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Serious adverse events and missed observations impact of limited resources of nurses based on national early warning score (NEWS)

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Abstract

Background: Since become an obligation for hospital, Early Warning System (EWS) are widely used. National Early Warning Score (NEWS) is common EWS adopted in Indonesia. There are not many studies evaluating the implementation of the in hospitals with limited resources in Indonesia.
Purpose: To analyze the NEWS performance in the medical ward at one regional hospital in Serang District, Banten Province, Indonesia.
Method: Observational analytic study with retrospective approach using NEWS observation sheet of 163 medical adult patients. NEWS's performance was assessed by analyzing the amount of observation that was not carried out in the first 24 hours of hospitalization according to hospital safety protocols. The observed outcome was the occurrence of serious adverse events (SAE), unplanned Intensive Care Unit (ICU) admission, and in-hospital mortality. The data analyzed with Fisher Exact Test and Spearman Rho.
Results: Participants' age mean of 48.2 years old (range 17-85). Most were male (87/53.4%) with a NEWS score of 0 in the first 24 hours of hospitalization (91/55.8%). Of 72 (44.2%) missed observation patients, 8 (4.9%) experienced SAE, 5 (3.1%) transferred to the ICU, and 3 (1.8%) died in the ward. There are significant relationship (p-value 0.001) between missed observation and the occurrence of SAE and unplanned ICU admission (p-value 0.015). There is no relationship between missed observation and in-hospital mortality.
Conclusion: About forty percent of NEWS observation frequency in medical wards is still not under safety protocols that have been made by the hospital. Missed observation associated with SAE and unplanned ICU admission. Hospital stakeholders need to evaluate the implementation of NEWS in the hospital ward and take strategic action to increase its effectiveness.

Keywords: In-Hospital Mortality; Medical Wards; NEWS; Serious Adverse Events, Unplanned ICU Admission

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INTRODUCTION

About 10% of hospitalized patients are at risk of experiencing adverse events, 0.6-30% of which can even cause fatality. More than 50% of preventable adverse events occur in the general ward. Some contributing factors are failing to identify at-risk patients and take preventive measures before untoward events occur. Delays or inaccuracies in these at-risk patients can increase the risk of disability or death (Lee & Hong, 2019; Lyons, Edelson, & Churpek, 2018; Schwendimann, Blatter, Dhaini, Simon, & Ausserhofer, 2018).

An Early Warning System (EWS) is a system designed to identify deteriorating patients outside of the ICU. This system was first introduced in the 1990s as a tool to assess a patient's clinical condition based on vital signs by projecting it into a score. This score serves to detect the deterioration of the patient's clinical condition. An increasing score indicates a worsening clinical condition. A certain score value will trigger a series of responses and actions to prevent further deterioration. These preventive actions are called the Rapid Response System (RRS) (Lee & Hong, 2019). RRS protocols in each hospital vary greatly, tailored to the resources owned by the hospital (Lyons et al., 2018). Although the effectiveness of RRS and EWS is still a matter of debate, some studies suggest that EWS implementation can reduce unexpected deaths in hospitals (Lee, Cho, Kwon, Park, Lee, Kwon, & Jo, 2021; Bassin, Raubenheimer, & Bell, 2023; Haegdorens, Monsieurs, De Meester, & Van Bogaert, 2019; Sebat, Vandegrift, Oldroyd, Kramer, & Sebat, 2020; Thorén, Joelsson-Alm, Spångfors, Rawshani, Kahan, Engdahl, & Djärv, 2022).

Starting in the United States and Australia, EWS has become an important part of patient safety and has been widely adopted in the world (Lee & Hong, 2019). Since 2015, the implementation of EWS in hospitals has been required in Indonesia. One of the EWS that is widely adopted in Indonesia is the National Early Warning Score (NEWS). Research on NEWS in Indonesia is mostly conducted in tertiary teaching hospitals. However, studies in smaller hospitals with limited resources are still rare. This study aims to analyze the NEWS performance in a limited-resourced hospital in Indonesia.

