ORIGINAL ARTICLE

Implementation of an early warning score system and associated factors in a hospital in Bali, Indonesia: a mixed-methods study

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ABSTRACT

Hospitalized patients are at risk of worsening clinical conditions. This requires the implementation of an early warning score (EWS) for monitoring and standardizing patient safety. This study aimed to explore the implementation of an EWS and its associated factors in a hospital in Bali. This mixed-methods study (exploratory sequential design) began with descriptive qualitative research and continued with a cross-sectional component. The qualitative study involved 14 participants (nurses), and the quantitative study involved 302 respondents (nurses). The qualitative data collection used focus group discussions, and the quantitative study used a questionnaire. The qualitative data were analyzed using thematic analysis. The quantitative data were analyzed using univariate (frequency and proportion), bivariate (chi-square test), and multivariate analysis (binary logistic regression). The qualitative analysis identified three themes: adequate EWS knowledge, poor EWS implementation, and perceived barriers. Quantitative analysis revealed that of the 302 respondents, 74.5% showed good EWS implementation. The factors associated with EWS implementation were knowledge (AOR: 2.26; 95% CI: 1.25–4.08; p=0.007), attitude (AOR: 4.32; CI: 2.39–7.80; p<0.001), and leadership support (AOR: 4.12; CI: 2.28–7.43; p<0.001). Therefore, EWS implementation needs to be improved by conducting seminars and training to gain knowledge and attitude, as well as regular supervision to increase leadership support and minimize implementation barriers.

Keywords:
early warning score, hospital, Indonesia, mixed-methods study

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INTRODUCTION

Hospital inpatients are at risk of worsening clinical conditions, which can increase patient transfer to the intensive care unit, morbidity, and mortality.[1] The death rate in the health service process is classified into two categories: the number of inpatients who died after 48 hours of treatment is calculated using the net death rate (NDR), and the total number of inpatient deaths is calculated using the gross death rate (GDR).[2-3] In a hospital setting, the net death rate (NDR) refers to the percentage of inpatient deaths occurring 48 hours or more after admission, relative to the number of discharges and deaths in the same period. The gross death rate (GDR), on the other hand, includes all inpatient deaths during a given period, divided by the total number of discharges in that same timeframe.

Evidence shows that up to 14-28% of patients admitted to the intensive care unit (ICU) are not well-planned. Before experiencing a poor condition, patients generally show early signs of worsening [1]. If deterioration can be detected early, unexpected deaths, cardiac arrest, and adverse conditions can be prevented.[2] Hospitals strive for various strategies to prevent the death and disability of inpatients through early detection and rapid response when they show a clinical or physiological decline in their condition.[4-5]

An early warning score (EWS) is an assessment of a patient's clinical changes based on physiological parameters: systolic blood pressure, pulse, temperature, oxygen saturation, need for oxygen aids, and consciousness status. An EWS supports decision-making regarding changes in the patient's condition to provide safe, effective care in hospitals.[4] It is essentially used to detect early clinical deterioration. EWSs are widely used, especially in hospitals, but records regarding this remain limited.[1]

EWS implementation can be used as a predictor of patient outcomes including length of stay, mortality within 48 days, high-care unit and ICU admission, and emergency code system activation, known as code blue activation.[2,6,7] The EWS algorithm has accurately predicted the probability of mortality at least 40.8 hours before death.[6] A systematic review found that the implementation of an EWS had a positive impact on nurse performance, preventing adverse events such as in-hospital deaths, unplanned ICU admissions, and heart attacks. Reduced EWS implementation impacts cardiac arrests, unplanned ICU admissions, and unexpected deaths.[7] A study in a hospital in Taiwan found that an EWS was useful for reducing cardiopulmonary resuscitation and adverse events.[5] Furthermore, good implementation of an EWS can positively impact clinical outcomes.[4]

