International Journal for Multidisciplinary Research (IJFMR)
E-ISSN: 2582-2160 ● Website: www.ijfmr.com ● Email: editor@ijfmr.com

Effectiveness of the Modified NUTRIC Score in Predicting Mortality Among Mechanically Ventilated Critically Ill Patients in a North Indian Tertiary Care ICU

Soumya Ranjan Mohanty[1], Mallavarapu Manisha[2], Manish Kumar[3]

[1,2]Senior Resident, Department of Endocrinology & Metabolism, Institute of Medical Sciences, Banaras Hindu University, Varanasi
[3]Senior Resident, Department of Cardiology, Institute of Medical Sciences, Banaras Hindu University, Varanasi

Abstract

Background: The modified Nutrition Risk in Critically Ill (m-NUTRIC) score is a validated tool for predicting mortality and clinical outcomes in critically ill patients globally. This study aims to evaluate the effectiveness of the m-NUTRIC score in predicting mortality among mechanically ventilated patients in a tertiary care ICU in North India.

Methodology: A cross-sectional observational study was conducted in the medical ICU of a tertiary care hospital in North India. Baseline clinical, hematological, and biochemical parameters, mNUTRIC, APACHE II and SOFA scores were collected within 24 hours of ICU admission, and patients were followed for ICU length of stay and 28-day mortality. Statistical analysis included ROC curve assessment and evaluation of sensitivity and specificity for mNUTRIC, APACHE II, and SOFA scores in predicting mortality.

Results: Among 114 mechanically ventilated ICU patients, hypertension (31.6%) and diabetes (23.7%) were the most common comorbidities. High nutritional risk (mNUTRIC ≥5) was present in 35.1% of patients. The mNUTRIC score showed a sensitivity of 70%, specificity of 68.9%, PPV of 54.9%, and NPV of 81% for predicting mortality. APACHE II had higher sensitivity (80%) and specificity (74.3%), with a PPV of 62.7% and NPV of 87.3%. SOFA demonstrated the highest sensitivity (83.9%), specificity of 69.9%, PPV of 51.0%, and NPV of 92.1%. However, ROC analysis revealed only modest discriminatory power for all three scores: mNUTRIC (AUC 0.5915), APACHE II (AUC 0.5842), and SOFA (AUC 0.5223).

Conclusion: The mNUTRIC score is a practical tool for predicting mortality in ICU patients, but larger multi-center studies are needed to validate its effectiveness across diverse populations.

Keywords: mNUTRIC, ICU, APACHE 2, SOFA

Introduction

Malnutrition is a pervasive and critical concern among patients admitted to intensive care units (ICUs), with prevalence rates reported between 38% and 78% in the published clinical studies.[1,2] Its causes are

multifactorial, including inadequate intake, decreased absorption, and increased metabolic demands due to critical illness.[3] Malnutrition in this population is linked to prolonged hospital stays, higher rates of nosocomial infections, poor outcomes, and increased mortality.[4,5]

Assessing nutrition in mechanically ventilated critically ill patients is challenging. Many screening systems exist, but conventional tools rely on patient-reported data such as such as recent weight loss and reduced dietary intake, which is often unavailable due to sedation. This leads to inaccurate nutritional assessments and complicates malnutrition identification.[6,7] Furthermore, scoring systems like APACHE II and SOFA scores do not address nutritional risk stratification, which is vital for improving outcomes in critical care settings.

Recently, the modified Nutrition Risk in Critically Ill (m-NUTRIC) score has emerged as a prominent tool for nutritional risk stratification, demonstrating strong predictive value for clinical outcomes such as 28-day mortality and resource utilization among critically ill patients in global studies.[6,8] However, there is a notable lack of research evaluating the performance of the m-NUTRIC score specifically in critically ill patient populations in India. Addressing this gap, the current study aims to assess the effectiveness of the modified NUTRIC score in predicting mortality outcomes among critically-ill patients receiving mechanical ventilation in a tertiary care medical ICU in North India.

Methodology

Study Setting and Design

The current cross-sectional observational study was conducted among patients admitted to the Medical ICU, Atal Bihari Vajpayee Institute of Medical Sciences and Dr. Ram Manohar Lohia Hospital, New Delhi between 1st November 2019 to 31st March 2021.

