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## Use of national early warning score in emergency department among adults with febrile illness to predict admission, ICU admission and mortality

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### Abstract

**Introduction:** National Early Warning Score (NEWS) is now a well-known tool used by many countries in the Emergency Department (ED) to predict the severity of the disease and intervene on time. The main aim of this study is to check the sensitivity of the national early warning score in finding sick cases that require possible ICU admission and possible mortality cases.

**Method:** A cross-sectional study was conducted in the Emergency Department at Patan Academy of Health Science (PAHS) over one year. The inclusion criteria of the data for this study were age > 15 years old and patients with febrile illness (temperature  $\geq 38^{\circ}\text{C}$ ) presenting to the Emergency Department. Data was analyzed using Microsoft Excel and Statistical Package for Social Sciences version 28.0.

**Result:** Predictive sensitivity of medical severity of overall cases was observed. The National Early Warning Score was highly sensitive in foreseeing and finding severe cases that required immediate ICU admission (0.74) or cases with high mortality (0.94).

**Conclusion:** As per the findings from the study, introducing a National Early Warning Score tool for screening at the Emergency Department in Nepal can be very helpful in identification of deteriorating cases which need ICU admission or risk of mortality.

**Keywords:** Fever; NEWS Score; Sensitivity

## INTRODUCTION

In 2012, Royal College of Physicians of London (RCPL) proposed a vital signs-based aggregate known as National Early Warning Score (NEWS) to predict clinical deterioration. The score has now been validated extensively and consists of seven parameters which includes heart rate, respiratory rate, systolic blood pressure, oxygen saturation, level of consciousness, body temperature and oxygen support.<sup>1</sup> A score is assigned to each parameter and increase in total score can predict clinical deterioration earlier. Beside the UK, Norwegian Healthcare practice has also introduced NEWS in 2016.<sup>2</sup>

Recent studies in NEWS are also focused on sepsis and COVID-19 patients. Study done in Daegu, South Korea among COVID cases has demonstrated that higher NEWS is more predictive of ICU admission than just initial vital signs.<sup>3</sup> Despite the triage system, emergency departments are making considerable efforts to ameliorate their capacity and rapidly identify the sick cases. Though various scoring system are being studied, NEWS is simple to use and validated.<sup>4</sup> Overcrowding and extended ED stays are one of the major problems in most of the Emergency departments in Nepal and in such chaos, there is high likelihood of missing the important signs of deteriorations.<sup>5</sup>

In addition, the national protocol of Covid management of Nepal incorporates use of NEWS to detect moderate and severe cases so this study can be beneficial to see its effectiveness. Hence this study aims to evaluate the sensitivity of NEWS in identifying the sick cases and need for ICU admission or mortality in febrile patients presenting to the Emergency Department.

## METHOD

This was a prospective observational study conducted at Covid and non-Covid Emergency Department of Patan Academy of Health Sciences, Nepal. After obtaining the ethical approval from Institutional Review Committee of Patan Academy of Health Sciences (Ref: drs2106181540), data was collected from July 2021 to January 2022. The general objective of the study was to predict the hospital admission, Intensive care unit admission and mortality within 72 hours using the NEWS.

The specific objectives were to evaluate the sensitivity of NEWS for prediction of hospital admission, Intensive care unit admission and mortality within 72 hours among Covid and Non Covid febrile patients presenting to the emergency department. The Inclusion Criteria were patients >15 years presenting to the emergency department with documented febrile illness whereas the patients not meeting the working definition and those unable to provide consent were excluded from the study. The working definition were as follows:

Febrile illness: Patients with documented axillary temperature of 100.4° F (38°C) or greater.

Non Covid 19 patients: Febrile patients with negative PCR report of COVID 19 test.

NEWS Scoring: Low risk: Score 1-4,

Medium risk: Score 5-6,

High risk: 7 and over

Regarding the sampling technique, convenience consecutive sampling was done and the sample size was calculated using the sample size based on sensitivity:

$$N = Z^2_{1-\alpha} \times S_n \times (1 - S_n) / d^2 \times \text{prevalence}$$

$S_n$  = anticipated sensitivity

$d$  = precision

Sensitivity is calculated from the results of the similar study<sup>1</sup> and prevalence is calculated from the data of the previous year of the Emergency Department.