An EWS is a prediction model widely used in daily clinical practice. However, clinically used EWSs have been found to have methodological weaknesses. They may not work as well as expected and thus have an adverse impact on patient care.[8] Although EWS is able to predict heart attacks and deaths in hospital, it cannot yet determine its impact on the use of hospital resources.[9]

Based on the previous studies, the implementation of EWS varied. A literature study stated that there were inconsistent findings on the implementation of EWS, where one study stated that there was an increase in the incidence of cardiopulmonary arrest while other findings stated the opposite, namely a decrease in the incidence.[10]

The suboptimal implementation of EWSs remains a major concern. The implementation of EWSs in a hospital in America is relatively poor, and EWSs are

often ignored by frontline nurses,[11] even though their duties include the early detection of deterioration in a patient's condition.[12-13] Suboptimal implementation of EWSs can increase the length of hospital stays and result in unexpected ICU admissions and increased morbidity and mortality.[14]

In Indonesia, a policy mandating the monitoring of the use of EWSs was introduced in 2012, and included in the national standard of hospital accreditation by the Ministry of Health of the Republic of Indonesia; this was consistent with a trend toward patient-centered standards for health services in hospitals.[15] Studies have shown that EWS implementation in hospitals is suboptimal, although the findings are inconsistent and limited in-depth information is available. Therefore, we conducted a study to assess the implementation of EWS, identify associated factors, and explore the barriers and challenges to its effective use.

METHODS

Study design and population

This research was an exploratory sequential mixed methods approach which began with a descriptive qualitative study and continues with a quantitative study using a cross-sectional study design. This study was conducted at the largest public hospital in Bali. The study population consisted of 346 nurses from all inpatient units of the hospital.

Sample size and sampling procedure

The total number of participants for the qualitative study was 14 nurses in charge, who were selected using purposive sampling based on sample criteria. The inclusion criteria were a minimum of three years of work experience and a minimum educational qualification of a Diploma III in Nursing. Exclusion criteria include nurses who are on study assignments and nurses who are on leave (sickness/giving birth). The sample for the quantitative study took all executive nurses who were still on active duty when the research was conducted, totaling 302 respondents.

Data collection

Qualitative data were collected using focus group discussions (FGD). Two FGDs were conducted, involving 14 participants (7 per FGD) who were implemented nurses and responsible nurses (heads of treatment rooms). The questions focused on nurses' knowledge of EWSs, how the EWSs were used, and the barriers and challenges involved. Next, this FGD was recorded using a tape recorder with a duration of around 45-60 minutes. Notes are also used to record all very important matters related to EWS. The next step is to summarize several important points and carry out verification as a form of participant validation. The participants were asked to read the summary and indicate whether it matched what they said during their FGD.

Meanwhile, the quantitative data collection tool uses a questionnaire designed by researchers based on a review of several previous related research instruments. The questionnaire consists of several parts, namely: 1) general characteristics of respondents (age, gender, education, length of service); 2) Implementation of the EWS consists of 10 question items with yes and no answer choices; 3) Knowledge consisted of 14 question items with multiple answer choices; the questions focused on understanding respondents in terms of EWS and EWS follow-up; 4) Attitude consisting of 10 question items with answer

choices using a Likert scale (strongly agree, agree, disagree, strongly disagree); 5) Perception consists of 20 question items with answer choices using a Likert scale; 6) Motivation consisting of 10 question items using a Likert scale; and 7) Work load consists of 13 question items (no work load, light work load, medium work load, heavy work load); 8) support from leadership consists of 15 question items using a Likert scale. Next, a validity test was carried out using content validity and reliability testing involving 30 respondents and the results of all questionnaires showed a Cronbach alpha value of ≥0.7.

Data analysis

Qualitative data were analyzed using thematic analysis and quantitative data were analyzed using univariate, bivariate (Chi-Square Test) and multivariate analysis (binary logistic regression), with measures of association being the Adjusted Odds Ratio (AOR), 95% Confidence Interval (CI) and p value analyzed with the help of the SPSS version 23 program.