Sample Size Calculation

The sample size was determined based on the area under the curve (AUC) of the mNUTRIC score in predicting mortality, as observed in the study by M.S. Kalaiselvan et al.,[6] which reported an AUC of 0.582. Using this value as a reference, with a margin of error (δ) of 0.10, a 5% level of significance, and a 20% dropout rate, the calculated minimum required sample size was 102 patients. The current study recruited 114 in the timeperiod.

Methodology

For each patient, standard hematological and biochemical tests, as well as arterial blood gas analysis, were performed. Baseline data including including age, APACHE II score, SOFA score components, modified NUTRIC (mNUTRIC) score, comorbidities, and days in hospital before ICU admission—were recorded within 24 hours of ICU entry. Patients were monitored for outcomes such as ICU length of stay and 28-day mortality.

Arterial blood samples were collected and analyzed with an automated blood gas analyzer. Complete blood count (including hemoglobin, total leukocyte count, differential count, and platelets) was measured using the Medonic CA620 autoanalyzer. Routine biochemical assessments—covering liver function tests (total, direct, and indirect bilirubin; alkaline phosphatase; aspartate transaminase; alanine transaminase), kidney function tests (urea, creatinine, uric acid), serum total protein, albumin, globulin, fasting blood sugar, and electrolytes (sodium, potassium, calcium, phosphate)—were performed.

Data and statistical analysis

Data was collected and entered in an excel sheet. Statistical analysis was conducted with Graph Pad PRISM. Continuous variables were expressed as Median [IQR] or mean ± SD and compared using students t-test. Categorical variables were expressed as N (%). Sensitivity, specificity, positive predictive value, and negative predictive value were evaluated for the APACHE II score, SOFA score, and the modified NUTRIC (mNUTRIC) score. A receiver operation curve was developed for all three scoring systems. $P<0.05$ was considered to be statistically significant.

Results

The current study included 114 patients with an average age of 45.2 ± 15.6 years with an M:F ratio of 1.1 and about 25.4% were overweight or obese. Table 1 provides the demographic details and clinical profile of the study population. The majority (78.9%) of individuals had an ICU stay of ≥7 days. Hypertension (31.6%) and diabetes (23.7%) were the most common co-morbidities.

Table 1: Patient demographics and clinical profile

	Total population
N	114
Age	45.2 ± 15.6
Age distribution	
<30 years	20 (17.5%)
30-44 years	36 (31.6%)
45-59 years	31 (27.2%)
≥60 years	27 (23.7%)
Gender	
Male	60 (52.6%)
Female	54 (47.4%)
BMI	21.2 ± 3.8
BMI distribution	
<18.5	22 (19.3%)
18.5-22.9	63 (55.3%)
23.0-25.0	11 (9.6%)
>25	18 (15.8%)
Duration of ICU stay	4.3 ± 6.4
ICU duration	
<7 days	24 (21.1%)
≥7 days	90 (78.9%)
SBP	120.7 ± 26.4
DBP	74.7 ± 18.7
Mean Arterial Pressure	89.6 ± 20.2
Respiratory rate	18.8 ± 3.7
SpO2	98.0 ± 3.3
Temp	98.5 ± 1.7

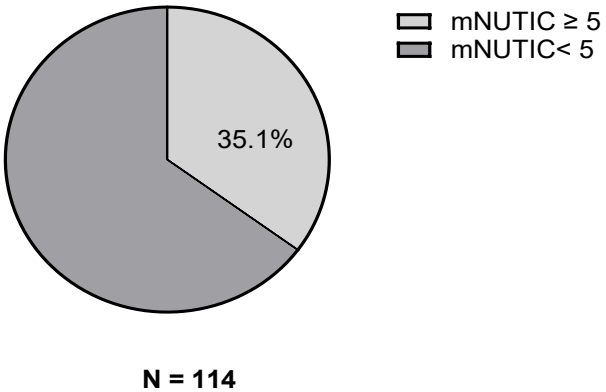
RBS	191.9 ± 90.3
RBS distribution Normal (<140 mg/dl) Prediabetes (140-199 mg/dl) Diabetes (>200 mg/dl)	 45 (39.5%) 19 (16.7%) 50 (43.9%)
FiO2	81.9 ± 21.9
FiO2 distribution 40% 50% 60% 70% 80% 100%	 10 (8.8%) 9 (7.9%) 10 (8.8%) 15 (13.2%) 8 (7%) 62 (54.4%)
Acute Kidney Injury	41 (36.0%)
Creatinine (mg/dl)	1.7 ± 2.0
Creatinine distribution Men (n = 60) Normal (0.7-1.3) Abnormal (<0.7, >1.3) Women (n = 54) Normal (0.6 – 1.1) Abnormal (<0.6, >1.1)	 19 (31.7%) 41 (68.3%) 18 (33.3%) 36 (66.7%)
Uric acid	5.5 ± 3.3
BUN (mg/dl)	61.9 ± 52.6
BUN distribution Men (n = 60) Normal (8-24) Abnormal (<8, >24) Women (n = 54) Normal (8-21) Abnormal (<8, >21)	 9 (15%) 51 (85%) 11 (20.4%) 43 (79.6%)
Na (mg/dl)	141.3 ± 9.1
Hyponatremia (<135) Normal (135-145) Hypernatremia (>145)	27 (23.7%) 60 (52.6%) 27 (23.7%)
K+ (mg/dl)	3.8 ± 0.7
Hypokalemia (<3.7) Normal (3.7-5.2) Hyperkalemia (>5.2)	56 (49.1%) 52 (45.6%) 6 (5.3%)
Ca++ (mg/dl)	9.1 ± 0.8

