501 ± 4.216 and 6.830 ± 3.31 respectively) and actual mortality of 33% and 25% respectively. As shown in Table No. 2.

Table No. 2: Predicted vs Actual Mortality as per Sub speciality Group

Sub Speciality	Predicted	Actual
SURGICAL	≤33%	25%
GYNAE/OBS	≤33%	33%
MEDICAL	≤33%	51.91%

Predicted and actual mortalities were then regrouped according to working diagnosis based on relevant appropriate investigations and clinical decision making. 8 patients (n=8) admitted with organophosphate poisoning had a predicted mortality of ≤33% (mean SOFA 3.57 ± 1.714) and an actual mortality of 0%.

Patients with Malaria and multiorgan dysfunction (MOD) with n=14, had a predicted mortality of ≤33% and actual mortality (6 out of 14) calculated at 42.85%. In dengue shock syndrome with multiorgan dysfunction (MOD) (n=20) predicted mortality ≤33% against calculated mortality of 100% with 20 out of 20 patients expiring.

Amongst Diabetic Ketoacidosis (DKA) with MOD (n=18) ≤33% predicted mortality and actual mortality of 22.22% (4 out of 18). Patients were admitted with Acute Liver Failure (ALF) with MOD (n=6), 5 out of 6

(83.33%) patients expired. Their predicted mortality was $\geq 95\%$.

In Guillain Barre Syndrome (GBS) with bulbar involvement, (N=10) predicted mortality was $\leq 33\%$ (mean SOFA 7.48 \pm 3.797) and 3 out of 10 admitted patients expired (30%). With a working diagnosis of meningoenephalitis 11 out of 23 patients, that is 47.8% patients expired. SOFA score of this group was at a

mean of 8.06 \pm 4.130 ($\leq 33\%$). Those (n=16) with a diagnosis of Eclampsia had predicted mortality $\leq 33\%$ (mean SOFA 6.71 \pm 3.385), actual mortality 12.5% and d=20.5

Patients brought in for intensive care after exploratory laparotomy showed a mortality rate of 17.64 with 3 out of 17 patients expiring and predicted mortality $\leq 33\%$ (mean SOFA 8.89 \pm 4.328).

Table No. 3: Predicted mortality, actual mortality and difference in mortality for all patients grouped according to diagnosis ¹SOFA= Sequential Organ Failure Assessment, ²MODs= Multi-Organ Dysfunction, ³DSS= Dengue Shock syndrome, ⁴DKA= Diabetes Keto Acidosis, ⁵ALF= Acute Liver failure, ⁶SLE= Systemic Lupus Erythematosus, ⁷GBS= Guillain Barre Syndrome.

S. No	Diagnosis	SOFA ¹ Score (Mean)	Predicted Mortality (%)	Total Patients (N)	Mortalities (N)	Actual Mortality (%)
1	Organophosphate Poisoning	3.57 \pm 1.714	≤ 33	8	0	0
2	Malaria with MODs ²	9.056 \pm 4.174	≤ 33	14	6	42.85
3	DSS ³ with MODs	8.516 \pm 3.895	≤ 33	20	20	100
4	DKA ⁴ with MODs	8.198 \pm 4.46	≤ 33	18	4	22.22
5	ALF ⁵ with MODs	14 \pm 2.250	≥ 95	6	5	83.33
6	SLE ⁶ flare	7.11 \pm 3.990	≤ 33	4	2	50
7	Tetanus	4.81 \pm 2.491	≤ 33	6	2	33
8	GBS ⁷ with Bulbar Involvement	7.48 \pm 3.797	≤ 33	10	3	30
9	Meningoenephalitis	8.06 \pm 4.130	≤ 33	23	11	47.8
10	Status Epilepticus	8.45 \pm 3.938	≤ 33	7	4	57.14
11	Eclampsia	6.71 \pm 3.385	≤ 33	16	2	12.5
12	Puerperal Sepsis	10.67 \pm 3.206	50	5	4	80
13	Post Exploratory Laparotomy	8.89 \pm 4.328	≤ 33	17	3	17.64

