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VALIDATION OF NATIONAL EARLY WARNING SCORE (NEWS) IN PATIENTS ADMITTED IN INTERMEDIATE MEDICAL CARE (IMC) IN A TERTIARY CARE HOSPITAL IN INDIA

General Medicine

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ABSTRACT

Critical illness is a substantial burden in developing countries. Reliable epidemiological data on critical illness in low resource settings are scarce. Critically ill patients are often cared in the wards due to lack of intensive care unit (ICU) beds. It was shown that physiological changes (early warning signs) start as early as 8 hours prior to an event like cardiac arrest or death. There are very few evidence - based studies on early recognition of such warning signs. Intermediate Medical care unit (IMC) is a step - down unit in between acute care and general ward care. Implementation of National Early Warning score (NEWS) in patients admitted in Intermediate Medical Care enable us to recognize patients with moderate scores and act at the right time by shifting them to ICUs and to prevent worsening of their condition.

KEYWORDS

Early Warning score, Scoring systems, Medical care unit

INTRODUCTION

Majority of the patients in general wards and intermediate care become critically ill. Critically ill patients are often cared for in the wards due to lack of intensive care unit (ICU) beds [1 - 3]. Critical illness is a substantial burden in developing countries [4] which is contributed by high rates of malnutrition, infections including HIV/ AIDS, trauma and maternal morbidity [5]. Reliable epidemiological data on critical illness in low resource settings are scarce [6]. Documenting the burden of critical illness is challenging. In a study, it was found that physiological changes started as early as 8 hours, prior to an arrest event and deaths had been attributed to inability of care giver to recognize early signs of deterioration and lack of communication between health care providers [7]. Early recognition of such warning signs and initiation of appropriate action can prevent further deterioration [8].

Scoring systems for use in intensive care unit patients have been introduced and developed over the last 30 years. Since then, many scoring systems have been developed, though only a small minority are used. They allow an assessment of the severity of disease and provide an estimate of in-hospital mortality. Various factors have been shown to increase the risk of in-hospital mortality after admission to ICU, including increasing age and severity of acute illness, certain pre-existing medical conditions. Physiology-based scoring systems are applied to critically ill patients and have several advantages over diagnosis-based systems that may be used in other patient groups [9].

A feasible, low cost and reliable method of identifying patients, requiring critical care is needed. The first early warning score (EWS) system was designed by Morgan et al in 1997 to alert clinicians, to deteriorating patients, using aggregate weighted scoring of vital signs [10]. Several different EWS systems were developed and their performance in predicting the clinical deterioration was evaluated in various trials [11, 12, 13, 14]. Among them vital Pac TMEWS (ViEWS) was found to be superior in predicting short term mortality in acutely admitted patients [15]. Most studies have analyzed vital signs obtained only at the time of admission. But one study concluded that the simultaneous presence of 3 critically abnormal vital signs can occur at any time during the hospital admission and is associated with very high mortality. Early recognition of these events presents an opportunity for decreasing mortality [16]. A slightly modified version of ViEWS had been proposed as National Early Warning Score (NEWS) by the Royal College of Physicians in UK [17]. It was found to perform well in predicting short term mortality and unexpected ICU admission [11, 18].

There are very few evidence-based studies on how to respond to increased or changing early warning scores in the admitted patients. It is impossible to develop rational treatment guidelines for early warning signs, without information on how often, to what extent and what time frame EWS change and what are the implications of these changes [10, 19, 20]. Most hospitals in India, especially government hospitals are overburdened. Use of an early warning scoring system could help the on - call teams in prioritizing their work by identifying the patients in need of urgent review. Linking it with locally agreed protocols for review of sick patients will help in fixing accountability and improving the quality of acute care.

Intermediate Medical care unit (IMC) is a step - down unit in between acute care and general ward care. This study was planned to evaluate the efficacy and validity of the NEWS in patients present in Intermediate medical care unit, Osmania general hospital. The main purpose of this study is to recognize patients with moderate scores and act at the right time by shifting them to ICUs, to prevent worsening of their condition.

MATERIAL AND METHODS:

The present study was conducted in the IMC ward, Osmania General Hospital, Hyderabad, Telangana, India, between 1st December 2016 to 31st April 2018. It was a prospective, observational study. *Inclusion criteria* were 1. Patients aged between 18 - 60 years of either sex 2. Patients admitted to IMC ward. *Exclusion criteria* were 1. Patients who already had cardio - respiratory arrest in the previous week 2. Patients who were on ventilator 3. Pregnant patients.