Hypocalcaemia (<8.5) Normal (8.5-10.2) Hypercalcemia (>10.2)	20 (17.5%) 85 (74.6%) 9 (7.9%)
Bilirubin (mg/dl)	0.5 ± 1.2
Bilirubin distribution Abnormal Normal (0.1-1.2)	 106 (93%) 8 (7%)
ALT (IU/ml)	38.00 [19.0, 69.0]
ALT distribution Abnormal Normal (7-56)	 35 (30.7%) 79 (69.3%)
AST (IU/ml)	40.00 [25.75, 76.0]
AST distribution Abnormal Normal (8-33)	 74 (64.9%) 40 (35.1%)
ALP (IU/ml)	126.5 ± 97.3
ALP distribution Abnormal Normal (44-147)	 23 (20.2%) 91 (79.8%)
Total Protein (g/dl)	6.3 ± 1.1
TP distribution Normal (6.0-8.3) Abnormal	 62 (54.4%) 52 (45.6%)
Albumin	3.0 ± 0.7
Albumin distribution Normal (3.5-5.5) Abnormal	 29 (25.4%) 85 (74.6%)
pO4	3.6 ± 1.2
pO4 distribution Normal (2.5-4.5) Abnormal	 78 (68.4%) 36 (31.6%)
PCV (%)	31.2 ± 6.7
PCV distribution Normal (28-61) Abnormal	 93 (81.6%) 21 (18.4%)
Hb (%)	10.2 ± 2.1
Haemoglobin distribution Men (n = 60) Normal (14-18) Abnormal	 4 (6.7%) 56 (93.3%)

Women (n = 54) Normal (12-16) Abnormal	 6 (7.4%) 46 (92.6%)
TLC	13319 ± 5512
TPC	196920 ± 80785
Number of Comorbidities None One Two More than 2	 48 (42.1%) 41 (36%) 15 (13.2%) 10 (8.8%)
Types of Co-morbidities DM COPD CAD CKD CLD HTN Hypothyroidism CVA RA Seizure AF HIV ILD DCMP Covid Lung	 27 (23.7%) 3 (2.6%) 7 (6.1%) 3 (2.6%) 3 (2.6%) 36 (31.6%) 6 (5.3%) 2 (1.8%) 1 (0.9%) 5 (4.4%) 1 (0.9%) 2 (1.8%) 1 (0.9%) 1 (0.9%) 1 (0.9%)
History of organ failure/ immunocompromised	10 (8.8%)

About 35.1% of the patients admitted to the medical ICU have a high nutritional risk score (mNUTRIC ≥ 5) (Figure 1). A positive correlation was observed between mNUTRIC score and mortality in the study population (r = 0.4807, 95% CI [0.3256 to 0.6107]; P<0.0001).

Figure 1: mNUTRIC score distribution in the study population



The mean mNUTRIC, APACHE II, and SOFA scores were compared between the mortality group and the overall study population (Table 2). The mNUTRIC score was significantly higher in the mortality group, with a mean of 4.9 ± 1.9 compared to 3.8 ± 2.0 in the study population (P = 0.0011; Table 2). Similarly, the APACHE II score was elevated in the mortality group, averaging 24.3 ± 6.8 versus 20.2 ± 7.3 in the remainder of the population (P = 0.0008; Table 2). Additionally, the SOFA score was significantly greater in the mortality group, at 8.7 ± 3.0 compared to 7.2 ± 2.8 in the study population (P = 0.0022; Table 2).

