ORIGINAL ARTICLE

NURSES' PERCEPTION ON THE INITIAL IMPLEMENTATION OF AN EARLY WARNING SYSTEM: A MIXED-METHOD STUDY

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ABSTRACT

The early warning system (EWS) has been decided as a new standard for Indonesian hospitals. The main objective of EWS implementation is to help nurses quickly recognize and react to deteriorating patients. This study explores how EWS contributes to nurses' clinical decisions around patient deterioration. The research design for this study was mixed-method sequential explanatory. A purposive sampling approach was used to recruit the participants. Closed and open-ended questionnaires were distributed (n = 53) to adult unit nurses and the data was analyzed by using descriptive statistics. Focus group discussions were conducted to evaluate the implementation process and the results obtained were analyzed by using thematic analysis. Both data were integrated by using a joint display table. We found that 79% of nurses indicated that they needed education about how to use the EWS and 92% of nurses required education on physiology and management of the deteriorating patient. Three themes emerged: (1) the nurses' experience of EWS Implementation, (2) the impact of EWS implementation, and (3) ameliorating the EWS Implementation. The participants showed that the EWS has been used for the assessment, documentation, and communication process of deteriorating patient management. The EWS is a complex tool for nurses, and they need support from stakeholders to maintain and optimize the advantages.

Keywords: *Deterioration; early warning system; emergency; general nurses; perception*

INTRODUCTION

The early warning system (EWS) is widely recognized as part of the early detection methods for patient deterioration (Downey, Tahir, Randell, Brown, & Jayne, 2017). The EWS is a system that allows nurses to measure respiratory rate, systolic blood pressure, pulse, temperature, and level of consciousness, and each cumulative elevation score triggers an action (Odell, 2015). A previous study has stated how vital sign monitoring is more effective for the early recognition of patient deterioration (Churpek, Adhikari, & Edelson, 2016). Early recognition, response, and treatment of deteriorating patients are essential elements for improving patient outcomes and reducing unanticipated inpatient hospital deaths (Lambe, Currey, & Considine, 2016).

The Early Warning System is a tool used by health care teams to recognize the deteriorating patient early on to initiate responses and interventions, such as nursing care, informing physicians, and activating the rapid response team. However, the implementation of EWS becomes challenging due to a lack of resources or different health care systems of hospitals (Teasdale, 2012). Therefore, the EWS has been modified in many hospitals. The modified early warning system that has been run in a teaching hospital in Yogyakarta has adopted the New Zealand Early Warning Score parameters. The local-development of an EWS has caused the development of a wide range of scoring systems (McGaughey, O'Halloran, Porter, & Blackwood, 2017). Several studies have evaluated EWS to enhance the accuracy and efficiency of EWS

implementation in each setting (Drower, McKeany, Jogia, & Jull, 2013; Olsen, Mooney, & Evans, 2016; Salt, 2013).

The success of EWS implementation depends on the facilitation and support from the organization, staff empowerment, and cultural factors (McGaughey et al., 2017). Nevertheless, it is difficult to determine the positive impact of EWS implementation without calculating the score completely. However, some studies have shown that the implementation of EWS increases the nurse's workload (Hope et al., 2018; Neary, Regan, Joyce, McAnena, & Callanan, 2015; Salt, 2013). Therefore, this study will assess the effect of the implementation of EWS on nurses in a training hospital.

METHOD
Study Design
A sequential mixed method design was used in this research. The sequential mixed method model allowed the researcher to merge the results from the second phase with the first phase (Teddlie & Tashakkori, 2003).

Participants
The selection of participants for the quantitative and qualitative phase followed a criterion that included all nursing staff who were working in the adult unit with more than 6 months of clinical experience, experience in clinical practice before and after the Early Warning System (EWS) implementation, having used EWS for at least one month since the system was implemented and demonstrated a willingness to participate in the research study by signing a consent form. The exclusion criteria included all non-adult unit nurses and adult unit nurses who were not rostered during EWS implementation, such as nurses on annual leave, monthly leave, maternity leave, and retired during EWS implementation.