The study was conducted after obtaining Institutional Ethics Committee permission and written informed consent from all the patients. NEWS score chart (Table - 1) was attached for all the patients admitted into IMC and filled at the time of admission and at 12 and 24 hours. NEWS score consisted of measurement of 6 vital parameters - Respiratory rate (beats /minute), Temperature (Co), Oxygen saturation (%), Systolic blood pressure (mm of Hg), Pulse rate (beats /minute), Level of consciousness [11, 13]. Level of consciousness was assessed using alert, voice, pain unresponsive (AVPU) score. A weighting score of 2 was added for any patient requiring supplemental oxygen (oxygen delivery by mask or nasal cannula).

Table - 1. National Early Warning Score (NEWS)[12,20]

Physiological Parameters	Score						
	3	2	1	0	1	2	3
Respiratory Rate (Beats/ min)	≤ 8		9 - 11	12 - 20		21 - 24	≥ 25
Oxygen Saturation (%)	≤ 91	92 - 93	94 - 95	96 - 100			
Supplemental Oxygen		Yes		No			
Temperature (Co)	≤ 35		35.1 - 36	36.1 - 38	38.1 - 39	≥ 39.1	
Systolic BP (mm of Hg)	≤ 90	91 - 100	101 - 110	111 - 130			≥ 220
Pulse Rate (Beats/ min)	≤ 40		41 - 50	51 - 90	91 - 110	111 - 130	≥ 131
Level of Consciousness				A			V, P or U

A - Alert, V - Response to voice, P - Response to pain, U - Unresponsive

Additional score of 2 to be added, if the patient is on supplemental oxygen.

Each of the six NEWS physiological parameters was allocated a score reflecting the magnitude of disturbance to each of the physiological parameters. The individual parameter scores were combined with a score, for use of supplemental oxygen, to derive the aggregate NEWS score for the patient. Low score was between 1 - 4. These patients were monitored at every 6th hourly and NEWS was calculated at 12 and 24 hours. Medium score was 5 - 6 or a score of 3 in any parameter. These patients were monitored every hourly. If the parameters were stable NEWS was calculated at 12 and 24 hours. If any parameter was worsened, NEWS was calculated immediately and if the score was > 7, they were shifted to acute medical care (AMC). High score was ≥ 7 and all these patients were shifted to AMC for advanced life support (Inotropic support or mechanical ventilation). The primary endpoints were a) proportion of patients with an aggregated score of NEWS ≥ 5 at the time of admission and at 24 hours and their outcome (Death or Discharge) at 1-week b) Effect of each parameter on outcome. The secondary end points were recorded at the end of 1 week. They were 1) In - hospital deaths 2) discharge from the hospital. Patients discharged prior to 1 week were assumed to be alive at 1 week, when the study was completed.

Statistical Analysis:
Data was presented as mean ± SD. The proportion of patients were analyzed using chi - square test. The % change in parameters from the time of admission to 24 hours was analyzed using paired t test. P value of < 0.05 is considered statistically significant.

Results
A total of 104 patients were included in the study. Mean age of patients was 40.6 ± 11.8 years. Out of 104 patients, 61 (58.7%) were males and 43 (41.3%) were females. The mean age of males was 41.7 ± 12.3 years and of females was 39.4 ± 10.8 years (table - 2). All the patients were transferred from acute medical care (AMC).

Table - 2 Demographic Data

S No	Patients	Number of Patients (n)	Age (Yrs) (Mean ± SD)
1	Total Patients	104	40.6 ± 11.8
2	Males	61 (58.7%)	41.7 ± 12.3
3	Females	43 (41.3%)	39.4 ± 10.8

Most of the patients were with cardiovascular diseases followed by lung diseases. The number of cardiovascular patients was 21, lung patients - 19, Diabetic ketoacidosis - 9, liver diseases - 8, poisonings - 7, seizures - 6, postpartum disseminated intravascular coagulation (DIC) - 6, Cerebrovascular accidents (CVA) - 5, snake bites - 4, upper gastrointestinal bleeding - 4, Chronic kidney disease - 2, Cellulitis - 2, pancreatitis - 2, Miscellaneous - 9 (Acute kidney injury - 1, Severe anemia - 1, Fever with thrombocytopenia - 1, Diabetic foot with hypoglycemia - 1, Intracranial space occupying lesion (ICSOL) - 1, Cerebral Palsy - 1, Bilateral hydro uretero nephrosis - 1, Benzodiazepine poisoning - 1, Partial hanging -1). Percentage of diseases across the sample was given in table - 3.