Table 2: Descriptive statistics of different scores

	Total	**Mortality**	**P-value**
	N = 114	N = 51	
mNUTRIC score			
Mean ± SD	3.8 ± 2.0	4.9 ± 1.9	0.0011
Median (IQR)	4 [2,5]	5 [4,6]	
Min, Max	0, 9	1, 9	
APACHE II score			
Mean ± SD	20.2 ± 7.3	24.3 ± 6.8	0.0008
Median (IQR)	19 [15,26]	26 [20,29]	
Min, Max	7, 35	9, 35	
SOFA score			
Mean ± SD	7.2 ± 2.8	8.7 ± 3.0	0.0022
Median (IQR)	6 [5,9]	9 [6,11]	
Min, Max	2,16	4, 16	

The sensitivity and specificity of the mNUTRIC, APACHE II, and SOFA scores in predicting mortality were comparable (Tables 3, 4, and 5). The mNUTRIC score demonstrated a sensitivity of 70%, specificity of 68.9%, positive predictive value (PPV) of 54.9%, and negative predictive value (NPV) of 81%. The APACHE II score showed a sensitivity of 80%, specificity of 74.3%, PPV of 62.7%, and NPV of 87.3%. Meanwhile, the SOFA score exhibited the highest sensitivity at 83.9%, with a specificity of 69.9%, PPV of 51.0%, and NPV of 92.1%.

The ROC curve analysis showed that the mNUTRIC score had an AUC of 0.5915 (95% CI: 0.4868 to 0.6962; P = 0.0933), the APACHE II score had an AUC of 0.5842 (95% CI: 0.4795 to 0.6889; P = 0.1224), and the SOFA score had an AUC of 0.5223 (95% CI: 0.4159 to 0.6287; P = 0.6821) (Figure 2).

Table 3: Contingency Table for Sensitivity and Specificity Analysis of mNUTRIC score

	mNUTRIC score >=5 (N = 40)	mNUTRIC score <5 (N = 74)	
Mortality (N = 51)	28 **(True positive)**	23 **(False positive)**	54.9% **(PPV)**
No mortality (N = 63)	12 **(False-negative)**	51 **(True negative)**	81.0% **(NPV)**
	70% **(Sensitivity)**	68.9% **(Specificity)**	

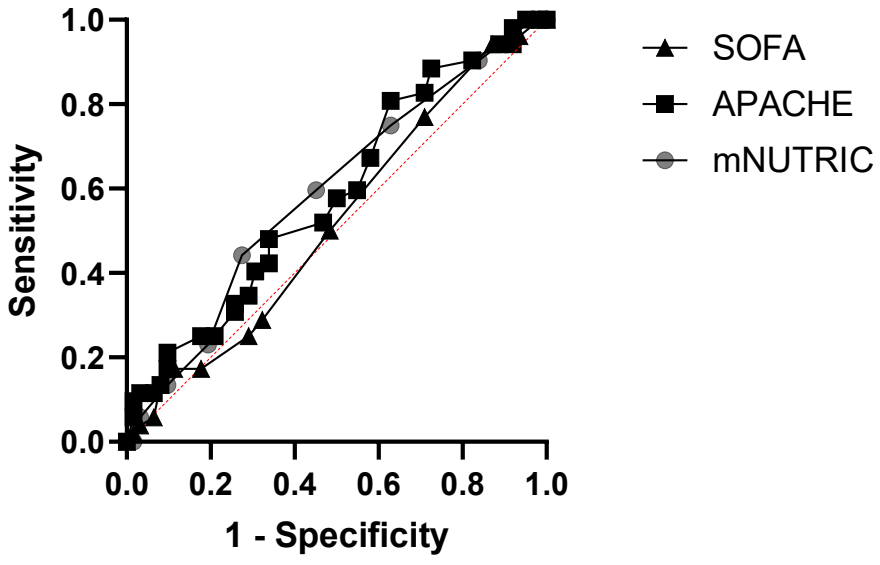
Table 4: Contingency Table for Sensitivity and Specificity Analysis of APACHE II score

