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Original Article

Efficacy of the National Early Warning Score (NEWS) in Predicting In-Hospital Mortality in Surgical High Dependency Unit (HDU): A Prospective Study

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ABSTRACT

Objective: To assess efficacy of the National Early Warning Score in predicting in-hospital mortality in surgical High Dependency Unit.

Study Design: Prospective longitudinal study.

Place and Duration of Study: Surgical HDU, Department of Surgery, Combined Military Hospital, Rawalpindi Pakistan, from Jul to Dec 2023.

Methodology: Patients admitted to surgical HDU were included by non-probability consecutive sampling. NEWS score was recorded for each patient within 24 hours of admission and classified into three triggering thresholds: low-risk (NEWS 1 to 4), medium-risk (NEWS 5 to 6) and high-risk (NEWS 7 or higher). Patients discharged within 3 days of admission, with missing NEWS variables and first NEWS recorded after 24 hours of admission were excluded. Demographic data and clinical characteristics were noted. Final outcome was recorded on 30th day after day of admission.

Results: The study analyzed 350 patients admitted to surgical HDU, where 103(29.4%) patients died within 30 days after admission. Mortality was considerably higher in patients with high-risk threshold (92.1%) compared to medium-risk (54.9%) and low-risk (2.2%). High-risk NEWS threshold (≥7) at admission had sensitivity of 68% and specificity of 98% as a predictor of in-hospital mortality, AUC 0.945 (95% CI 0.916-0.974) with *p*-value<0.001, making it statistically significant. Patients with high-risk NEWS threshold on day of admission had less than 10% survival at 30 days.

Conclusion: NEWS may be used as an objective scoring system to predict the risk of in-hospital mortality in surgical HDU settings.

Keywords: HDU, In-hospital mortality, Mortality risk, National Early Warning Score, Rapid response system.

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INTRODUCTION

Clinical deterioration can occur in patients admitted in HDUs, and this deterioration can lead to in-hospital mortality.[1-2] At present, a number of scoring systems are in use for predicting in-hospital mortality like the SAPS and APACHE.[3-4] However, these scores are based on clinical and biochemical parameters and cannot be used for rapid bedside assessment. Standardized NEWS scoring, introduced in 2012, is presently in widespread use for timely and accurately identifying critically ill patients who could deteriorate within 24 hours, by incorporating seven basic physiological parameters (rate of respiration, pulse rate, blood pressure, blood oxygen saturation, temperature and conscious level), the NEWS offers a practical, easier to implement and expedient bedside instrument.[5-7] Each parameter has a 0-to-3 point scale used to calculate the score and if the patient is getting oxygen therapy, 2 more points are added. The score ranges from 0 to 20 indicating risk of clinical deterioration.[8] Many studies have successfully shown NEWS to be a reliable predictor of mortality in the hospital setting.[9-10] However, literature on NEWS as a predictor of in-hospital mortality is limited in our region. To the authors' knowledge NEWS has not been used as a predictor of mortality in Pakistan due to which we hypothesized that higher NEWS score at admission to surgical HDU can be used to successfully predict in-hospital mortality.

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METHODOLOGY

This study was carried out at CMH, Rawalpindi, Pakistan, from July to December 2023, after gaining permission of the hospital Ethical Review Board via letter reference number 534. Using wnarifin online sample size calculator, a sample size of 350 participants was determined with expected sensitivity of NEWS score 73%, specificity of 52% and prevalence of disease 28%, confidence level 100(1 - α) 95% and expected dropout rate of 2%.[8-10] Patients were enrolled

using non-probability consecutive sampling and informed consent was taken from all participants. Primary source of data collection was clinical examination and medical records of the patients.

Inclusion Criteria: Patients of either sex, admitted to surgical HDU and whose first NEWS was recorded within 24 h after admission.

Exclusion Criteria: Patients under 18 years of age, discharged within 3 days of admission or missing NEWS variables.

