

Usage of NEWS for prediction of mortality and in-hospital cardiac arrest rates in a Turkish university hospital

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Background/aim: Early warning scores (EWS), widely used around the world but not yet in Turkey, are composed of physiological parameters designed to determine potentially worsening patients to perform necessary interventions in time. The aim is to determine the national EWS (NEWS) of the patients to assess the relation between this score and length of hospital stay (LOHS), transfer to the ICU, 24-h and 28-day mortality rates, and the frequency of in-hospital cardiac arrest (IHCA).

Materials and methods: NEWS of all the patients in the internal medicine clinics were calculated via a point prevalence study. The LOHS, transfer to the ICU, rates of mortality in the 24-h and 28-day period, IHCA rate, and the period of the stay in the ICU parameters were determined.

Results: Out of 104 patients, 84 of them had low scores (<5), while 20 had mid/high scores. In mid/high-score group (score ≥ 5), transfer to the ICU, IHCA rate, and mortality rates within 24 h and 28 days were significantly higher.

Conclusion: In this, the first prospective study about EWS in Turkey, 24-h and 28-day mortality rates, transfer to the ICU, and IHCA frequency of the patients with mid/high NEWS were higher.

Key words: National early warning score, cardiac arrest, intensive care unit, mortality

1. Introduction

Early warning scores (EWS) are scoring systems composed of physiological parameters (body temperature, heart rate, respiratory rate, blood pressure, oxygen saturation, etc.) that are developed for early detection of patients who might worsen and for the necessary intervention in time (1). Such scoring systems are also reported to be helpful for prediction of the prognosis of patients. In the earlier literature, there are studies showing that the EWS can lower the duration of intensive care unit (ICU) stays, mortality rates, and the frequency of cardiac arrests (2,3). The correlation between the duration of hospital stay prior to the admission to the ICU and mortality rate has also been shown as another finding (4,5). Moreover, the mortality rate of patients admitted to the ICU from medical wards has been reported to be higher than that of patients transferred from the emergency service or of postoperative patients (6). Moreover, it has been revealed that the patients from medical wards have higher risk in terms of arrest and there are several physiological changes that developed in those patients prior to the arrest (7,8). The most important aim in scoring systems is early recognition of deteriorating patients

and early intervention as well as the prediction of the need for the ICU (9). The first of such systems was proposed by Morgan et al. In time, the same system has been modified and become the most frequently used scoring system (3). Expert opinions and clinical experience are the basis of these modified EWS; validation studies for the scoring systems have followed the modifications (10,11). The abnormal physiological parameters recorded during admission to the hospital have been shown to be correlated with the increased duration in the ICU, increased mortality rate, and increased time spent in hospital (12). In the present study, the aim was to determine the EWS of patients in the internal medicine clinic, to assess any relation between these points and length of stay in hospital, any necessity for intensive care, first 24-h and 28-day survival, and the frequency of cardiac arrest.

2. Materials and methods

All the patients in the internal medicine clinic were evaluated via a cross-sectional point prevalence study, conducted on the same day, at the same hour. As for the scoring system, the National Early Warning Scoring

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(NEWS) (Table 1), validated in 2012 by the Royal College of Physicians, UK, was used (13). Having this basis, blood pressure values, heart rates, respiratory rates, body temperatures, level of consciousness, any requirement for oxygen, and percutaneous oxygen saturation values of the patients were measured and NEWS scores were calculated. The demographic data of the patients (age, sex), comorbid conditions, admitting diagnosis, and any history of stay either in the hospital or in the ICU were also recorded. No changes in the treatment of the patient or no interventions in the routine care in the ward have been performed due to the NEWS results of the patients. The results were calculated after the completion of the study and the results were kept hidden from the primary doctors of the patients. According to the NEWS, the patients were divided into two groups. Patients with 4 points or less were assigned to the low-score group and those with more than 4 points were assigned to the mid/high-score group and statistical analyses were performed to determine any differences between these two groups. All the patients were monitored during their stay in the hospital and the parameters for period of stay in hospital, any necessity for intensive care, 24-h and 28-day survival, and the frequency of cardiac arrest in the ward were recorded. The statistical analysis of the study was performed using Statistical Package for the Social Sciences (SPSS) 20.0. The distribution of the numbers and percentages were investigated in the analyses. They are reported as mean ± standard deviation, median (min.–max.) where appropriate. The chi-square test, t-test, and Mann–Whitney U test were used in comparison between groups according the property of the parameters. The results with P value higher than 0.05 were considered statistically significant.