Data Collection
This study was conducted in a teaching hospital in Indonesia which has a 72-bed inpatient capacity in five adult units. All adult unit nurses (73 Nurses) were invited to participate in this study. A purposive sampling approach was used to recruit the participants. The first phase of the study was conducted through an exploratory descriptive approach by using a survey design that had been used in a previous study (Greenwood, Genford, Goward, & Doherty, 2015). A qualitative approach was used for this second phase by conducting a Focus Group Discussion (FGD). The researcher held two FGDs that consisted of one group for senior nurses and another group for junior nurses. This approach was used to prevent the senior nurses from subduing the junior nurses during the discussion process.

Instrument
A 24-item survey was used to evaluate the nurses' understanding of EWS aspects, the need for EWS education, nurses' behavior toward EWS, nurses' perception toward their colleagues in EWS implementation, enablers and barrier factors of EWS, and the negatives of EWS implementation. The survey was translated into Bahasa Indonesia and validated using face validity by three nurses who have a minimum of two years of clinical experience. Next, the researcher sent the link to the electronic survey to participants who were willing to participate. Dichotomous, Likert-scale, and open-ended responses were collected. The second phase was a confirmation of the data obtained in the first phase.

The survey was anonymous and voluntary. The researchers maintained the confidentiality of the participants by not mentioning their real names, gender, age, and workplace in the result of this study. The FGD session was held in a confidential setting and recorded after the consent form was signed. Data was kept in a secure drive in a cloud drive and was only accessible by the researcher and supervisors.

Data Analysis
Quantitative data was analyzed by extracting the electronic survey results into a Microsoft database Excel file and the responses were counted. Descriptive statistics were used to analyze the frequency of response rates. The qualitative data was analyzed by using thematic analysis. The researcher then mixed the quantitative and qualitative study results by integrating the data during the analysis data by using the joint display technique (Creswell, 2014).

Ethical Consideration
Ethics approval for this study was received from the University of Tasmania (UTAS) H0017853 and Universitas Gadjah Mada (UGM) KE/FK/1243/EC/2018.

RESULTS
The electronic survey was completely filled by 53 nurses (75% of 73 rostered nurses); see respondent characteristics in Table 1.

Table 1. Characteristic participants in the quantitative phase (n = 53)

Variable	Frequency	Percentages (%)
Gender		
Female	44	83
Male	9	17
Education		
Diploma	21	40
Bachelor	32	60
Years of experience		
0 – 2 years	17	32
2 – 4 years	12	23
> 4 years	24	45

In Table 2, over half of the nurses were found to have a "good" understanding of EWS. However, there is still one respondent (2%) that stated that her understanding of EWS was poor.

Table 2. The understanding aspect of the EWS chart

Aspect	Very poor n (%)	Poor n (%)	Common n (%)	Good n (%)	Very good n (%)
Documenting observations on the EWS chart	0 (0%)	1 (2%)	6 (11%)	35 (66%)	11 (21%)
Calculating an early warning score on the EWS chart	0 (0%)	1 (2%)	5 (9%)	37 (70%)	10 (19%)
Following the actions outlined on the EWS chart	0 (0%)	1 (2%)	15 (28%)	30 (57%)	7 (13%)

The need for EWS education is shown in Table 3. Most nurses still need education about EWS. As many as 42 (79%) respondents stated that they need training in using the EWS chart and escalation procedure. Over half, 49 (92%) of the

respondents also stated that they need education on the physiology of clinical deterioration and the management of the deteriorating patient.

Table 3. The need for EWS education

Question	Yes n (%)
Do you feel that you need more training about the use of the EWS chart and escalation of care procedures?	42 (79%)
Do you feel that you need more education about the physiology of clinical deterioration?	49 (92%)
Do you feel that you need more education about the treatment/management of patients who deteriorate?	49 (92%)

Nurses' behaviors towards EWS are shown in Table 4. Half (49%) of the nurses increased the rate of observation and escalated the care (51%) frequently according to the EWS escalation. Half (51%) of the nurses also indicated to "always" use the EWS during clinical handover to nurses. However, only six nurses (11%) "always" use the EWS during clinical handover to the doctor and 13% of the nurses indicated that they never use the EWS during clinical handover to another health professional. Moreover, only 11 nurses (21%) stated that they never obtained an appropriate response from the specified health professional when a score of ≥ 6 was triggered.