	APACHE II score >=23 (N = 40)	APACHE II score <23 (N = 74)	
Mortality (N = 51)	32 **(True positive)**	19 **(False positive)**	62.7% **(PPV)**
No mortality (N = 63)	8 **(False-negative)**	55 **(True negative)**	87.3% **(NPV)**
	80% **(Sensitivity)**	74.3% **(Specificity)**	

Table 5: Contingency Table for Sensitivity and Specificity Analysis of SOFA score

	SOFA >=8.5 (N = 31)	SOFA<8.5 (N = 83)	
Mortality (N = 51)	26 **(True positive)**	25 **(False positive)**	51.0% **(PPV)**
No mortality (N = 63)	5 **(False-negative)**	58 **(True negative)**	92.1% **(NPV)**
	83.9% **(Sensitivity)**	69.9% **(Specificity)**	

Figure 2: Receiver operating curves of mNUTRIC, APACHE II and SOFA scores



Legend: The receiver operating characteristic (ROC) curve for the mNUTRIC, APACHE II and SOFA scores to predict mortality in critically ill patients.

Discussion

Malnutrition may be present upon admission to the ICU or may develop during the ICU stay due to increased metabolic demands, inadequate nutritional intake, or impaired nutrient absorption. About one-third of patients admitted to the ICU had malnutrition (mNUTRIC score ≥5). A significant correlation was

observed between higher mNUTRIC scores and mortality. The sensitivity and specificity of the mNUTRIC, APACHE II, and SOFA scores in predicting mortality were comparable.

The prevalence of high nutritional risk (mNUTRIC ≥ 5) in the current study population (35.1%; Figure 1) aligns with established patterns observed in Indian ICU settings, though slightly lower than previously reported ranges. Previous studies among South Asian patients admitted to the ICU have observed a similar prevalence (42.5 – 45%) of high nutritional risk score (mNUTRIC ≥ 5).[6,9] These studies together highlight the need for early and routine screening for malnutrition in ICU patients.

High mNUTRIC scores have been consistently linked to worse clinical outcomes in critically ill patients, including longer ICU stays and higher mortality rates. Multiple studies have demonstrated that patients with elevated mNUTRIC scores face significantly higher mortality: Kalaiselvan et al. reported a mortality rate of 41.4% in patients with high scores (≥5) compared to 26.1% in those with low scores (≤4),[6] while Mukhopadhyay et al. observed 36% mortality in high-score groups versus 12.7% in low-score groups.[10] Similarly, Ata Ur-Rehman HM et al. found a mortality rate of 26% in high-score patients, compared to just 3% among those with low mNUTRIC scores.[8] In the present analysis, mNUTRIC, APACHE II, and SOFA scores were all significantly higher in the mortality group than in the overall ICU population. Notably, 54.9% of patients who died had high mNUTRIC scores (≥5), compared to only 19% among survivors, underscoring the strong association between high nutritional risk and adverse outcomes in the ICU. The higher mortality observed in the high mNUTRIC score group in our study may be attributed to the predominance of critically ill patients admitted with severe conditions such as septic shock, respiratory failure, and cerebrovascular accidents with neurological deterioration. In contrast, previous studies often included patients from multidisciplinary ICUs with a broader range of diagnoses.[6,9] For example, in the study by Mukhopadhyay et al., only 68% of patients were on mechanical ventilation, indicating a potentially less critically ill population compared to ours.[9]

In this study, the sensitivity and specificity of the mNUTRIC, APACHE II, and SOFA scores for predicting mortality were comparable, with the mNUTRIC score demonstrating a sensitivity of 70% and a specificity of 68.9%. Previous studies have reported a wide range of sensitivity for the mNUTRIC score in mortality prediction, varying from 41.5% to 97.2%.[6,11,12] Additionally, a meta-analysis assessing the predictive performance of the mNUTRIC score found pooled sensitivities of 70.3% and 61.3%, further supporting its accuracy in identifying patients at risk of mortality.