RESEARCH METHOD

This study is an analytical observational study with a retrospective approach. The sample of the study is medical adult patients who have been treated in May- June 2023 in the medical ward. Surgical patients, pregnant, and less than 17 years old were excluded from the study. Data taken secondarily from the NEWS observation sheet in the patient's medical record and recorded manually. NEWS scores and observation frequency were observed for 24 hours since hospitalization.

NEWS includes measurements of 7 vital signs consisting of respiratory rate, oxygen saturation, use of breathing apparatus, body temperature, systolic blood pressure, heart rate, and level of consciousness based on the Alert-Verbal-Pain-Unresponsive (AVPU) category. Each vital sign was given a score ranging from 0 to 3 (Table 1).

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Table 1. National Early Warning System (NEWS)

Physiological parameters	3	2	1	0	1	2	3
Respiratory rate (per minute)	≤ 8		9-11	12-20		21-24	≥25
SpO2 (%)	≤ 91	92-93	94-95	96			
Supplementary oxygen?		Yes		No			
Temperature (°C)	≤ 35		35.1-36.0	36.1-38.0	38.1-39.0	≥39.1	
Systolic Blood Pressure (mmHg)	≤ 90	91-100	101.110	111-219			≥220
Pulse (per minute)	≤ 40		41-50	51-90	91-110	111-130	≥131
Consciousness				A			V/P/U

Source: Hospital medical record (adapted from Royal College of Physicians. The National Early Warning Score (NEWS) scoring system.
Abbreviation: A/V/P/U: A, Alert; V, respond to voice; P, respond to pain; U, unresponsive.

The study was conducted in a medical ward of a regional hospital in Serang District, Banten Province, Indonesia. The ward has a capacity of 20 beds. Twenty nurses were employed in the ward. Five nurses are on duty in the morning shift, and 3 nurses each in the day and night shifts. The hospital does not yet have an established rapid response team (RRT), Emergency Medical Team (EMT), or code blue team. When a patient's condition worsens, hospital has safety protocols that must be followed (Table 2).

The safety protocol is based on NEWS measurements with a very low classification if the score is 0 with a clinical response followed by routine observation 3x/24 hours; Low classification if the score is 1-4 with a clinical response, the ward nurse reports to the doctor on duty, and the doctor decides whether or not the frequency of monitoring needs to be increased (minimum observation 4-6 hours); Moderate, if the score is 5-6 or score 3 on one of the clinical response parameters, the nurse reports to the ward duty doctor, the doctor intervenes on the patient, and/or reports to the ICU duty doctor (observation every 1 hour); And high if the score is ≥7 with a clinical response, the ward nurse reports to the ICU duty doctor, and the ICU duty doctor intervenes on the patient and immediately reports the definitive doctor who is treating the patient. If within 3 calls he can't be reached, call another one doctor at the same specialist (all the time/continuous monitoring).

The safety protocol involving multidiciplines nurses and doctors but not in a specific team (like RRT or EMT). In this protocol the nurse has an important role in initiating the protocol. The nurse independently assesses whether or not it is necessary to increase the escalation of observations on the patient by NEWS scoring. The total score of 7 vital signs is classified into 4 levels and the nurse must implement the appropriate clinical response and observation frequencies according to the score obtained. The nurses also have responsibility to carry out the observations and do appropriate clinical response according to the clinical conditions of the patients.

In this study, NEWS performance was analyzed by observing the frequency of observation carried out in 24 hours is compared to the number of

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observation frequencies that should be carried out according to hospital safety protocols. The observed outcome was the occurrence of serious adverse events (SAE) in the form of ICU admission and in-hospital mortality. The number of missed observations that occurred and the occurance of SAE were analyzed using fisher exact test and Spearman Rho. This research was reviewed and approved by an independent ethics committee of a local hospital on May 22nd, 2023 (No: 800/Timkordik 150/V/2023).