DISCUSSION

In resource limited countries, the burden of critically ill patients remains unsupported due to lack of resources and infrastructure especially pertaining to public sector tertiary care hospitals.^{6,7} It is pertinent to note that the mortality rate of ICUs of resource limited countries is much higher than developed countries.⁸ In our study majority of the patients had already developed multiorgan dysfunction, a major cause of mortality in ICUs worldwide.⁹

Inaccurate as concurred by other study.¹⁰ However, amongst surgical and gynecology pre/post-operative patients SOFA score remained accurate in predicting mortality as other study.^{11,12}

A major limitation that we encountered while using the SOFA score mortality prediction, was the lack of incorporation of diagnosis related outcome.¹³ Other tools such as APACHE 2 and APACHE 4 were not considered as regular means for outcome calculation as they do not significantly consider factors such as cardiovascular shock and vasopressors, paramount to mortality.¹⁴

In patients of Dengue Shock Syndrome (DSS), we found a significant inaccuracy in prediction of mortality by SOFA scores of the first 24 hours. We noted severe liver involvement in all patients admitted and expired with DSS. We must note here that our set up does not provide facilities of emergency liver transplant. DSS with multiorgan involvement to date remains high in the list of all-cause mortality.¹⁵

In patients of meningoenephalitis which is most likely to cause death secondary to hydrocephalus followed by brain herniation, circulatory failure, intractable seizures and other brain injury¹⁶ are unlikely to reflect in the categories of SOFA scoring. Concurrently the pathophysiology and cause of death, possibly intractable seizures, underlying neurological disease¹⁷ would yet again fail to reflect in the score of patients with status epilepticus.

However, it is interesting to note that the SOFA score which had been initially developed as a score of sepsis related organ dysfunction was unable to correctly predict mortality in patients admitted into the category of puerperal sepsis.

To note, Malaria is more likely to have a more severe progressive hematological, pulmonary and renal

involvement,¹⁸ for which outcomes didn't accurately match with first day predictive mortality by SOFA score. GBS being more likely to have cardiovascular/autonomic involvement^{19,20} and tetanus is more likely to have involvement of the respiratory category²¹ in the SOFA score as a cause of mortality could be accurately predicted by SOFA score.

In patients with eclampsia, the multiorgan involvement starts improving as soon as termination of pregnancy is done and so is the reason of accurate prediction of outcomes by a single point SOFA calculation on first day as evident by our data. In patients admitted with pre/post-operative care for exploratory laparotomy were not presented with multiorgan involvement and SOFA score accurately predicted the mortality.

Conclusion and Future Directions: The SOFA score proved to be over all inaccurate at predicting actual mortality amongst most patients in our low-resource critical care set up. However accurate prediction was still seen amongst surgical and Gynecology sub groups of the patients and also in patients with diagnoses of organophosphate poisoning, Diabetic ketoacidosis with Multi-Organ Dysfunction, GBS, Tetanus, eclampsia and post exploratory laparotomy. The most inaccurate predication was seen in patients with severe liver involvement.

From the observations made in this study, we aim to raise three imperative questions:

1. Is the hepatic component of the SOFA score contributing to inaccuracy of its mortality prediction?
2. Does the mortality rate per valid literature of specific diagnoses need to be incorporated in a formal calculation of mortality prediction?
3. Is the relation between SOFA score and predictive percentage of mortality, the correct scale to be implemented in the critical care of resource constraint countries?

We hope our study may initiate research on these queries to develop a more inclusive scoring for mortality prediction.

CONCLUSION

The SOFA score proved to be over all inaccurate at predicting actual mortality in our study. Accurate prediction was only seen amongst surgical and Gynecology sub groups of patients and also in patients admitted with diagnoses of Organophosphate Poisoning, Diabetic ketoacidosis with Multi-Organ Dysfunction, Guillain Barre Syndrome (GBS), and Tetanus, eclampsia and pre / post-exploratory laparotomy.

Author's Contribution:

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Conflict of Interest: The study has no conflict of interest to declare by any author.

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