Table 4. Nurses' behavior towards EWS

Questions	Always n (%)	Usually n (%)	Sometimes n (%)	Never n (%)
When I document the vital signs of a patient, I calculate the EWS score	36 (68%)	15 (28%)	2 (4%)	0 (0%)
I use the EWS score during clinical handover to nurses	51% (27)	34% (18)	15% (8)	0 (0%)
I use the EWS score during clinical handover to doctors	6 (11%)	7 (13%)	33 (62%)	7 (13%)
I use the EWS score during clinical handover to allied health professionals	8 (15%)	14 (26%)	24 (45%)	7 (13%)
When a score of ≥1 is triggered, I increase the rate of observations according to the EWS escalation of care flowchart	15 (28%)	26 (49%)	10 (19%)	2 (4%)
When a score of ≥6 is triggered, I called the general doctor and ask him to report the patient's condition to the responsible doctor (specialist).	16 (30%)	30 (57%)	7 (13%)	0 (0%)
When a score of ≥6 is triggered, and I do not get an appropriate response from the specified	4 (7%)	8 (15%)	30 (57%)	11 (21%)
I escalate the care according to the EWS escalation of care flow chart	18 (34%)	27 (51%)	8 (15%)	0 (0%)

The respondents were also asked to select the enabling factors of EWS implementation (Table 6). Over half (62%) of the respondents voted that the EWS chart is easy to use and that they are now familiar with it. The respondents' expectation to obtain clear medical reviews and to notify senior colleagues in the event of clinical deterioration was also common at 47% for both factors. Less than half (47%) of the respondents cited that there is a clear flowchart to follow if the right response is not/cannot be acted upon by a colleague. As many as 14 (26%) responses also mentioned that the EWS chart is efficient to use. However, only 15 (28%) respondents stated that they obtained support and value from their line managers during the EWS implementation.

Table 5. Enabling factors of EWS

Question	Yes n (%)
The EWS chart is easy to use, now that I am familiar with it	33 (62%)
Expectations for medical review in the event of clinical deterioration are clear	25 (47%)
Expectations of doctors and nurses to notify senior colleagues in the event of clinical deterioration are clear	25 (47%)
There is a clear flowchart to follow if the right response is not/cannot be acted upon by a colleague	25 (47%)
My line managers value and support the EWS	15 (28%)

Two Focus Group Discussions were held during the qualitative phase. All the participants in this phase were female (100%) and more than half (67%) of the participants in this phase have a bachelor's degree.

Table 6. Participants' characteristics in the qualitative phase (n = 9)

No	Group	Gender	Education	Years of experience
1	1	Female	Diploma	> 4 years
2	1	Female	Bachelor	> 4 years
3	1	Female	Bachelor	> 4 years
4	1	Female	Bachelor	> 4 years
5	2	Female	Diploma	0-2 years
6	2	Female	Diploma	0-2 years
7	2	Female	Bachelor	0-2 years
8	2	Female	Bachelor	0-2 years
9	2	Female	Bachelor	0-2 years