RESEARCH RESULTS

Table 2. Characteristics of Respondents (N=163)

Variable	Results
Age (Years) (n/%)	
(Mean ± SD) (Range)	48.2 ± 17.0 (17-85)
17-25	24 /14.7
26-45	44 /27.0
46-65	72 /44.2
>65	23/14.1
Gender (n/%)	
Male	87/53.4
Female	76/46.6
NEWS score 24 h admission (n/%)	
Mean ± SD (Range)	0.6 + 1.3 (0-7)
NEWS 0	91/ 55.8
NEWS 1-4	66/40.5
NEWS 5-6	2/1.2
NEWS >6	4/2.5

According to the patients characteristics in the Tabel 2 above, a total of 163 patients were involved in this study. Patients were aged between 17-85 years and an average of 48.2 years. Most patients were male (87/53.4%) and had a NEWS score of 0 in the first 24 hours of admission (91/55.8%).

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Table 3. Observation Analysis (N=163)

Variables	No Missed Observation (n=91)	Missed Observation (n=72)	p-value
SAE (n/%)			
Yes	0/0.0	8/4.9	**0.001***
No	91/55.8	64/39.3	
Unplanned ICU admission (n/%)			
Yes	0/0.0	5/3.1	**0.015***
No	91/55.8	67/41.1	
In-Hospital Mortality (n/%)			
Yes	0/0.0	3/1.8	0.084
No	91/55.8	69/42.3	
NEWS score level within 24 h admission (n/%)			
NEWS 0	91/55.8	0/0.0	1.000 (rs 0.97)
NEWS 1-4	0/0.0	66/40.5	
NEWS 5-6	0/0.0	2/1.2	
NEWS >6	0/0.0	4/44.2	

Abbreviation: SAE: Severe Adverse Events; ICU: Intensive Care Unit; NEWS: National Early Warning Score; *significance (2-tailed α 0.05)

Based on observation result analysis in the Table 3 above, on 163 NEWS observation sheets obtained 72 samples (44.2%) with missed observation. Eight patients (4.9%) experienced SAE, 5 patients (3.1%) were transferred to the ICU and another 3 patients (1.8%) died in the ward. The results of data analysis using the Fisher Exact test showed a significant relationship (p-value 0.001) between missed observation, the occurrence of SAE, and unplanned ICU admission (p-value 0.015). Meanwhile, between missed observation and in-hospital mortality, there was no significant relationship (Table 3).

Researchers conducted further analysis by analyzing the average NEWS score of the first 24 hours of hospitalization with the number of missed observation using the Spearman test. The results of data analysis showed a strong relationship between the NEWS score and the number of missed monitoring with a value of rs 0.97 (Table 3). This means that the higher the NEWS score obtained when patients are admitted, the more the number of missed observation.

We also conducted further analysis to the patient's data who experience SAE by analyzed their characteristics, NEWS scores, and the number of missed observation 24 hours before the occurrence of SAE. The results showed that most of the SAE patients were men 5 (62.5%) aged between 40-67 years (average 54.9 years). The average NEWS score for the first 24 hours of admission was 5.2 (range 4-7) and the 24 hours before the onset of SAE was 4.9 (range 3-7.3). All patients with SAE were in the missed observation group.

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Table 4. SAE Patients Analysis (N=8)

NEWS Classification	Number of missed observation		p-value
	24 hours of admission Mean + SD (Range)	24 hours before SAE Mean + SD (Range)	
NEWS (all levels)	22.5 + 20.4 (1-45)	22.5 + 20.4 (1-45)	
Low (score 1-4)	1.0 + 1.0 (1-1)	15.7 +25.4 (1-45)	0.928
Moderate (score 5-6)	21.0 + 21.0 (21-21)	11.0 + 14.1 (1-21)	(rs 0.55)
High (score >6)	45.0 + 45.0 (45-45)	37.0 + 13.9 (21-45)	

Abbreviation: SAE: Severe Adverse Events; NEWS: National Early Warning Score

The results of data analysis of SAE patients found that there was no relationship between the average NEWS score 24 hours before SAE and the number of missed observation 24 hours before SAE. This means that even though a high NEWS score was found before the SAE occurred, missed observations still occurred. This phenomenon also found between the NEWS score of the first 24 hours of admission and the NEWS score 24 hours before SAE occurred (Table 4). Our analysis with Spearman Rho found that there was a sufficient relationship between the number of missed observation in the first 24 hours of admission and the number of missed observation 24 hours before SAE with rs 0.55 although not significant p 0.928. This means that patients who are admitted for 24 hours in the ward who experience missed observations will tend to experience missed observations up to 24 hours before the SAE occurs.