Table - 3 Diseases across the Sample

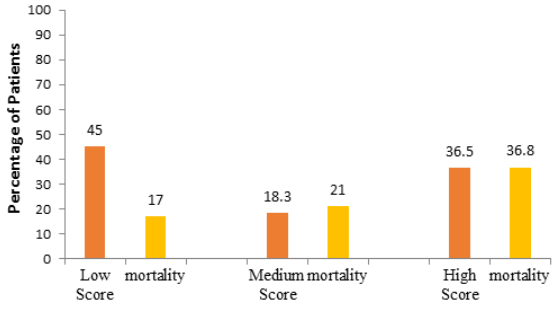
S No	Disease	Actual Number of Patients (n = 104)	Percentage
1	Cardiovascular Diseases	21	20.2
2	Lung Diseases	19	18.3
3	Diabetic Ketoacidosis	9	8.7
4	Liver Diseases	8	7.7
5	Poisonings	7	6.7
6	Seizures	6	5.8
7	Postpartum DIC	6	5.8
8	CVA	5	4.8
9	Snake Bites	4	3.8
10	Upper GI Bleeds	4	3.8
11	Chronic Kidney Disease	2	1.9
12	Cellulitis	2	1.9
13	Pancreatitis	2	1.9
14	Miscellaneous	9	8.7

At the time of admission into IMC:
Patients with low NEWS score (1- 4) at the entry into IMC were 47 (45%) and deaths in this group were 8 (17%). Patients with medium score (5 - 6) were 19 (18.3%) and deaths in this group were 4 (21%). Patients with high score (7 or more) were 38 (36.5%) and deaths in this group were 14 (36.8%) (Figure - 1). We found that the number of deaths (36.8%) was more in patients with high scores (table - 4). The number of patients with a NEWS score of ≥ 5 at the time of admission into IMC was 57 (54.8%). The number of patients required supplemental oxygen was 42 (40.4%). The number of patients brought with VPU state was 22 (21.2%) (Table - 4).

Table - 4 NEWS Score at the time of Admission

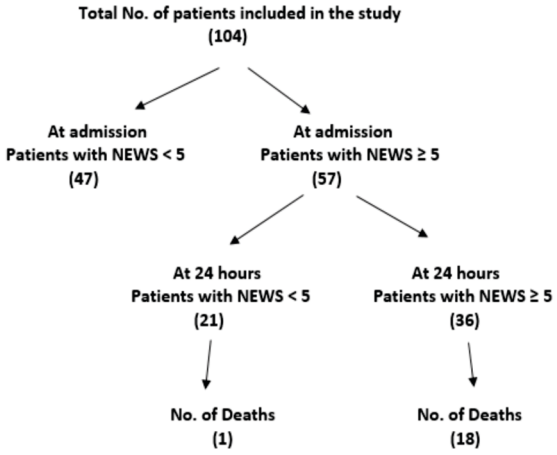
S No	Scores	No of Patients (n = 104)	No of Deaths
1	Low Score (1 - 4)	47 (45%)	8 (17%)
2	Medium Score (5 - 6)	19 (18.3%)	4 (21%)
3	High Score (≥ 7)	38 (36.5%)	14 (36.8%)
4	Supplemental oxygen Required	42 (40.4%)	17 (40.5%)
5	Patients with VPU state	22 (21.2%)	12 (54.5%)

Figure - 1 Percentage of patients in different NEWS Scores at the time of admission and percentage mortality



End points: There was no significant difference in NEWS score at 12 hours from the baseline score (at the time of admission). Out of 104 patients, the number of patients with NEWS scores of ≥ 5 at baseline were 57 (54.8%). At 24 hours, out of 57 patients, 36 (63.2%) patients had their NEWS of ≥ 5. In 21 patients (36.8%) NEWS score improved to below 5 (Flow chart). Out of these 21 patients, one patient died, and all others were discharged. Out of 36 patients who had a NEWS score of ≥ 5 at 24 hours, the number of deaths was 18 (50%). The total in hospital deaths were 26, out of which 18 deaths had occurred in patients with a NEWS score of ≥ 5. This constituted 69% of total deaths.