3. Results

On 28 January 2014, there were 104 patients in the internal medicine ward. The sex distribution was 57 males and 47 females, and the median age was 56 (lowest age was 19,

greatest age was 94). The higher median age was observed in mid/high-score group patients (P < 0.01): median age in the mid/high group was 69.5 (19–94) while in the lower score group it was 53.5 (22–83). The average NEWS was 2.62 ± 2.32, the average score of the patients with mid/high NEWS was 6.5 ± 1.67 whereas the average score of those with low NEWS was 1.70 ± 1.25. qSOFA scores of all patients were also calculated and found to be 0.45 ± 0.63. The distribution of the qSOFA points was as follows: 97 patients (93.2%) had 0–1 qSOFA points while 7 patients had 2 or more qSOFA points (6.7%). The average qSOFA point of patients with low NEWS was 0.25 ± 0.46 (median score is 0) whereas the patients with mid/high NEWS had an average of 1.30 ± 0.57 (median score is 1). This difference was statistically significant (P < 0.001). No difference was observed between the patients having qSOFA score 2 or more and those with scores 2 or less in terms of period of stay in hospital, any necessity for intensive care, 28-day survival, or mortality rate within the first 24 h. The frequency of cardiac arrest among the patients with higher qSOFA scores was higher than among those with lower qSOFA scores; however, this difference was not statistically significant.

The comorbid conditions of the patients are presented in Table 2. As presented, 46.2% of the patients had at least one malignancy (either hematologic or oncologic) and 51.9% of the patients had stayed in the hospital at least once in the previous year. Moreover, 10.6% of them were admitted to the ICU in the previous year. Table 2 shows detailed information on the comorbid conditions, admission to hospital or ICU histories, and any urinary or central catheter that can present any risk of infection of the patients divided according to their NEWS. According to this table, 30% of the patients with mid/high NEWS had either coronary artery disease or heart failure, whereas among the patients with low scores such conditions were present in 9.5%, resulting in a statistically

Table 1. Royal College of Physicians. National Early Warning Score (NEWS) (13).

Physiological parameters	3	2	1	0	1	2	3
Respiratory rate (/min)	≤8		9–11	12–20		21–24	≥25
Oxygen saturations (%)	≤91	92–93	94–94	≥ 96			
Any supplemental oxygen		Yes		No			
Temperature (°C)	≤35.0		35.1–36.0	36.1–38.0	38.1–39.0	≥39.1	
Systolic blood pressure (mmHg)	≤90	91–100	101–110	111–129			≥220
Heart rate (/min)	≤40		41–50	51–90	91–110	111–130	≥131
Level of consciousness				A			V, P, or U
Score 1–4: Low score, 5–6: Middle score, ≥7: High score.							

A: Alert, V: Response to verbal stimulant, P: Response to pain , U: Unconscious

Table 2. Comparison of comorbidities, and history of hospital and ICU admissions of low and mid/high-NEWS groups.

		Low score (<5) n = 84	Mid/high score (≥5) n = 20	*P value
Age	Median (Min–Max)	53.5 (22-83)	69.5 (19-94)	0.01
Sex	Female	46.4 % (39)	40.0% (8)	0.63
	Male	53.6 % (45)	60.0% (12)	
qSOFA	Mean ± std. deviation	0.25 ± 0.462	1.30 ± 0.571	<0.001
	(Median)	(0)	(1)	
Diabetes		22.6% (19)	15.0% (3)	0.45
Hypertension		31.0% (26)	50.0% (10)	0.11
Chronic renal failure		21.4% (18)	30.0% (6)	0.41
CAD/CHF		9.5% (8)	30.0% (6)	0.02
Malignity		46.4% (39)	45.0% (9)	0.91
Lung disease		10.7% (9)	10.0% (2)	0.93
Presence of urinary catheter		33.3% (28)	60.0% (12)	0.03
Presence of central venous catheter		28.6% (24)	15.0% (3)	0.21
Previous hospitalization ^a		52.4% (44)	50.0% (10)	0.8
Previous ICU stay ^b		10.7% (9)	10.0% (2)	0.93

*P value, calculated by chi-square and Mann–Whitney U tests.

^aHistory of hospital admission in last one year, ^bHistory of ICU admission in last one year

significant difference ($P = 0.02$). For the other comorbid conditions, there was no other significant difference. As for the presence of a central or urinary catheter, there was no statistically significant difference for the presence of a central catheter whereas the presence of a urinary catheter was more frequent among the patients with higher scores ($P = 0.03$). Moreover, admission to hospital or ICU history of the patients had no difference significantly.