During the qualitative data analysis of the 2 FGDs, the researchers found three themes. The main finding of the qualitative analysis is shown in Figure 1.
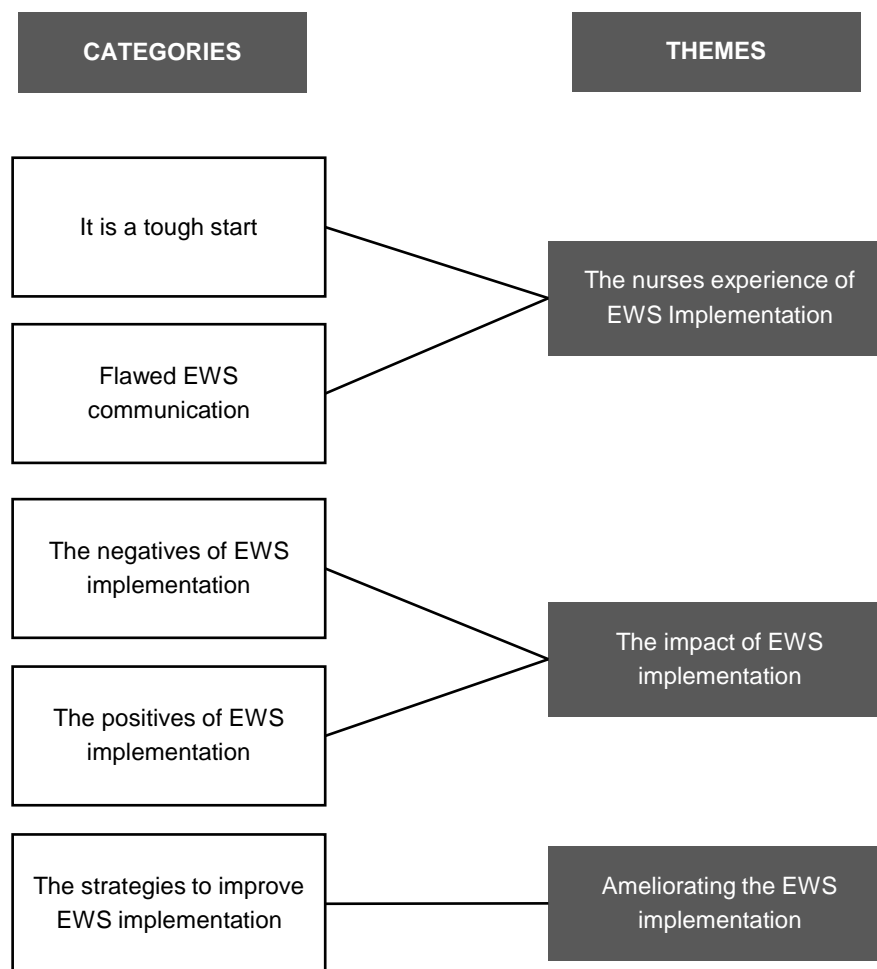
Figure 1. Themes and categories obtained in FGDs of nurses' perception during EWS implementation

1. Theme 1: The nurses' experience with EWS implementation

The researchers found that the nurses have different perspectives and varying responses to when the EWS was implemented. During the FGD, the nurses had quite different opinions about EWS. Most of the nurses expressed that the EWS implementation is difficult for them.

a. Category 1: It was tough to start implementing the EWS

According to the respondents, the implementation process was challenging. In both FGDs, the participants expressed that the EWS implementation is complicated, and they were confused about how to apply the EWS. The nurses said that the burden of EWS implementation was only handled by them and that other health professionals were less aware of the EWS implementation. This is despite the fact that the implementation process is affected by varying factors such as nurse ward manager, nurse's experience, and supporting system. Therefore, some nurses in other wards could adapt and support the implementation and use of EWS.

b. Category 2: Flawed EWS communication

Most of the participants reported that the nurses did the documentation process carelessly. The nurses understood when to commence the re-measuring of vital signs in response to changes in the condition of the patient, but they did not do that. The main point of nursing documentation is to inform other health care professionals during the handover process of the patient's condition and progress. However, the nurses' responses varied regarding communication and handover of the EWS.