$S_n=0.8$

Precision=0.05

Confidence interval= 95%

Prevalence=0.20

$$N = (1.96)^2 \times 0.7 \times 0.2 / (0.05)^2 \times 0.25$$

$$= 0.537 / 0.000625$$

$$= 859$$

After obtaining the ethical approval from IRC-PAHS, consent was taken by the researcher or the doctor on duty from patients meeting the inclusion criteria. Patients were selected by convenience sampling technique for the calculated sample size. The data was collected in the form consisting of demographic variables (age, sex), chief complaints and seven parameters needed for NEWS (seven parameters include pulse, respiratory rate, saturation, blood pressure, use of oxygen, temperature and level of consciousness by AVPU). Then the national early warning score was calculated according to these parameters. Since the NEWS score of  $\geq 7$  is categorized as a high score requiring prompt emergency care the data was calculated for score less than 7 and  $\geq 7$ .

Patients were then followed up via the electronic medical record system after 72 hours for the primary outcome of admission, need of ICU and mortality. For the referred and discharged cases, follow up was done after 72 hours via telephone with prior consent for the primary outcome of admission, need of ICU and mortality. The data was recorded to Microsoft Excel and analysis was done using SPSS software.

Sensitivity was calculated for NEWS to predict admission, ICU admission and mortality of patients presenting with febrile illness using the formula: Sensitivity = True Positive (TP) / [True Positive (TP) + False Negative (FN)]. A Receiver Operating Characteristic (ROC) curve analysis was done in

SPSS to determine the overall diagnostic accuracy of the NEWS.

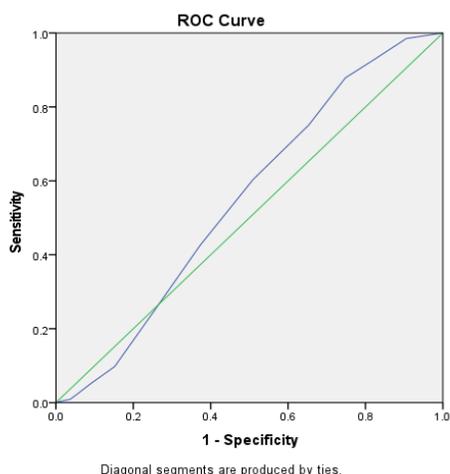
**RESULT**

The NEWS sensitivity (Table 1) with score more than or equal to seven for both COVID and Non COVID cases for predicting mortality and ICU admission was higher than that of general admission [0.95 vs 0.74 vs 0.55]. Similar results were obtained for COVID mortality, ICU admission, general admission [0.95 vs 0.72 vs 0.59], and non-COVID mortality, ICU admission and general admission [1 vs 0.85 vs 0.46].

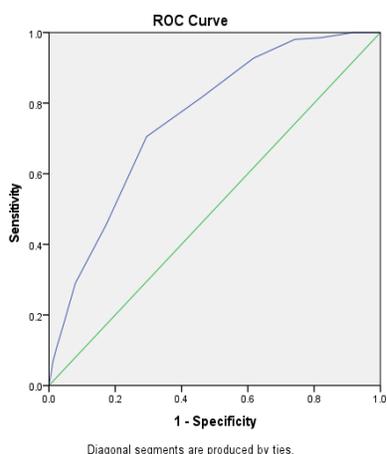
**Table 1. National Early Warning Score sensitivity**

	Sensitivity		
	Admission	ICU admission	Mortality
Total	0.55	0.74	0.95
COVID	0.59	0.72	0.95
Non- COVID	0.46	0.85	1

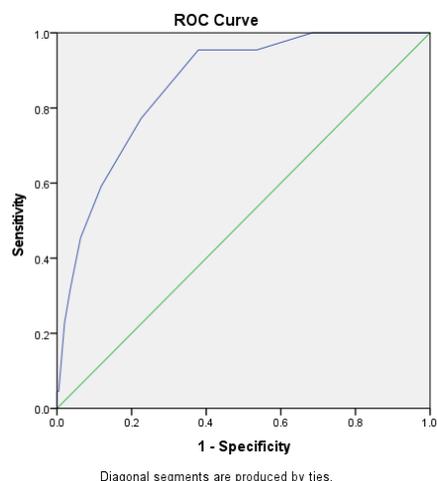
The ROC curve plotted for total admission, ICU admission and mortality after 72 hours showed the sensitivity being highest for mortality, followed by ICU admission and sensitivity of admission being the least (Fig. 1, 2 & 3).



