

Research Paper

Predictive Value of National Early Warning Score and Modified Early Warning Score in Outcome of Patients With Poisoning



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ABSTRACT

Background: Using different scores to predict the outcome of patients and determine the severity of their illness could be effective in making better clinical decisions and helping patients. The purpose of this study is to determine the predictive value of the National Early Warning Score (NEWS) and Modified Early Warning Score (MEWS) of in-hospital mortality in patients with a suicide attempt.

Methods: In a diagnostic study, we included 453 patients with suicide attempts in the poisoning unit and Intensive Care Unit (ICU) poisoning unit of Sina Hospital from December 2019 to September 2021. Patients' vital signs and level of consciousness were recorded and then analyzed by statistical methods.

Results: The Mean±SD of patients' age was 31.82±12.28 and the mortality rate was 7.7%. The median (25%-75%) of NEWS and MEWS in all patients was 4(2-7) and 2(1-3), respectively. Based on the Receiver Operating Characteristic (ROC) curve of NEWS, the Area Under The Curve (AUC) (CI95%), standard error, and cut off point were 0.915(0.876-0.995), 0.020, and 7.5 respectively (85% sensitivity and 81% specificity) (P<0.001). The results of MEWS based on Receiver Operating Characteristic (ROC) curve were 0.87 (0.805-0.932), 0.033, and 3.5 respectively (74% sensitivity and 84% specificity) (P<0.001).

Conclusion: Based on our study results, we concluded that in hospitalized patients with suicide attempts, the accuracy of NEWS in predicting hospital mortality is higher than MEWS.

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1. Introduction

Suicide is a critical public health problem with long-term health and social implications and is among the top ten reasons for human death [1]. The origin of suicide is complex behavioral, biological, social, and psychological issues, and their impacts on one another [2]. Physical disease and fear of it, sorrow, feelings of rejection, guilt, prolonged pain, disappointment and helplessness, and particularly the loss of a spouse are risk factors for suicide, especially in the elderly [3]. Suicide due to drug abuse, and drug poisoning, is one of the most common complaints in emergency wards [4]. While the rate of suicide attempts among women is three times higher than in men, the success rate is four times higher in men than in women [5]. Suicide is a complex action that starts with a desire to commit suicide and ends in a successful suicide [6].

Employing a classified disease system can assist the physicians objectively evaluating the outcome and estimating the patient's chance of rehabilitation and prioritizing the provision of appropriate care amenities. These systems can be utilized more to determine the patient's hospitalization section and the severity of the disease. These systems are also used to estimate the quality of care provided to the patient and compare it to global standards [7, 8]. Certain criteria are used to assess patients with different diagnoses, including patients in the Intensive Care Unit (ICU) [9], trauma [10], and gastrointestinal and cerebral hemorrhage [11, 12]. One of the paramount features of the patient follow-up predictive index is its ease of use [13].

National Early Warning Score (NEWS) is a score based on 6 vital signs and the respiratory rate of the patients. Higher NEWS scores mean higher disease severity and the risk of poor outcomes. NEWS was presented by the Royal College of Physicians of London (RCPL). In this system, 7 parameters of respiratory rate, oxygen saturation, supplemental oxygen requirement, pulse rate, systolic blood pressure, body temperature, and level of consciousness (Alert, Voice, Pain, Unresponsive [AVPU] system) are evaluated. A higher score means poor clinical status and severity of an illness. In NEWS, the risk level is categorized into 3 levels, low risk (4-0 NEWS), moderate risk (6-5 NEWS), and high risk (NEWS>6). Moreover, the level of patient care depends on the level of NEWS risk [14]. MEWS (modified early warning score) is an aggregated score based on respiratory rate, pulse rate, systolic blood pressure, body temperature, and AVPU score [15].

Hodgson et al. confirmed that NEWS higher than 5 has a 97% sensitivity in determining the mortality rate of patients With respiratory disorders [16]. Spangfors et al. stated that NEWS is a helpful tool in evaluating the outcome of critically ill patients by nurses [17].

Based on the previous studies, these scores are used even in the pre-hospital phase to determine hospital mortality [18, 19]. Nevertheless, these scores were not evaluated for suicidal patients who consumed medicines or chemicals. Utilizing simple and functional scoring systems and assessing their value can help determine the proper status of patients. The current study aimed to assess the NEWS and MEWS in predicting hospital mortality of patients who attempted suicide.

2. Materials and Methods

This study is a diagnostic study conducted at the Referral Drug Poisoning Medical Education Center of the province, affiliated with the University of Medical Sciences, from November 2019 to December 2021. The sample size was estimated to be at least 450 patients according to the calculated number of admitted patients in the poison department annually, based on hospital statistics, also considered our exclusion criteria. The sampling method was entirely census.