2. Theme 2: The impact of EWS implementation

The implementation of EWS is new for nurses in this hospital. This implementation has positive and negative impacts on nurses in this study's location.

a. Category 3: The negatives of EWS implementation

Most of the nurses reported the negative impact of implementing EWS was that they received complaints from patients as they would measure the vital signs during the patient's resting time. The participants in both groups felt that the doctors are less aware of the EWS. The nurses experienced difficulties when they reported the EWS to the doctors. One nurse during an FGD session stated that the EWS chart is less informative. Some participants pointed out that the key issue in implementing EWS is the limited availability of resources. The implementation process could imply that improvement is needed in the provision of various resources in the ward such as human resources and equipment.

b. Category 4: The positives of EWS implementation

The participants reported that EWS generally helps to assess the patients' conditions. The EWS assists their clinical judgment, identifies the deteriorating patient, gives them an early warning of physiological changes, and makes them warier of the patients' condition. The EWS also helped nurses to observe the patient's condition and alerted them when the re-observation should be conducted. Moreover, during FGDs, the nurses expressed that they could contact senior colleagues and transfer the deteriorating patient into the critical care unit.

3. Theme 3: Ameliorating the EWS implementation
The participants were asked whether they have any suggestions to improve the use of the EWS. The participants stated they still need further education to support the EWS implementation. Most nurses suggested making the EWS clearer and easier to use, especially the EWS form. The nurses felt that the EWS form is too complicated. Furthermore, to maintain the implementation of EWS, one group that consisted of senior nurses stated that the EWS needs to be evaluated to learn what the manager can do to improve the implementation.

Integrated Results
In terms of results integration, the researchers integrated both the quantitative and qualitative results obtained by using the joint display technique (Creswell & Plano Clark, 2017). The joint display below shows that the qualitative results support the survey that had been distributed before the focus groups.

Table 7. Quantitative and qualitative integration results

Survey Result	Focus Group Discussion
79% of respondents indicated they need more education on EWS and 92% stated they needed more information on the physiological management of deteriorating patients.	Theme: Ameliorating the EWS implementation "Need a refresh (re-education), … especially regarding materials that we need to be aware of when the patient's vital signs are worsening." (1st FGD)
77% of respondents agreed that EWS supports their clinical judgment. 68% of respondents indicated early intervention is delivered to patients who are deteriorating.	Theme: The impact of EWS implementation Category: The EWS outcome "When the EWS score reaches 7, we would contact the specialist about the patient's condition and ask about whether the patient could be transferred to the critical care unit." (2nd FGD)
68% of respondents answered that the EWS replaced their clinical judgment. 58% of respondents indicated not always communicating the score to the specified health professional.	Theme: The impact of EWS implementation Category: The EWS shortcomings "Sometimes we don't work based on the EWS score itself but follow the patient's clinical condition instead." (1st FGD)
51% of respondents indicated that they "always" use the EWS score during the handover to nurses. 11% of respondents indicated that they "always" use the EWS during the handover to doctors. 68% of respondents indicated that nurses "always" calculate the score.	Theme: The nurses' experience with EWS implementation Category: Flawed EWS communication "sometimes the nurses fill the charts carelessly." (1st FGD) "sometimes the nurses forget to fill the chart." (2nd FGD)
62% of the respondents agreed that the chart is too complicated. 77% of respondents showed that their line manager did not support the EWS.	Theme: The nurses' experience with EWS implementation Category: It's a tough start "It looks complicated." (1st FGD) "The chart is too complicated" (2nd FGD)

DISCUSSION
The EWS has been implemented at this teaching hospital since November 2018 and this research is the first report that considers nurses' perspectives. The results from this study found varying responses from adult ward nurses regarding EWS implementation. More than half (62%) of the respondents indicated that the EWS chart is too complicated. During the FGDs, both groups discussed the complicated chart and most of them advised for the chart to be revised. One of the FGD participants also said that it was difficult for them to implement the EWS for the first time and that they needed some time to get used to it. However, from the survey's results, after the EWS had been implemented for three months, the majority of respondents (62%) agreed that the EWS is easy to use because they were used to it. This result is similar to a published study in which 58% of respondents found the EWS was easy to use (Salt, 2013).