In the last section of the study, the information of the patients of both groups during their treatment and these outcomes are presented in Table 3. As presented, re-admission rates of the patients did not differ among the groups with a statistical significance. However, the percentage of the patients admitted to the ICU in the mid/high group was 40% while this percentage in the low-score group was 13.1% ($P = 0.01$). In the low-score group, there was no patient with cardiac arrest whereas 25% of the mid/high-score patients developed cardiac arrest ($P = 0.001$). Mortality rate within the first 24 h of the patients with a low score was higher and statistically significant (1.2% compared to 20%, $P = 0.05$). When the 28-day mortality rates were compared, 4 patients (4.8%) among the patients with low scores and 5 patients (5%) among the patients with mid/high scores died and this difference was statistically significant ($P = 0.01$).

4. Discussion

This study is the first prospective and point-prevalence study about EWS in Turkey. Within the scope of the study, the parameters of transfer to the ICU, 24-h mortality rate, and 28-day mortality ratio of the patients in the mid/high-NEWS group were higher in comparison to the patients with lower score points (respectively $P = 0.01$, $P = 0.01$, and $P = 0.005$). This result shows that the NEWS are valuable to determine the patients with high mortality risk and who require intensive care.

The frequency of cardiac arrest among the patients with mid/high NEWS was higher, similar to previous findings in the literature. It has already been stated that NEWS are quite effective to determine IHCA (14).

The higher frequency of coronary artery disease or heart failure in the mid/high-NEWS group can be proposed as an explanation for the higher rate of mortality and the longer duration of stay in the ICU. Lately, there have been some findings examining the similarities of NEWS and qSOFA on determining the mortality rate and sepsis formation among patients who might or might not have infections (15,16). In the present study, without checking for a potential infection, qSOFA scores were calculated as well; however, no difference was stated among the patients with low or mid/high scores in terms of first 24-h mortality,

Table 3. Comparison of outcomes of low and medium-high NEWS groups.

	Low NEWS (0-4)	Mid/high NEWS (>4)	*P value
Transfers to ICU	13.1% (11)	40.0% (8)	0.01
In-hospital cardiac arrest (IHCA)	1.2% (1)	25.0% (5)	0.001
28-day mortality	4.8% (4)	25.0% (5)	0.01
Mortality in the first 24 h	1.2% (1)	20.0% (4)	0.005
Readmission to the hospital	7.1% (6)	10.0% (2)	0.65
LOHS, day \pm standard deviation	22.9 \pm 18.1	19.3 \pm 16.5	0.35**

*P value, calculated by chi-square test

**P value, calculated by Mann-Whitney U test

LOHS: Length of hospital stay, ICU: intensive care unit

28-day mortality, or cardiac arrest frequency. On the other hand, the same parameters were clearly higher among the patients with higher NEWS than those with low scores. The reason for that might be that the NEW scoring system requires more detailed information about patients when compared to the qSOFA system; oxygenation, changes in blood pressure, and fever are additionally examined within the NEW scoring system.

There are some differences among the short-term mortality rates of patients with high NEWS in the literature (17,18). In our study, 24-h mortality rate was clearly higher ($P = 0.005$). This result illustrates that the NEW scoring system is beneficial for determining the short-term mortality rates of the patients, increasing the importance of usage of this scoring system.

The shorter hospitalization period trend among the patients with mid/high score was related to the fact that these patients are admitted to ICU more quickly and their high mortality rates. This result was also in accordance with other findings in the literature (19).

The frequency of re-hospitalization within 28 days (7.1% in the low-score group, 10% in the mid/high-score group) was higher in the mid/high group; however, this difference was not statistically significant. Earlier studies showed that the frequency of re-hospitalization within 28

days was weakly correlated with NEW scoring systems (20).

There were some limitations in the study. Firstly, the study was conducted with patients in the internal medicine ward and the patients of other wards were not included, resulting in a low patient number of the study. Moreover, due to the low number of patients, the mid-score group and the high-score group were combined during the statistical analysis of the study. As for the other limitations of the study, the following can be included: the study was carried out as a point-prevalence study and the analysis of presence of comorbid conditions and analysis of cost-labor force survey were not performed. Even though the age, coronary-artery diseases, and heart failure frequencies were higher, and this might affect the score, there was no similarity detected among the two groups in terms of these parameters due to the point-prevalence nature of the study. Urinary catheter presence was higher among the mid/high-score group, yet this can be related to the severity of the disease.

In conclusion, it was seen in this study that the use of early warning scoring systems successfully predicted worsening patients, any requirement for the ICU, any risk of mortality, and cardiac arrests and it was observed that the use of these systems will be beneficial.

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