The inclusion criteria included patients with drug and chemical poisoning admitted to Sina Medical Center and the exclusion criteria included self-discharge (discharge against medical advice) from the emergency department and discharge of patients less than 24 hours after hospitalization, those patients referred by the Emergency Medical Services (EMS), patients who transferred from other hospitals, positive history of chronic diseases, such as chronic lung disease, chronic heart disease and ..., and dissatisfaction with participating in the study.

This study has been approved by the Ethics Committee of the Tabriz University of Medical Sciences on 06.08.2018 with the code IR.TBZMED.REC.1397.428.

After admitting patients to the emergency department, concurrent with acquiring medical records and starting treatment, the needed variables, including age, sex, social history, and variables related to NEWS and MEWS scores, including heart rate, respiration rate, blood pressure, arterial oxygen saturation, need for oxygen supplementation, body temperature, and alertness levels of conscious were recorded based on AVPU. Ultimately, based on the registered variables, NEWS and MEWS scores were determined [14, 20, 21]. The patients' conditions

Table 1. Comparison of the demographic features, vital signs, NEWS, and MEWS between two

Variables	Outcome	No. (%)		P
		Dead (35 Patients)	Alive (418 Patients)	
Age (y)		36(24-59) [#]	28(22-35) [#]	0.003*
Gender	Male	27(77.1)	265(63.4)	0.071 ^{&}
	Female	8(22.9)	153(36.6)	
Social history	Yes	20(57.1)	135(32.3)	0.003 ^{&}
	No	15(42.9)	283(67.7)	
Supplementary O ₂	Yes	34(97.1)	130(31.1)	<0.001 ^{&}
	No	1(2.9)	288(68.9)	
Level of consciousness	Alert	6(17.1)	271(64.8)	<0.001 ^{&}
	Verbal response	13(37.1)	93(22.2)	
	Pain response	3(8.6)	33(7.9)	
	Unresponsive	13(37.1)	21(5.0)	
Vital signs	Heart rate (per minute)	90(75-104) [#]	85(75-95) [#]	0.353*
	Respiratory rate (per minute)	19(15-25) [#]	18(16-19) [#]	0.090*
	Body Temperature (°C)	36(36-37) [#]	37(36-37) [#]	0.001*
	Mean arterial pressure (mmHg)	70(56-90) [#]	83(80-90) [#]	0.004*
	O ₂ saturation (%)	88(77-94) [#]	95(94-97) [#]	<0.001*
Duration of admission		3(1-8) [#]	1(1-2) [#]	<0.001*
NEWS		10(9-13) [#]	3(1-6) [#]	<0.001*
NEWS categories	Low risk	0(0)	255(61.0)	<0.001 ^{&}
	Moderate risk	4(11.4)	67(16.0)	
	High risk	31(88.6)	96(23.0)	
MEWS		5(3-6) [#]	2(1-3) [#]	<0.001*

Median (IQR25-75%); *Mann Whitney-U; & Chi-square.

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NEWS: National Early Warning Score; MEWS: Modified Early Warning Score.

were monitored during hospitalization, and their outcomes, regarding mortality, were evaluated and recorded during the hospitalization period. Patients were further classified into three categories based on NEWS, such as low risk, moderate risk, and high risk. Moreover, their demographic features and outcomes were compared in these three categories.

Data were entered into SPSS v.22.0, Chicago, USA. The Kolmogorov-Smirnov statistical program was used to assess the normal distribution of data. Due to the P value <0.05, the data distribution was abnormal. Median (the interquartile range [IQR] 25%-75%) was used to describe the quantitative data and frequency (percentage) was utilized to describe qualitative data. The chi-square test was employed to compare qualitative data and the Mann-U-Whitney test was used to compare quantitative variables.

The Receiver Operating Characteristic (ROC) curve and the Area Under The Curve (AUC) was employed to determine the predictive value of the scores in the hospital outcome of patients. In all cases, P value less than 0.05 was considered significant.

3. Results

In this research, 453 patients who committed suicide due to drug overdose were studied. The Mean±SD of the age of these patients was 30.82±12.28 years. A total of 292 patients (64.5%) were male and the others were female. Regarding social history, 298 patients (65.8%) had no history of drug abuse and with respect to the others, smoking, opium consumption, alcohol consumption, or a combination of these were recorded in their history.