Flow Chart



We observed that in 15 patients (14.4% of total patients) the initial NEWS was low and subsequently the NEWS had been increased at 24 hours. Out of 15 patients 11 died at the end of study. Mortality in these patients was 73.3%. We observed that out of these 15 patients, 5 patients had initial low score of < 5 at the time of admission and their score had increased to > 5 at 24 hours (Table - 5). Out of these 5 patients, 2 patients died and 3 were discharged.

Table - 5 Patients with initial low NEWS (<5) and subsequent high NEWS at 24 hours

S No	Subject No	NEWS at admission	NEWS at 24 hours	Outcome
1	23	4	9	Death
2	25	0	2	Discharge
3	44	3	4	Discharge
4	89	2	10	Death
5	90	1	8	Discharge

The in - hospital deaths at 1 week were 26 (25%). Total number of patients discharged was 78 (75%) [Table - 6]. Fifteen patients (27.3%) were discharged to home within the study period (Prior to 1 week).

Table - 6 Outcomes of patients at 1 week after admission into IMC

S No	Secondary Outcomes	Number of Patients (n = 104)
1	In hospital deaths	26
2	Total Discharges from hospital	78

Comparative analysis of parameters at 24 hours:
There was highly significant ($p < 0.0001$) decrease in the NEWS scores at 24 hours after admitting into IMC. Actual values are given in table - 7.

A significant ($p < 0.01$) decrease was found in mean pulse rate compared from the baseline (time of entry into IMC) to 24 hours after. A raise in pulse rate score from 2 to 3 at 24 hours was associated with high mortality.

Table - 7 Difference in Scores at admission and 24 hours

S No	Parameter (n = 104)	At the time of admission into IMC (Mean ± SD)	24 hrs After Admission (Mean ± SD)	p value
1	NEWS Score	5.26 ± 3.04	4.12 ± 3.46	$p < 0.0001$
2	Pulse Rate (beats/ min)	102.2 ± 17	97 ± 16.5	$p < 0.01$
3	Systolic BP (mm of Hg)	117 ± 31	114.7 ± 22.7	NS
4	Respiratory rate score	1.2 ± 1.5	0.74 ± 1.2	$p < 0.0001$
5	O2 Saturation score	0.61± 0.76	0.44 ± 0.57	$p < 0.05$
6	Temperature (C0)	37.4 ± 0.2	37.6 ± 0.2	NS

Twenty-seven out of 104 patients presented with a score of 3 for BP at the time of admission. Discharges in these patients were 17 (63%) despite initial high score and deaths were 10 (37%). Seventy-seven patients had an initial score of ≤ 2, out of which 9 patients had an increase in the score at 24 hours. The deaths in these 9 patients were 6 (66.7%). We observed that mortality was high when low initial score changed to high score at 24 hours. Mild decrease was found in mean systolic blood pressure, though this difference was not statistically significant (Table - 7).

There was a highly significant decrease ($p< 0.0001$) in respiratory rate score from admission to 24 hours (Table - 7). Twenty-one out of 104 patients had an initial score of 3. Discharges in these patients were 14 (66.6%) despite initial high score and deaths were 7 (33.3%).

We found a significant decrease ($p < 0.05$) in the score of oxygen saturation at 24 hours (Table - 7). Forty-two out of 104 patients (40.4%) required supplemental oxygen at admission and mortality in this group was 17 (40.5%). Out of 42, 12 patients did not require oxygen at 24 hours and these patients had good outcome with 11 discharges and 1 death. Five patients required oxygen at 24 hours, who had not initially required oxygen. The outcome was poor in these patients and all 5 patients succumbed to death finally.

In our study, patients brought with VPU state were 22 (21.2%) and mortality in this group was 12 (54.5%). Six patients out of 104 were alert initially and showed a subsequent decline in sensorium (VPU). These patients had extremely poor outcome with 5 deaths and only 1 patient discharge. There was no significant difference in the mean temperature score at admission and 24 hours.