Only half of the respondents indicated that they use the EWS in the handover process to the nurse in the next shift, and few respondents use the EWS during the handover to doctors. The participants in the FGDs stated that the doctors did not need the EWS report. Moreover, the reported conflict between nurses and other healthcare professionals makes the EWS less effective to help nurses communicate with other professionals. This finding is contrary to previous studies in which the EWS was found to empower communication between nurses and doctors to seek assistance from senior medical staff and avoid conflict (Neary et al., 2015; Shearer et al., 2012; Stafseth, Gronbeck, Lien, Randen, & Lerdal, 2016). One of the FGD participants said that the doctors were not informed that the EWS had been implemented, and they were not familiar with the scores. Therefore, to harmonize nurses' and doctors' support of EWS, it is necessary to implement and provide education on the EWS for all health professionals in the hospital, not only for the nurses.

The EWS is proposed to help nurses' ability to assess and manage deteriorating patients. Most of the participants in this study felt that the EWS had helped them in clinical practice, especially when managing deteriorating patients. The majority of the respondents (68%) agreed that the EWS helped them to deliver interventions earlier to the deteriorating patient. Additionally, the majority of respondents (77%) supported the EWS and backed up their clinical judgment. Previous studies support this finding as they stated that the EWS has been found as a predictor and could help nurses to manage deteriorating patients (Kovacs et al., 2016; Le Lagadec & Dwyer, 2017).

The participants in this study reported that sometimes nurses filled the chart carelessly and forget to sum the score. Moreover, the majority of respondents (77%) felt that they did not obtain any value or support from their line manager in implementing EWS. From the second FGD, a respondent stated that they did not obtain support from their senior nurse.

These findings suggest that the implementation of EWS requires regular evaluation and monitoring from line managers to maintain the adherence to and the effectiveness of the EWS (Petersen, 2018).

Furthermore, the participants in this study proposed several recommendations to improve the current EWS for the end-user. From the survey's results, a significant number of nurses (92%) needed education on the physiological management of deteriorating patients. This data was also supported by the qualitative result in which both groups stated that they need re-education about the EWS. These findings are similar to Rattray et al. (2011) who stated that education is a vital component of maintaining and enhancing the effectiveness of the use of the EWS. Furthermore, during this study, the researchers also found recommendations from the participants that the EWS chart should be revised to make it easier and clearer.

This study found limitations during EWS implementation at this hospital. Most of the participants stated that the lack of resources was a vital issue for the effective implementation of the EWS. Some nurses indicated that the scores could be inaccurate, especially for a patient who is not in a critical condition. Moreover, while the nurse had to monitor the patient during the night, they received complaints because the monitoring disturbs the patient's sleeping time. Those limitations are similar to a previous study (Petersen, 2018). Therefore, nurses tend to rely more on their clinical judgment rather than the score itself. A previous study explained that relying on the EWS is not enough and nurses have to improve their clinical judgment in managing patient deterioration (Kyriacos, Jelsma, & Jordan, 2011).

This study presents evidence of the contribution of the EWS implementation to adult unit nurses regarding patient deterioration. This study explored the impact of the EWS implementation, nurses' perception of the EWS implementation, and ideas to improve the efficiency of the EWS. This study involved all adult unit nurses to collect their perspectives on EWS implementation and to obtain a greater breadth and depth of the current EWS implementation, FGDs were also conducted. Nevertheless, there are limitations to this study. The study was conducted in a single location. Secondly, the survey that has been used in the quantitative phase of this study has not been tested for construct validity and reliability. Thirdly, the researcher did not perform triangulation in this study. Moreover, the researcher, who is a senior nurse in this hospital, was present as a moderator in FGDs and this may have altered the participants' natural responses. Additionally, the influence of the personal experience of the researcher and his interest in the subject area may have a bearing on the interpretations made during the analysis.

CONCLUSION AND RECOMMENDATION

The participants in this study explained that the EWS is a useful system that helps adult unit nurses to assess, communicate, and manage deteriorating patients. They stated that during the first year of EWS implementation, they require more support from hospital management to recognize that the EWS has the benefit of improving patient safety. From the nurses' perspective, during the EWS implementation, there are still barriers and imperfections regarding its effectiveness. Therefore, improvements in terms of the chart and protocol need to be made to improve its usefulness.

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