DISCUSSION

The results showed that as many as 72 samples (44.2%) had missed observation within 24 hours of treatment in the inpatient room. There is a significant relationship between missed observation and the occurrence of SAE and unplanned ICU admission. However, there was no significant association between missed observation and in-hospital mortality.

NEWS is one of the EWS options that can be used in various diagnoses (Price, Prytherch, Kostakis, & Briggs, 2023) and is the most accurate EWS to predict the risk of death and ICU admission within the first 24 hours of the patient's arrival (Thorén et al., 2022; Covino, Sandroni, Della Polla, De Matteis, Piccioni, De Vita, & Franceschi, 2023). However, there is low protocol compliance in implementing EWS (Eddahchouri, Koeneman, Plokker, Brouwer, van de Belt, van Goor, & Bredie, 2021). As happened in this study it was found that 44.2% of cases were not under existing protocols. In addition, the study also found that the higher the NEWS score obtained, the more needed observation was not carried out.

It is understandable, that in poorly-resourced hospitals such as hospitals where studies are conducted, the limited number of nurses is one of the difficulties to carry out safety protocols. Based on the results of preliminary research, it is known that the nurses on duty in the morning shift are 5 nurses, and in the day and night shifts, each of the 3 nurses provides nursing care on 20 beds. The higher the NEWS score, the more the obligation of the nurse on duty to observation in addition to routine monitoring of other patients. The absence of Medical Emergency Team (MET), RRT, and code blue teams will further increase the workload of ward nurses. In addition, in poorly-resourced hospitals generally the task of nurses is not only to carry out nursing activities. Nurses also have administrative tasks, such as making details of patients discharged, or completing patient filings.

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The Relationship between Missing Monitoring and the Occurrence of SAE

About 10% of hospitalized patients are at risk of adverse events, 0.6-30% of which can even cause fatality. Fifty-three percent of unexpected preventable adverse events occur in general wards (Lee & Hong, 2019; Schwendimann et al., 2018). Based on the results of the study it was found that 8 patients (4.9%) experienced SAE in the medical ward. Some contributing factors were the failure to identify patients at risk and take preventive actions before adverse events occurred. Delay or inaccuracy of management in patients at risk can increase the risk of disability or death (Lee & Hong, 2019; Schwendimann et al., 2018). These data follow the results of studies where there was a significant relationship between the existence of missed observation and the experience of SAE.

The high number of missed observation reflects the low compliance of nurses to the hospital safety protocols. Low compliance with EWS implementation also occurs in various hospitals in the world, especially in smaller hospitals (Eddahchouri et al., 2021). This low compliance occurs at low, moderate, and high NEWS levels. However, there is no missed observation at a very low NEWS level.

An interesting founding is that patients with low levels of NEWS at 24 hours of admission also experience SAE. Of the 3 SAEs that occurred in this group, 2 of them died before they could be transferred to the ICU. It appears that at low NEWS scores, nurses tend to neglect to identify the risk of worsening and fail to take anticipatory steps before an SAE occurs (Lee & Hong, 2019).

On the other hand, a high NEWS score does not allow nurses to monitor as much as expected due to the heavy workload. This can be seen from the results of the analysis 24 hours before the patient experienced SAE there was no decrease in the number of missed observation. There is a relationship between the number of missed observation in the first 24 hours of admission and missed observation 24 hours before the occurrence of SAE. This means that patients who are admitted from the beginning with unmet monitoring needs will be less likely to be met up to 24 hours before SAE (Ullah, Albrett, Khan, Matthews, Perry, GholamHosseini, & Lu, 2022). This result is different from other studies that say generally the frequency of monitoring will increase 24 hours closer to the occurrence of SAE (Eddahchouri et al., 2021).