Table 2. Comparison of the demographic features, vital signs, NEWS, and MEWS between two groups of ICU admitted patients

Variables		Outcome	No. (%)		P
			Dead (34 Patients)	Alive (64 Patients)	
Age (y)			39.50(24.75-59.25) [#]	27(23-31) [#]	0.006*
Gender	Male		27(79.4)	52(81.20)	0.513 ^{&}
	Female		7(20.6)	12(18.8)	
Social history	Yes		19(55.9)	27(42.2)	0.140 ^{&}
	No		15(44.1)	37(57.8)	
Supplementary O ₂	Yes		33(97.1)	58(90.6)	0.229 ^{&}
	No		1(2.9)	6(9.4)	
Level of consciousness	Alert		6(17.6)	19(29.7)	<0.001 ^{&}
	Verbal response		12(35.3)	6(9.4)	
	Pain response		3(8.8)	21(32.8)	
	Unresponsive		13(38.3)	18(28.1)	
Vital signs	Heart rate (per minute)		90(75-104) [#]	85(75-95) [#]	0.353*
	Respiratory rate (per minute)		19(15-25) [#]	18(16-19) [#]	0.090*
	Body Temperature (°C)		36(36-37) [#]	37(36-37) [#]	0.001*
	Mean arterial pressure (mmHg)		70(56-90) [#]	83(80-90) [#]	0.004*
	O ₂ saturation (%)		88(77-94) [#]	95(94-97) [#]	<0.001*
Duration of Admission			3(1-8)	3(2-4)	0.745*
NEWS			10(9-13) [#]	3(1-6) [#]	<0.001*
NEWS categories	Low risk		0(0)	12(18.8)	<0.017 ^{&}
	Moderate risk		4(11.8)	10(15.6)	
	High risk		30(88.2)	42(65.6)	
MEWS			5(3-6) [#]	2(1-3) [#]	<0.001*

[#]Median (IQR25-75%); *Mann Whitney-U; & Chi-square.International Journal of
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NEWS: National Early Warning Score; MEWS: Modified Early Warning Score.

Throughout the patients' hospitalization, 35 of them (7.7%) died. Among the patients, 98 (21.6%) were admitted to the intensive care unit, of which 34 died. The remaining patients were admitted to the poisoning unit, and one of them died. The demographic status and vital signs of the patients were compared based on their outcome (died or survived) as presented in Table 1. As the table shows, significant statistical differences are observed between the two groups of patients in terms of vital signs excluding heart rate and respiratory rate ($P < 0.05$). Furthermore, among the deceased patients, a higher percentage required supplemental oxygen, and their age was higher ($P < 0.05$). Patients were classified into three low-risk, moderate, and high-risk categories based on the NEWS numerical rate, and their mortality rates in these three groups were compared, as presented in Table 1. We analyzed the demographic status and vital signs of the ICU admitted patients based on their outcome (died or survived). Based on table 2 results, a

statistically significant difference is observed between groups in terms of age, level of consciousness, vital signs (body temperature, mean arterial pressure, and O₂ saturation), NEWS, and MEWS ($P < 0.05$).

The median (25%-75%) of NEWS and MEWS in all patients was 4 (2-7) and 2 (1-3), respectively. To determine the predictive value of patients' initial NEWS and MEWS on their hospitalization outcome, the receiver operating characteristic (ROC) curve was used as presented in Figure 1. Table 3 includes the results of the predictive value of each score. According to the AUC of the NEWS score, it holds a higher value than the MEWS score in determining patient outcomes.

4. Discussion

In this research, the predictive value of NEWS and MEWS, in determining hospital mortality of patients

Table 3. Predictive Value of NEWS and MEWS in Patients' Mortality

Variable	AUC (95% CI)	Cut Off Point	Standard Error	Sensitivity	Specificity	PPV	NPV	J Point	P
NEWS	0.915(0.876-0.955)	7.5	0.020	0.86	0.81	0.82	0.85	0.67	<0.001
MEWS	0.869(0.805-0.932)	3.5	0.033	0.74	0.84	0.82	0.76	0.58	<0.001

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NEWS: National Early Warning Score; MEWS: Modified Early Warning Score; AUC: area under the curve; PPV: Positive Predictive Value; NPV: Net Present Value; J: Junction.