RESULTS

Qualitative Results

In this qualitative study, two FGDs were conducted with seven participants in each FGD. The characteristics of the participants are shown in Table 1.

Table 1. Characteristics of FGD participants (n=14).

FGD	Group characteristics	Number of participants	Age	Male / female	Diploma 3/Ners/master's degree	Range of work period (years)
FGD 1	Implemented by a nurse at adult inpatient ward	7	31–45	5/2	2/5/0	7–25
FGD 2	Nurse responsible for the adult inpatient ward	7	40–53	2/5	0/4/3	16–33

After conducting a thematic analysis, three themes and six sub-themes were found, as shown in Table 2.

Table 2. Themes and sub-themes

Themes	Sub-themes
▪ Adequate EWS knowledge	▪ Good understanding of EWS
	▪ Good understanding of EWS follow-up
▪ Poor EWS implementation	▪ Lack of EWS assessment parameters
	▪ Lack of EWS assessment scores
▪ Perceived Barriers	▪ Barriers related to duties and responsibilities
	▪ Barriers related to environmental conditions and availability of facilities

Adequate EWS knowledge

The first subtheme was a good understanding of EWS. The nurses were aware of the meaning, parameters, and use of EWS. They knew how to take EWS measurements, record them in the computer system, and obtain the score.

EWS is an assessment of the patient's physiological condition [through] EWS parameters such as pulse, temperature, respiration, and level of consciousness. We input the measurement results into the computer; then, instructions are issued according to the score obtained. For example, [the instructions for] a score of six is observation every four hours (P01, Implemented Nurse).

EWS is a physiological assessment of the patient's condition, similar to measuring the patient's vital signs. We measure blood pressure, pulse, breathing, saturation and also check the patient's GCS consciousness. Then later the input of the measurement results will get a score and from that score we can get further instructions for patients like that who are undergoing treatment in the hospital (P03, Implemented Nurse).

The second subtheme was a good understanding of EWS follow-up. The nurses understood how to follow up on EWSs by following the instructions received from the scoring system.

... EWS is very good for observing patients because we can find out what actions [to take] from the further results of the EWS measurements, the parameters are the same as when we measure vital signs: there is blood pressure, pulse, respiration, temperature, saturation, and GCS of the patient (P06, Implemented Nurse).

... EWS is what is on the computer, assessing the condition of the patient we are treating from the results of vital signs such as pulse, respiration, temperature, blood pressure, consciousness… oxygen saturation too. After that we input it into the computer and get a score and instructions—for example, observation every eight hours or one hour according to the EWS score (P07, Implemented Nurse).

Poor EWS Implementation

The first subtheme was the lack of EWS assessment Parameters. EWS parameters are being measured in inpatient units and the results are input, but the recommendations received based on the EWSs have not been followed up optimally.

"The examination results have been input into the EWS system at SIMARS, but not all nurses carry out instructions [derived from] the scores" (P08, Responsible Nurse).

When checking the EWS measurements on the computer, the researchers found that all nurses in the inpatient room did not follow the EWS score instructions regarding observations every 4 hours, and the documentation did not state reporting documentation every 4 hours.

The second subtheme was the lack of EWS assessment scores. The nurse could not implement the assessment of EWS optimally.

For Room F, EWS has been running but not optimally. When we go down to see the patient, our friends have already done a vital sign check. It tends to be that patients who do not experience a decline will definitely get EWS but further treatment from the EWS results is still lacking (P12, Responsible Nurse).

There are still some who do not understand the implementation, whether from the time, such as the time maybe some are four hours, some are one hour, some are eight hours to do monitoring. For at that time sometimes they do not do

monitoring or they do it only when inputting, they look again according to the EWS results (P11, Responsible Nurse).

Perceived Barriers

The first subtheme of *Barriers to EWS Implementation* was *Barriers Related to Duties and Responsibilities*. The perceived barriers included the many nursing tasks, high workload, poor patient conditions, and patient dependency on the nurses.