It is necessary to explore further obstacles faced by room nurses in implementing NEWS. Workload, division of tasks, number of nurses on duty, and nurse staffing system are some factors that need to be evaluated further (Spångfors, Molt, & Samuelson, 2020; Ullah, Baig, GholamHosseini, & Lu, 2022; Currey, McIntyre, Taylor, Allen, & Jones 2022). Clinician's perception of the system also needs to be evaluated to build an effective and applicable track system in the hospital (Chua, Tee, Hassan, Jones, Tam, & Liaw, 2021; Smith, Redfern, Maruotti, Recio-Saucedo, & Griffiths, 2020; Sprogis, Currey, Jones, & Considine, 2021; Fadel, Tauquir, Crosby, Orlosky, Alayan, Edwards, Mcmahan, Murphy, Cassara, & Al-Jaghbeer, 2022).

In addition to using scores, the clinical ability of health professionals to assess the patient's condition is also important (Nielsen, Langkjær, Schultz, Kodal, Pedersen, Petersen, & Iversen, 2022). There are several studies about vital signs that can be used in daily practice to sharpen health professionals' (including nurses') intuition on critical condition patients. Improving the ability of nurses to identify deterioration signs in patients based on the latest scientific evidence through formal and informal forums can be an alternative to improve hospitals' EWS performance (Sebat et al., 2020; Simon, Jauslin, Bingisser, & Nickel, 2022; Le Lagadec, Dwyer, & Browne, 2023; Shan, Yang, Kuo, Lee, Hu, Boyle, & Do, 2022). Hospitals may also consider using other EWS or modifying existing EWS tailored to hospital circumstances to improve protocol compliance (Lee et al., 2021; Nielsen et al., 2022;

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Kyriacos, Burger, & Jordan, 2019). Combining the EWS scoring system with optimizing the involved health professional's ability or the patient's family also can be another solution (Noguchi, Yokota, Kimura, & Yamasaki, 2023; Crouch, Trahair, & Aitken, 2021; Dwyer, Flenady, Kahl, & Quinney, 2020; Weatherburn & Greenwood, 2023).

The Relationship between Missed Observation and Unplanned ICU Admission

In this study, one of the SAEs observed was unplanned ICU admission. The results of the data analysis showed a significant relationship between missing monitoring and unplanned ICU admission. This is in line with research that states that NEWS has the best performance in predicting the risk of ICU admission compared to 30 other types of EWS. In addition, NEWS is the most accurate EWS for predicting the risk of ICU admission in the first 24 hours of a patient's coming (Covino et al., 2023; Price et al., 2023; Colombo, Colombo, Maves, Branche, Cohen, Elie, George, Jang, Kalil, Lindholm, Mularski, Ortiz, Tapson, & Liang, 2021).

There were 4 patients admitted with high NEWS scores (>6). Three patients were transferred to the ICU and 1 patient did not experience SAE. Although it is possible to avoid SAE, most patients with a NEWS score of >6 eventually have to be transferred to the ICU. Patients with a NEWS score of >6 should be decided from the beginning to be hospitalized in an intensive care room that can provide more intense monitoring. One factor that may affect is the lack of ICU capacity. Unavailable ICU beds in hospitals force officers to hospitalize critical patients in a regular ward. Emergency Department (ED) was not designed for hospitalization. This is the reason why the patient cannot continue to be treated in the ED until the patient stabilizes or until an ICU bed is available.

Patients with the NEWS >6 category require continuous monitoring which in this case is only possible using bedside vital sign monitors. Limited-resourced hospitals generally do not have bedside vital sign monitors in regular wards and do not have observation wards or high-care units equipped with adequate resources. This condition happens in hospitals where studies are conducted. A previous study reported that the use of continuous vital sign monitoring in the ward can reduce unplanned ICU admission and RRS calls (Eddahchouri et al., 2021; Han, Sohn, Hwangbo, Park, Kim, Choi, & Kim, 2022). They are adding a mobile bedside vital sign monitor that can be used in the hospital wards only when patients with a NEWS score of >6 may be an alternative while hospitals build better systems.