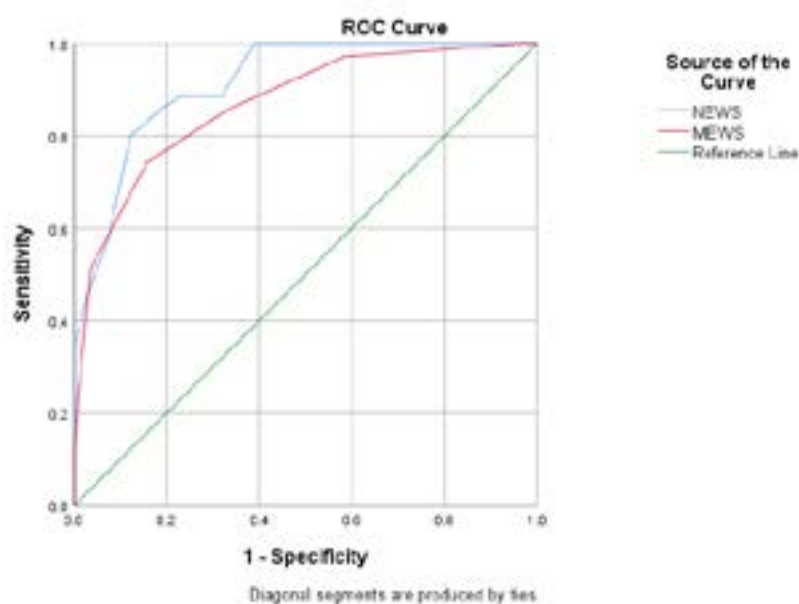
with drug poisoning has been evaluated. The higher value of the NEWS score was determined in our study.

One of the most vital means to discover the quality of medical care services and the severity of the disease and its consequences is the application of various scoring systems that have been used in patients with different diagnoses [13]. NEWS and its revised form, MEWS, are among the indicators that can be calculated based on the initial examination and can be used in many diseases according to the studies performed [14, 15, 21].

Early Warning Scores (EWSs) include scores that provide physicians with the necessary warnings about disease severity and outcome at the moment of admission to the hospital [22, 23]. Scores, such as Rapid Emergency Medicine Score (REMS), NEWS, MEWS, Acute Physiologic Assessment And Chronic Health Evaluation (APACHE), Systemic Inflammatory Response Syndrome Criteria (SIRS), and the quick Sequential Organ Failure Assessment (qSOFA) are from this category. The

main difference between the two is the use of physiological and laboratory parameters. The REMS, NEWS, and MEWS consist of only physiological parameters and are therefore easier to use [22-25].

Ghaffarzad concluded that REMS has an accurate score to predict the non-surgical patients' outcomes in the Emergency Department (ED) [26]. Ruangsomboon showed that the REMS and NEWS have the same accuracy to predict the hospital outcome of patients [23]. Upanisakorn employed NEWS to inform the readmission of patients after ICU discharge and showed that a score above 7 predicted patients' readmission after 24 hours of discharge with high sensitivity and specificity [27]. Concerning the value of the MEWS in diagnosing patients with severe sepsis, Zavatti concluded that a score higher than 4 helped diagnose severe sepsis and the need for hospitalization in the ICU with a sensitivity of 43% [21]. Regarding the determination of the outcome of patients with shortness of breath with NEWS, Bente Bilben gath-


Figure 1. Value of NEWS and MEWS in predicting hospital mortality of patients

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ered that this score can be valuable in clinical decision-making [24].

Yu et al. decided that the NEWS score has a comparatively high significance in predicting the mortality rate of critically ill elderly patients [28]. Kovacs et al. concluded that the NEWS score is not as good in surgical patients as in non-surgical patients and is much less helpful in unselected patients, particularly in surgical patients [29]. One of the points of these two scores is the application of vital signs and independence of paraclinical diagnostic results. In addition, they can be practiced even in pre-hospital stages [17, 18].

Our study revealed that NEWS is better than MEWS and higher in the Youden index. Moreover, according to Table 1, it can be assumed that old age, the need for supplemental oxygen, positive social history, oxygen saturation, and low blood pressure are risk factors for mortality. Nevertheless, additional studies are required to assess the effect of these variables on the course of the disease and the outcome of patients in suicide attempts with drug abuse.

One of the limitations of the present research is the collection of data in one center which prevents the generalization of the research results to the entire community. We used the AVPU system to evaluate the level of consciousness and did not use Glasgow Coma Scale, which is another limitation. Another limitation is lack of gathering all types of drugs that are used for suicide.

5. Conclusion

According to the results of the current study in evaluating the predictive value of mortality in hospitalized patients due to poisoning, the NEWS criterion has a higher value. Additionally, Regarding the NEWS criterion, scores higher than 7.5, and the MEWS criterion, higher than 3.5 is associated with an enhanced risk of hospital mortality in patients who have attempted suicide. The application of these scores in the ED to determine the severity of disease or hospital outcomes of patients helps clinicians to make better decisions about patients' conditions. It is suggested to conduct more studies with a larger sample size from different centers.

Ethical Considerations

Compliance with ethical guidelines

This study has been approved by the Ethics Committee of the Tabriz University of Medical Sciences on 06.08.2018 with the code IR.TBZMED.REC.1397.428.

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Authors' contributions

All authors were involved in the conception and design, data collection, data analysis and interpretation, drafting of the article, reviewing of the article, and finding approval.

Conflict of interest

The authors declared no conflict of interest in this study.

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