We have many tasks apart from the EWS, which must be implemented and equipped as well. We are in a third-class ward where the workload is very high; one nurse can handle six to eight patients, so in my opinion, the many tasks and workload are the main obstacles (P09, Responsible Nurse).

The obstacles that I see are sometimes their inability to carry out checks according to the time because of the lack of time, being busy, [or] the patient's condition being bad, and sometimes they do it but not at the time they are supposed to (P11, Responsible Nurse).

The second subtheme was *barriers related to environmental conditions and the availability of facilities*.

There are many patients, the patient's condition is getting worse and even the patient's room is often full. We are experiencing obstacles due to the limited number of monitors (P13, Responsible Nurse).

. . . the number of patients is not balanced with the number of nurses and we also find it difficult to document patient data because there are limited monitors and there are even rooms that do not have monitors (P14, Responsible Nurse).

Quantitative Results

Respondent Characteristics

Among the 302 respondents, the majority were female (80.1%), aged >30 years (68.5%), with a Diploma 3 of Nursing (61.3%), and length of work of >10 years (54.0%).

Table 3. Respondent Characteristics (n=302).

Characteristic	Frequency (%)
Age (years)	
≤30	95 (31.5)
>30	207 (68.6)
Gender	
Male	60 (19.9)
Female	242 (80.1)
Education	
Diploma 3 of Nursing	185 (61.3)
Bachelor's degree in nursing (Ners)	117 (38.7)
Length of work (years)	
≤10	139 (46.0)
>10	163 (54.0)

Implementation of EWS

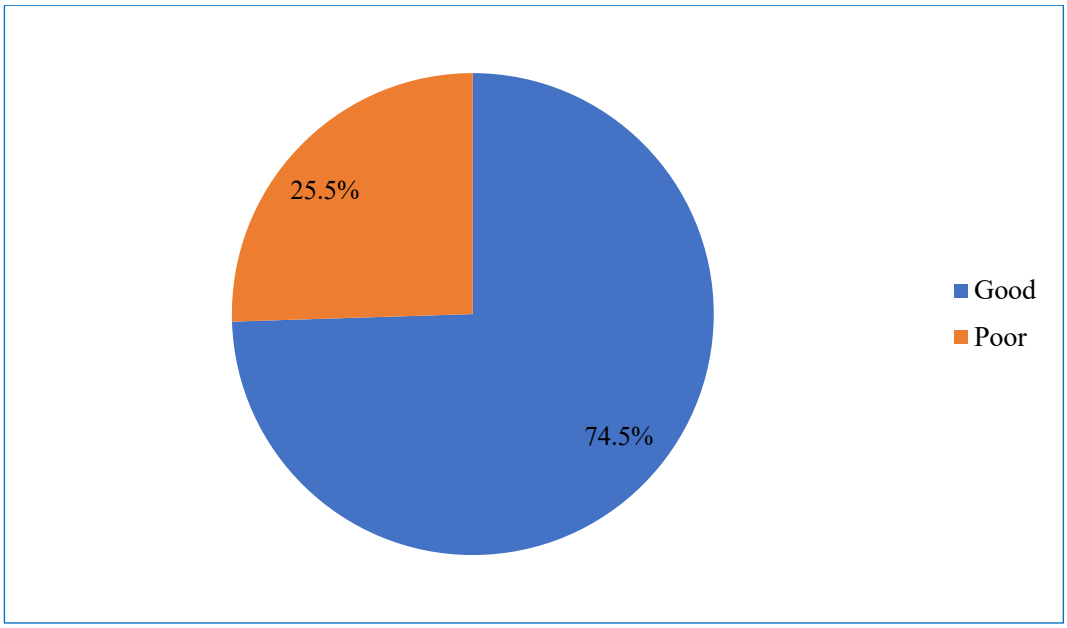

Figure 1. Proportion of EWS Implementation (n=302).