All patients admitted to surgical HDU were screened by on-duty surgery resident. Demography and clinical characteristics were noted while clinical parameters related to calculation of NEWS were recorded from medical records of patients or examination and NEWS was calculated on the day of admission. Resident surgeons were trained in calculating NEWS and scores were classified into three triggering threshold groups: low risk (NEWS 1 to 4), medium risk (NEWS 5 to 6) and high risk (NEWS 7 or higher). Patients were followed for 30 days where primary outcome was presence or absence of mortality within 30 days of admission. Patient data de-identification was done before statistical analysis on Statistical Package for Social Sciences (SPSS) version 23.0. Frequencies and percentages were computed for quantitative variables. The performance of the NEWS score on predicting risk of mortality was determined using receiver operating characteristic (ROC) curves. Survival analysis at 30 days of admission with respect to NEWS score was done using Kaplan-Meier survival curve and statistical significance was considered where *p*-value ≤0.05.

RESULTS

During the period of study, 492 individuals were admitted to Surgical HDU, out of which 142 were excluded, due to being discharged within 3 days of admission (n=57), under 20 years of age (n=31), those with missing NEWS variables (n=18) and NEWS documented 24 h after admission (n=36) with 350 patients included in the final analysis. Table - I depicts the demographic and clinical variables of the enrolled patients and their association with mortality. Out of 350 patients, 103(29.4%) died during 30 days of admission, these patients were more likely to have medical comorbidities (83.4%) including Hypertension, Diabetes Mellitus, Ischemic Heart Disease and poor functional status (34.9%). Out of 103 non-survivors, 70(67.9%) were at high risk based on NEWS threshold.

High Risk NEWS threshold (≥7) had 68% sensitivity, 98% specificity in predicting 30-day mortality with AUC 0.945 (95% CI 0.916-0.974, *p*-value<0.001), as shown in Figure-1.

Table-I: Clinical and Demographic Characteristics of Participants and Association with Mortality (n=350)

Variables		Non-survivors (n=103) n(%)	Survivors (n=247) n(%)
Age group (years)	20-39	9(8.7)	33(13.3)
	40-59	11(10.6)	75(30.3)
	60-79	60(58.2)	123(49.7)
	80 and above	23(22.3)	16(6.7)
Gender	Male	58(56.3)	130(52.6)
	Female	45(43.7)	117(47.4)
Medical Comorbidity	Yes	86(83.4)	105(42.5)
	No	17(16.6)	142(57.5)
Functional Status	ECOG 0	0 (0)	30(12.1)
	ECOG 1	14(13.6)	132(53.4)
	ECOG 2	53(51.4)	76(30.8)
	ECOG 3	27(26.2)	9(3.7)
	ECOG 4	9(8.7)	0(0)
Type of Admission	Colorectal	25(24.2)	57(23.1)
	Hepatobiliary	15(14.5)	30(12.1)
	Thoracic	12(11.6)	30(12.1)
	Vascular	10 (9.7)	27 (11)
	Plastic	5 (4.9)	14(5.6)
	Orthopedic	15 (14.5)	47(19)
	Neurosurgery	21(20.3)	42(17)
Duration of Hospital Stay (Days)	3-10	62(60.2)	219(88.7)
	11-20	34(33)	27(10.9)
	21-30	7(6.8)	1(0.4)
NEWS Threshold	Low Risk 1-4	5(4.9)	218(88.3)
	Medium Risk 5-6	28(27.2)	23(9.3)
	High Risk ≥ 7	70(67.9)	6(2.4)

** ECOG: Eastern Cooperative Oncology Group Score11*

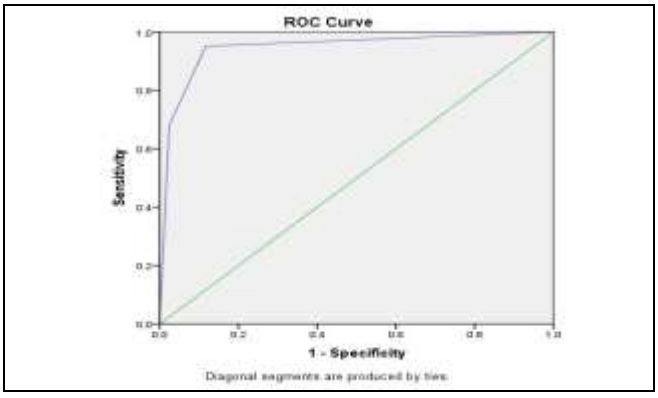

Figure-1: ROC Curve Depicting 68% Sensitivity and 98% Specificity for High-Risk NEWS (≥7) in Predicting Mortality (n=350)

The cumulative risk of in-hospital mortality for each risk threshold revealed that patients with low-risk NEWS had 90% 30-day survival according to Kaplan–Meier survival curves, medium-risk NEWS

patients had 35% while those with high-risk NEWS threshold had less than 10% survival at 30 days, as seen in Figure-2.