The Relationship between Missed Observation and Mortality

The results showed that 3 patients (1.8%) died before receiving intensive care. The results of the data analysis showed that there was no relationship between missing monitoring and patient mortality. This is following studies that state that NEWS has poor prognostic accuracy in predicting IHCA (Thorén et al., 2022). However, some studies say that NEWS has a good performance in predicting death (Covino et al., 2023; Loisa, Kallonen, Hoppu, & Tirkkonen, 2022).

Two out of 3 patients who died had low NEWS scores (1-4) upon arrival. There was a spike in the NEWS score in the 24 hours before SAE became a moderate NEWS level (5-6). This is in line with the results of previous studies that about 10% of patients who come to the hospital are at risk of AE, and about 0.6-30% will be at risk of developing SAE (Lee & Hong, 2019; Schwendimann et al., 2018). Therefore, ward nurses must remain alert even though the patient comes in stable condition.

Hospitals may consider establishing RRS or MET to improve patient monitoring practices and lower mortality (Lee & Hong, 2019; Haegdorens et al., 2019; Cho, Lee, Choi, Park, Cho, Yoon, & Lee, 2021; Lee, Lee, Lee, Kim, Yang, Lee, & Cho, 2019; Tirkkonen, Skrifvars, Parr, Tamminen, & Aneman,

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2020; Ou, Chen, Hillman, Flabouris, Parr, & Green, 2020; Jung, Ko, Ko, & Jeon, 2022). Of course, this is not an easy thing for limited-resourced hospitals. Hospital policymakers should consider available resources, as well as the possibility of fatigue that could cause the system to not work effectively or not achieve mortality reduction targets (Lee & Hong, 2019; Stærk, Lauridsen, Niklassen, Nielsen, Krogh, & Løfgren, 2022; Chrysochoou, Gunn, & Hillman, 2006).

Some RRS modifications can be alternatives to address these challenges. The use of simple additional technology, optimizing the role of ward and ICU nurses in the team, and holding knowledge-sharing discussion forums, as well as half-day RRS and other strategies can be done to form a simple but quite effective MET or RRS (Jerng, Chen, Chen, Kuo, Tsan, Hsieh, & Huang, 2022; Chalwin, Salter, Karnon, Eaton, & Giles, 2022; Song, Lee, Choi, Lee, Jo, Lim, & Lee, 2022; Sprogis, Currey, Jones, & Considine, 2023).

Improve Nurse Intuition

The role of nurses in the implementation of NEWS in hospitals is very important. Nurses play a role in providing health services and observe the patient's clinical condition for 24 hours. Nurses perform Nursing Care directly and observe the patient's progress in the inpatient room. Nurses must conduct assessments and document the results of routine examinations. Nurses must have the ability to document the results of EWS scoring observations, identify patient severity, and prioritize high-risk patients for appropriate treatment (Lee & Hong, 2019; Schwendimann et al., 2018).

Clinical examination and judgment are still required to activate RRS or safety protocols (Nielsen et al., 2022; Kellett, Holland, & Candel, 2023). One of them is by considering the age and vulnerability of the patient. Patients over 65 years old with an increase in NEWS > 3 can be the first step to monitor the patient's clinical progress (Simon et al., 2022). Nurses should also be aware of hospitalized patients with respiratory disorders. This is because most Pulseless Electrical Activity (PEA) or asystole cardiac arrest rhythms are due to respiratory disorders (Shan et al., 2022). According to another study, it is said that the state of tachycardia in patients with supplemental oxygen is a group with high content worsening (Le Lagadec, Dwyer, & Browne, 2023). In this regard, another study states that prolonged Capillary Refill Time (CRT) is associated with increased hospital mortality, unplanned higher levels of care, and length of stay (Sebat et al., 2020).

LIMITATION

There are some limitations of this study. The study was conducted at one center with a small sample number and the retrospective study approach caused the results of the study not to be widely generalized.

CONCLUSION

We found significant relationship between missed observation and the experience of SAE and unplanned ICU admission, but no significant association between missed observation and in-hospital mortality. About forty percent of the NEWS implementation is not under the safety protocols that have been made by the hospital.

SUGGESTION

Hospital stakeholders need to evaluate the implementation of NEWS in the hospital ward and take strategic action to increase its effectiveness.

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