Figure 1 shows the quality of EWS implementation by nurses in inpatient units. Most respondents reported good implementation (74.5%).

Table 4 displays the bivariate analysis results to determine the relationship between independent variables and EWS implementation. The variables age (p=0.040), education (p=0.034), level of knowledge (p=0.013), attitudes (p<0.001), perceptions (p=0.003), workload (p=0.001), and leadership support (p<0.001) were associated with the implementation of the EWS.

Multivariate analysis (binary logistic regression) aimed to determine the factors most associated with implementing EWS in inpatients. The independent variables included in the multivariate analysis were p<0.25 that resulted from the bivariate analysis (age, education, length of work, knowledge, attitude, perception, workload, and leader's support). In the multivariate analysis, three variables were significantly associated (p<0.05) with implementation of EWS in inpatients: knowledge, attitude, and leader's support.

A good level of knowledge, positive attitudes, and support from upper management were associated with the implementation of EWS. Good or sufficient knowledge was 2.26 times more likely to increase EWS implementation compared to respondents with poor knowledge (AOR: 2.26; CI: 1.25–4.08; p=0.007). A positive attitude was 4.32 times more likely to increase EWS implementation compared to a negative attitude (AOR: 4.32; CI: 2.39–7.80; p<0.001). High leadership support was 4.12 times more likely to increase EWS implementation than low leadership support (AOR: 4.12; CI: 2.28–7.43; p<0.001). The complete results of the multivariate analysis can be seen in Table 5.

Table 4. Relationship of general characteristics of respondents, level of knowledge, attitudes, perceptions, motivation, workload, leadership support with EWS implementation (n=302).

Variable	Implementation of EWS				p-value
	Good		Poor		
	n	%	n	%	
Age (years)					
≤30	78	82.1	17	17.9	0.040*
>30	147	71.0	60	29.0	
Gender					
Male	46	76.7	14	23.3	0.668
Female	179	74.0	63	26.0	
Education					
Bachelor's degree in nursing (Ners)	95	81.2	22	18.8	0.034*
Diploma 3 of Nursing	130	70.3	55	29.7	
Length of work (years)					
≤10	110	79.1	29	20.9	0.088
>10	115	70.6	48	29.4	
Knowledge					
Good/moderate	136	80.0	34	20.0	0.013*
Poor	89	67.4	43	32.6	
Attitude					
Positive	157	86.3	25	13.7	<0.001*
Negative	68	56.7	52	43.3	
Perception					
High	132	81.5	30	18.5	0.003*
Low	93	66.4	47	33.6	
Motivation					
High	118	72.0	46	28.0	0.267
Low	107	77.5	31	22.5	
Workload					
Low	118	83.7	23	16.3	0.001*
High	107	66.5	54	33.5	
Leader's support					
High	156	86.2	25	13.8	<0.001*
Low	69	57.08	52	43.0	

* Significance: $\alpha<0.05$

Table 5. Multivariate analysis of factors influencing implementation of EWS (n=302).

	Implementation of EWS						
	Good		Poor				
Variable	n	%	n	%	AOR	95% CI	p-value
Knowledge							
Good/moderate	136	80.0	34	20.0	2.26	1.25–4.08	0.007
Low*	89	67.4	43	32.6			
Attitude							
Positive	157	86.3	25	13.7	4.32	2.39–7.80	<0.001
Negative*	68	56.7	52	43.3			
Leader's support							
High	156	86.2	25	13.8	4.12	2.28–7.43	<0.001
Low*	69	57.08	52	43.0			