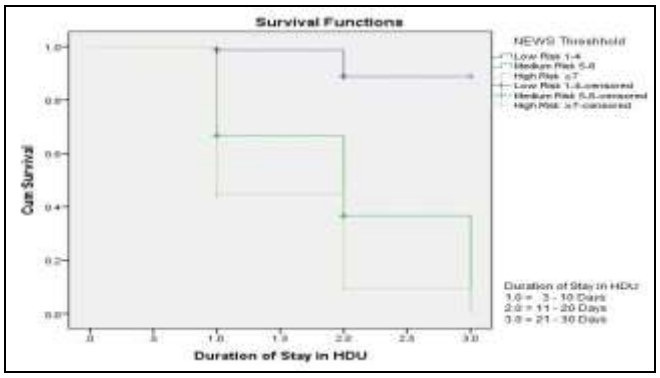

Figure-2: Kaplan-Meier Survival Analysis (n=350)

DISCUSSION

The purpose of this study was to evaluate the ability of NEWS to predict in-hospital mortality at admission, through risk stratification, and it showed that high-risk NEWS threshold can effectively predict in-hospital mortality in patients admitted to surgical HDU (AUC: 0.945) where a score of ≥7 (high-risk) should be considered as cut-off. Multiple scales are currently being used and developed to predict mortality, but their application cannot be generalized to all admitted patients as they rely on laboratory parameters and imaging, in contrast, the NEWS is an easy, rapid and efficient scoring system which can be utilized for all patients on admission, as it relies on basic physiological parameters that can be recorded easily on bedside. Medical comorbidities and old age are known risk factors for mortality, one author concluded that the NEWS can be used to predict mortality in hospital setting accurately (AUC: 0.765; 95% CI: 0.659–0.846) and also suggested that the predictive efficacy is further improved by the addition of age and presence of medical comorbidities to NEWS alone.[12,13,14] The cumulative risk of in-hospital mortality according to Kaplan–Meier survival curves showed that the patients at high risk NEWS threshold had a significantly shorter survival time than those at low risk NEWS threshold,[9] but this difference in AUC may be due to a larger sample size of their study and the fact that their study had only 8.4% patients in high-risk threshold in ward setting compared to 21.7% patients in our HDU setting. One study concluded that NEWS risk stratification can be reliably used in hospital ward patients to predict mortality, where high-risk patients experienced a 3.40 increase in odds of in-hospital death whereas for those at medium-risk it was 2.11(95% CI: 1.27–3.51 and 95% CI: 1.90–6.01) compared to patients in low-risk NEWS threshold. Furthermore, there was a 3.19 increase in odds of 30-day mortality in patients with high-risk NEWS and 1.98 increase for patients with medium-risk NEWS (95% CI: 1.32–2.97 and 95% CI: 1.97–5.18).[10] In our study, mortality was considerably higher in patients with high-risk threshold (92.1%) compared with that in the medium and low-risk thresholds (54.9% and 2.2% respectively) which shows that risk of mortality is linked to high-risk NEWS threshold, with possible utility of NEWS in predicting in-hospital mortality.

LIMITATIONS OF STUDY

Lack of a control group and short duration of follow up in this study may limit its generalizability, especially as this was a single center study. Certain confounding factors like smoking and medical co-morbidities such malignancy, which may affect the final outcome, were not addressed in this study. Only patients admitted surgical HDU were included in this study, which could also restrict the generalization of results of this study.

CONCLUSION

As an objective scoring system, NEWS may be used to predict the risk of in-hospital mortality in surgical HDU settings.

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Authors' Contribution

Following authors have made substantial contributions to the manuscript as under:

AT & SMK: Data acquisition, data analysis, critical review, approval of the final version to be published.

AH & CIA: Study design, data interpretation, drafting the manuscript, critical review, approval of the final version to be published.

MW & MAL: Conception, data acquisition, drafting the manuscript, approval of the final version to be published.

Authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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