**Figure 1. Admission sensitivity ROC curve**



**Figure 2. ICU admission sensitivity ROC curve**



**Figure 3. Mortality sensitivity ROC curve**

The Area Under Curve (AUC) obtained from the statistical analysis determined the NEWS sensitivity as the strong predictor for mortality and ICU admission (Table 2).

**Table 2. Area Under Curve for Admission , ICU admission and mortality after 72 hours**

Total	Area Under Curve
Admission	0.549
ICU admission	0.756
Mortality	0.862

**DISCUSSION**

The NEWS was designed for the detection of the severity of the diseases presented to the Emergency Department and the need of the hospital ICU admission or detect chance of mortality in several countries. NEWS has been found to be an important tool which is simple to use in emergency department with good outcome.<sup>4</sup> Major tertiary hospital's Emergency Department in Nepal are overcrowded by the patients, with several medical cases that need immediate medical attention and requiring ICU admission.<sup>5</sup> With recent evidences from studies done in UK, Europe and East Asia, use of NEWS in Emergency Department within 24 hours of presentation can be used to prevent acute severe ED cases being missed out. In our study, prospective data collection was done within 72 hours of ED visit, and the study was conducted over the 7 months of time period, which showed the higher sensitivity of NEWS to predict possible ICU admission and mortality.

Overall findings from our study showed sensitivity of detection of overall ICU admission cases and mortality cases was much higher compared to normal admission with the use of NEWS in the ED within 72 hours of presentation. Recent study done in University of Chicago concluded the NEWS being more predictive of higher ICU

admission and mortality in sepsis related patients presented to ED.<sup>6</sup> Similarly, a retrospective observational study done on use of NEWS at triage in London and Finnish study found the higher sensitivity for early recognition and treatment of acutely ill patients in ED.<sup>7,8</sup>

In contrast to our findings, an observational Norwegian study did not conclude the NEWS as a strong predictor for disease prognosis and overall ICU admission. It rather recommended for further exploration in the ED to determine the clinical decision making in acute care chain.<sup>9,11</sup>

NEWS performed on both COVID and non- COVID patients in ED established the same findings done for overall cases. This indicated the use of NEWS in ED as a diagnostic tool for the identification of severely ill patients that need immediate ICU admission and chance of mortality. Study done among COVID patients in UK, 2021 had a similar finding to our study, and supported and strongly recommended the use of NEWS as a strong predictive ability for ICU admission cases.<sup>10</sup>

ROC demonstrated a much stronger curve supporting possible Mortality after 72 hours and ICU admission, and weaker curve for general admission. AUC for mortality and ICU admission were of moderate strength and weaker for general admission. Similar study done in Singapore on 2019 showed the higher prediction of possible ICU admission within 72 hour of hospital ED visit (AUC 0.89) compared to our study with AUC 0.75, however study done in Singapore was of longer duration (2 years retrospective study).<sup>11</sup> Likewise, a prospective cohort study done in UK and other observational study accurately showed the NEWS a strong predictor of mortality and disease outcome with high AUC.<sup>13,14</sup>

The results from our study showed a good outcome in support of the several study findings with the use of NEWS as an important tool in identification of the ED patient's clinical outcome and possible ICU admission or mortality. The outcome of the study strongly recommends the use of NEWS in Nepal's ED which not only helps emergency physicians and health persons in identifying sick cases that need immediate attention, but also prevents early deterioration with early intervention.<sup>14</sup>

A use of larger sample size could have given a better result and stronger predictive indicator. Moreover, study was done only for 7 months' time period collected data. Studies done over a longer period would strongly support the research question.

## CONCLUSION

NEWS has been used as an important tool in ED to accurately diagnose severe illness and early intervention. Our study result has effectively shown the higher sensitivity of NEWS in early identification of ICU admission cases and predict

the possible mortality with high AUC value. Introduction of NEWS in busy ED of tertiary hospitals in Nepal can be of great importance in preventing the possible mortality but also timely needful intervention to treat the severe medical conditions.

## DECLARATIONS

### Acknowledgement

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### Conflict of Interest

None.

### Funding

None.

### Ethical Clearance

It was obtained from the Institutional Review Committee of Patan Academy of Health Sciences, (Ref: drs2106181540).

### Consent for study and publication

Taken.

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