DISCUSSION

The National early warning score (NEWS) is a useful tool for identifying hospitalized patients who need higher level of care and those at risk of in hospital death. Limited Indian data is available in this regard. We have selected NEWS ≥ 5 as our primary endpoint based on previous literature [6, 11, 17, 21, 22]. Kruisselbrink et al [6] had selected NEWS ≥ 5 because of its superior specificity in identifying high risk patients and the importance of considering clinician's workload in resource constrained environments where, health care providers are limited, and automated monitors are scarce. Seven patients were needed to be evaluated to detect 1 unstable patient if NEWS score of 4 was kept as cut off, whereas less than 5 patients were required to be evaluated, if cut off score of 5 was considered. Many studies in developed nations without resource limitation used NEWS ≥ 2 or 3 at 24 hours as their end point [11, 21, 22, 23]. We included patients who required distinct monitoring plans according to guidelines.

It was well established that delayed intervention in high risk patients, is associated with poorer outcomes [12, 17]. A few studies were conducted to determine the optimum monitoring frequency [11, 23]. Ludikhuize et al [21] proved that NEWS determination 3 times daily results in better detection of physiological abnormalities and more early activation of Rapid Response Team (RRT). A minimum standard of 12 hours for vital sign assessment has been suggested. Royal college of Physicians [17] recommended that the minimum frequency of monitoring should be 12 hourly, for those scoring 0, increasing the monitoring to 4 - 6 hourly for those with scores of 1 - 4, unless more or less frequent monitoring is considered appropriate by a competent clinical decision-maker. However, we have measured NEWS at 12 and 24 hours in our study.

In majority of patients, we found no significant change in NEWS Score in the initial 12 hours which was consistent with the results of a previous study [10]. In this study it was shown that there were no changes in score in majority of patients during the first few hours, after their admission to hospital and that if they did occur these changes indicated little or no prognostic information. A change in the score occurred only after 12 hours in our study. Moreover, a change in the score was associated with a corresponding change in in hospital mortality.

In our study, we found that the mortality was high in patients with high score. Our results were consistent with previous studies [10, 24] . In a study in Uganda [6], they distributed the NEWS across all patients who died. The mortality was 14.6% among patients with NEWS ≥ 4 and for NEWS ≥ 5 mortality was 22.6%. In our study, the death rate in this subgroup was 50%, which was significantly more. This could be due to less sample size (104). In many studies [10, 20, 24, 25] it had been shown that in hospital deaths were raised significantly ($p < 0.0001$) as the national early warning scores increased. Subbe et al [26] showed that scores of 5 or more were associated with increased risk of death (ODDS Ratio 5.4).

In our study, the in-hospital mortality at 1 week was 50% in patients with NEWS ≥ 5. In the literature, in hospital mortality rates were different in different studies. Our results were consistent with one study [10] where, in hospital mortality rates of 57.9 % were obtained in patients with NEWS > 5. Burch et al [24] included 790 patients in a South African urban emergency room and their mortality rates were 16% in patients with NEWS 3 - 4 and 26% in patients with NEWS > 5. Our values were high when compared to the results of this study. In our study, we found mortality rates of 17% and 50% in patients with NEWS 3 - 4 and NEWS > 5 respectively. This could be because of less sample size (104) in our study.

We found that in 15 patients (14.4% of total patients) initial NEWS were low and subsequently the NEWS had been increased at 24 hours and mortality rate was high (73.3%) in this group. Our results were in accordance with a previous study [10]. They also showed that many patients with low initial score had an increased score than those with a high initial score. They also interpreted that the greater the change in the initial score, either up or down, the greater was the corresponding change in the mortality. In our study, we observed that a change (either increase or decrease) of 5 in NEWS score influenced the outcome. However further studies with larger sample size are required to confirm this finding.

We observed that an increase in score was mostly influenced by the need for inspired oxygen, respiratory rate, systolic blood pressure and level of consciousness. A reduction in the score is greatly influenced by

the need for inhaled oxygen. Our results were consistent with the findings of other studies [10, 27]. Subbe et al [20] identified that the independent predictors of in hospital death were abnormal systolic blood pressure (≤ 100 or ≥ 200 mm Hg), respiratory rate ≥ 25 breaths per minute and an impaired level of consciousness.

The limitation of the study was inclusion of a smaller number of patients. The strengths of our study include its prospective, observational design and the heterogenous sample of patients enrolled.

In conclusion, there is a significant burden of critical illness in our hospitals. We need resource - suitable and setting - specific management plans. Implementation of NEWS can provide as a useful tool to identify patients at greater risk of death and to enable closer monitoring and earlier intervention in these patients. Future research should include refinement of NEWS for low resource settings and development of appropriate interventions at appropriate time, for patients identified to be at high risk of death, based on early warning scores.

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