*Reference group; AOR=adjusted odds ratio; CI=confidence interval

DISCUSSION

The findings of this study show that 74.5% of EWS implementation in inpatients is in the good category. Qualitative findings showed poor implementation of EWS. A lack of measuring EWS parameters and inputting measurement results into the system on a computer has been carried out, but there is a lack of assessment of EWS scores. The findings of this study were also strengthened based on the results of observations of documentation of EWS measurements; it was found that all nurses in the inpatient room did not follow EWS score instructions such as observing every 4 hours, in terms of documentation there was no written documentation reporting every 4 hours. Poor implementation of EWS causes delays in detecting critical patient conditions and in providing patient care. Furthermore, it can seriously affect patient health conditions and even cause death. This was due to several obstacles, including nurses' heavy responsibilities and workloads, the large number of patients, and the need to focus on severely ill patients and those whose conditions were deteriorating. The workload of nurses greatly influences their adherence to EWS protocols.[13]

These findings are not optimal and are still below the standard target of the Team Code Blue indicators that have been determined, namely 100% implementation and completeness of EWS documentation.[16] The results of this research are in line with studies at Hasan Sadikin Hospital, Indonesia which show that the implementation of inpatient EWS has not been running according to standards, the proportion of EWS implementation was slightly lower than the findings of this study. Around 72% had complete EWS records, however only 21% were given follow-up according to EWS procedures.[17] Research at a private hospital in Jakarta, Indonesia showed that of the 109 respondents, the majority of nurses complied with EWS monitoring according to the SOP (53.2%), however based on direct observation results it was found that the majority of nurses carried out EWS monitoring not according to the SOP (51.2%).[18]

EWS is a good predictor for identifying patients at greater risk of death in the short term (24-48 hour time).[19] Poor implementation of EWS results in delays in appropriate management and late detection of worsening patient conditions leading to

life-threatening conditions, prolonged hospitalization, and significant disability.[20] Decreased implementation of EWS has an impact on cardiac arrest, unplanned admission of patients to the ICU and unexpected deaths.[7] Therefore, implementing EWS is very important for early decision-making and doing basic things for patients, including early detection, providing faster treatment, and reducing mortality rates.[21]

The implementation of EWS is still a concern because it cannot be implemented optimally.[22] Implementing EWS is part of the duties and roles of nurses that are often carried out daily related to observing patient vital signs.[12] The role of nurses in implementing EWS must be carried out consistently and not only document it but also need to analyze and carry out immediate maintenance actions according to the results of the examination.[23] Compliance with the frequency of EWS monitoring is considered an important part of nursing practice, however the implementation of monitoring is less compliant and is often sidelined.[13] The cause of failure in implementing EWS is nurses' non-compliance with protocols in documenting patient vital signs and other EWS parameters which experience changes in conditions caused by busyness and many other tasks (workload), too many patients and negative attitudes from staff.[24]

The findings of this research revealed the obstacles felt by participants related to the implementation of EWS for inpatients, which had not been implemented optimally, such as many nursing tasks, high workload, and patient dependence on nurses. This is in accordance with the condition of hospitals in Indonesia. The ratio between the number of nurses and patients is not yet in accordance with standards. Many tasks outside of nursing duties cause nurses to be unable to take up the proportion of their main task of caring for patients.[25]

The current study found that the majority of nurses' workload in inpatient rooms was in the heavy category (53.3%). Statistically, workload influences the implementation of EWS in inpatients, where a higher proportion of good EWS implementation was found in respondents with a light workload (83.7%), compared to respondents who had a heavy workload (66.5%). Implementation of EWS has not yet become a habit for nurses in hospitals, so EWS assessments will be felt as an additional workload, causing low levels of compliance and high levels of failure.[17]

These results are similar to previous research showing that factors influencing EWS implementation include individual and organizational factors. Individual factors (knowledge and experience) and organizational factors (organizational authority and situation) are the dominant factors that influence EWS implementation.[23] There is a significant relationship between workload and nurse compliance in EWS documentation in the inpatient room at Panti Rahayu Hospital Gunungkidul, the lighter the nurse's workload, the more complete compliance in filling in EWS documentation.[26] Nurse compliance in implementing EWS in hospitals varies greatly, and patient conditions influence compliance. Patients with complications tend to be followed by increased compliance of nurses implementing EWS in hospitals.[27]