The discriminatory power, as indicated by the area under the ROC curve (AUC), was modest for all three scores: mNUTRIC (AUC = 0.5915; 95% CI: 0.4868–0.6962), APACHE II (AUC = 0.5842; 95% CI: 0.4795–0.6889), and SOFA (AUC = 0.5223; 95% CI: 0.4159–0.6287). These findings suggest only good discriminatory ability for mortality prediction in Indian patients admitted to the ICU. Comparing these results to previous studies, Kalaiselvan et al. reported a similar AUC for mNUTRIC (0.582; 95% CI: 0.535–0.628),[6] while Ata Ur-Rehman et al. observed a higher AUC of 0.757 (95% CI: 0.713–0.801) for mNUTRIC in mortality prediction.[8] Other studies have also shown mNUTRIC to have sensitivity and specificity comparable to or slightly lower than APACHE II and SOFA, but often with a higher sensitivity for mortality prediction. Collectively these studies indicate that mNUTRIC score can offer good discriminatory power in predicting mortality among ICU admitted patients, especially those on mechanical ventilation.

Single center design is the main limitation of the study which limits the generalizability. The current study recorded mNUTRIC score at presentation only, subsequent scoring during stuy was not performed in patients who presented with low mNUTRIC score as they may have become worse during the hospital

stay. Serial nutritional assessment was not done to see adequacy of the feeding practices as it was not the aim of the study.

Conclusion:

The mNUTRIC scoring is a practical tool in predicting mortality among ICU patients. However, large-scale multi-centric studies are essential for understanding the effectiveness of this tool in predicting mortality among ICU patients.

References

1. Verghese PP, Mathai AS, Abraham V, Kaur P. Assessment of malnutrition and enteral feeding practices in the critically ill: A single-centre observational study. Indian J Anaesth. 2018;62:29
2. Mendes R, Policarpo S, Fortuna P, et al. Nutritional risk assessment and cultural validation of the modified NUTRIC score in critically ill patients—a multicenter prospective cohort study. J. Crit. Care. 2017;37:45-9.
3. Singer P, Blaser AR, Berger MM, et al. ESPEN guideline on clinical nutrition in the intensive care unit. Clin Nutr. 2019;38:48-79.
4. Lew CC, Wong GJ, Cheung KP, Chua AP, Chong MF, Miller M. Association between malnutrition and 28-day mortality and intensive care length-of-stay in the critically ill: a prospective cohort study. Nutrients. 2018;10:10.
5. Lee ZY, Heyland DK. Determination of nutrition risk and status in critically ill patients: what are our considerations?. Nutr Clin Pract. 2019;34:96-111.
6. Kalaiselvan MS, Renuka MK, Arunkumar AS. Use of nutrition risk in critically ill (NUTRIC) score to assess nutritional risk in mechanically ventilated patients: a prospective observational study. Indian J Crit Care. 2017;21:253.
7. Siobal MS, Baltz J, Wright J. A guide to the nutritional assessment and treatment of the critically ill patient. Irving, Texas: American Association for Respiratory Care. 2013:27-36.
8. Ata Ur-Rehman HM, Ishtiaq W, Yousaf M, Bano S, Mujahid AM, Akhtar A. Modified Nutrition Risk in Critically Ill (mNUTRIC) Score to Assess Nutritional Risk in Mechanically Ventilated Patients: A Prospective Observational Study from the Pakistani Population. Cureus. 2018 Dec 27;10(12):e3786. doi: 10.7759/cureus.3786. PMID: 30854273; PMCID: PMC6395015.
9. Ishtiaq W, Yousaf M, Bano S, Mujahid AM, Akhtar A. Modified nutrition risk in critically ill (mNUTRIC) score to assess nutritional risk in mechanically ventilated patients: a prospective observational study from the Pakistani population. Cureus. 2018;10(12).
10. Mukhopadhyay A, Henry J, Ong V, Leong CS, Teh AL, van Dam RM, Kowitlawakul Y. Association of modified NUTRIC score with 28-day mortality in critically ill patients. Clinical nutrition. 2017 Aug 1;36(4):1143-8.
11. Mendes R, Policarpo S, Fortuna P, Alves M, Virella D, Heyland DK, Portuguese NUTRIC Study Group. Nutritional risk assessment and cultural validation of the modified NUTRIC score in critically ill patients—a multicenter prospective cohort study. Journal of critical care. 2017 Feb 1;37:45-9.
12. Kumar S, Gattani SC, Baheti AH, Dubey A. Comparison of the performance of APACHE II, SOFA, and mNUTRIC scoring systems in critically ill patients: a 2-year cross-sectional study. Indian Journal of Critical Care Medicine: Peer-reviewed, Official Publication of Indian Society of Critical Care Medicine. 2020 Nov;24(11):1057.