The success of EWS implementation is largely determined by nurses' compliance in carrying out assessments and implementing the scores resulting from these assessments.[28] Nurses who work in inpatient units must have sufficient knowledge and training in identifying and assessing the condition of patients who experience changes to worsening physiological parameters.[29] The findings of this research show that the variables of age, education, level of knowledge, attitudes, perceptions, workload and leadership support influence

better implementation of EWS, while the variables of gender, length of service and motivation do not influence the implementation of EWS in inpatients. A good level of knowledge, positive attitude and high leadership support influence better EWS implementation.

Knowledge is a domain of behavior that is very important for the formation of a person's actions.[30] The level of knowledge of nurses is one of the factors that influences nurses' skills in implementing EWS. A good level of knowledge will make it easier for a nurse to implement their knowledge in handling emergency cases in the treatment room.[28,31] These findings are in line with other studies that show nurses' knowledge of EWS has a very significant relationship with compliance with EWS protocols.[32,31] Adequate knowledge of nurses about EWS assessment, including understanding EWS parameters and scores, is essential. Properly understanding EWS is vital for appropriate follow-up and can improve nurses' skills in implementing EWS in hospital patient care rooms. Statistically there is a significant relationship between nurses' attitudes and compliance with the implementation of EWS monitoring. Nurses who have a positive attitude are 7.028 times more likely to comply with the SOP for implementing EWS monitoring compared to nurses who have a negative attitude.[18] The nurse leader in directing the implementation of the nurse significantly influences the implementation of EWS in the hospital ward. There is a significant relationship between policy and supervision and nurses' compliance with the implementation of the EWS in inpatients.[33-34] Therefore, EWS is the most important part and is very much needed by nurses in managing hospital patient services.[35]

STRENGTHS AND LIMITATIONS OF THE STUDY

This study has strengths and several limitations. The strength of this research is the research design used, namely combining two types of research (a mixed methods study). Two times FGD for a qualitative study can explore the EWS implementation, while univariate, bivariate, and multivariate analyses result in more detailed analyses of EWS implementation and its associated factors. The main limitation is that the research location only took one hospital (public hospital). Therefore, the results could not be generalized to other hospitals.

CONCLUSION

The implementation of EWS for inpatient units has not been optimal and has not achieved the predetermined targets. Overall, nurses have good knowledge about EWS, positive attitude, high perception, high motivation, heavy workload and high leadership support regarding the implementation of EWS. Perceived barriers related to the implementation of EWS in inpatients include many nursing tasks, high workload, poor patient conditions and patient dependence on nurses. A good level of knowledge, positive attitude and high leadership support influence better EWS implementation. Therefore, researchers recommend improving knowledge, attitude, and leadership support through training, seminars, and a special team tasked with supervision to improve EWS implementation and minimize EWS implementation barriers. In addition, we recommend expanding the future research location to involve more than one hospital and conducting research with an experimental research design to improve EWS implementation.

AUTHOR CONTRIBUTIONS

INWP conceptualized the research topic and problem, as well as the methods, data collection, and data analysis. IKS conceptualized the research topic, methods, data collection, and analysis. NMDW and YNPY were involved in developing methods, creating instruments, and collecting data. All authors were involved in the writing and final approval of this manuscript.

ETHICAL CONSIDERATION

The ethics of this study were in compliance with the Declaration of Helsinki. The approval and ethical clearance of this research were obtained from the Research Ethics Committee at Udayana University, number 2456/UN 14.2.2.VII.14/LT/2022, dated September 8, 2022, and the Research Ethics Committee at Institute of Technology and Health Bali (ITEKES BALI), with assigned Institutional Review Board (IRB) approval number 04.0513/KEPITEKES-BALI/IX/ 2022, dated September 14, 2022.

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CONFLICT OF INTEREST

The authors declare that there is no conflict of interest in this study.

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