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### EVALUATING EFFECTIVENESS OF MEOWS TOOL IN IDENTIFYING MATERNAL DETERIORATION IN WOMEN RECEIVING CARE AMONG NURSES IN MATERNITY UNIT, AT GENERAL HOSPITAL, DAMMAM

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### ABSTRACT

Pregnant women are at risk of obstetric emergencies at all stages of life, including before, during, and after delivery. The lack of tools to help signal healthcare providers to initiate treatment can impact caregivers who cannot rely entirely on clinical judgment. Therefore, to avoid poor maternal outcomes due to delays or errors in maternal management, it is important that all midwifery staff understand the 'early warning signs' and are able to assess the clinical status of the mother using the MEOWS tool. This quantitative design study of the action research type using a cross-sectional method was conducted from October 2017 to July 2020 at the Maternity Unit, NGHA Dammam. The main objective of this study is to evaluate the effectiveness of implementing maternal early warning signs to identify maternal deterioration and reduce maternal transfer to the Intensive Care Unit (ICU). The data collected is related to the number of mothers transferred to the ICU in the absence of educational training related to the MEOWS tool in the health care system from October 2017 until October 2018. Data related to the number of mothers transferred to the ICU due to deterioration was collected and compared with the data on the number of mothers admitted to the ICU after the MEOWS tool was fully implemented in June 2019 until July 2020. A total of thirtythree (N = 33) nurses participated in this survey and passed tests related to maternal warning signs. There are more than three quarters of them showing good knowledge about early warning signs of mothers with a mean score of 1.98 (SD = 0.402), reaching a mean score of 1.99 (SD = 0.179), which reflects a good attitude towards the practice (mean score = 2.00; SD =0.000). However, the results showed that none of the tested variables, including age, highest qualification, marital status, and years of work experience, had a significant relationship with their level of knowledge in identifying maternal impairment using MEOWS. The statistics of the mother's transfer to the ICU were also found to decrease compared to before the implementation of MEOWS in the system. This study suggests that MEOWS should be practiced among nurses in the maternity unit, improving the midwifery syllabus and continuing nurses' competence related to MEOWS practice.

### Keywords: MEOWS tool, maternal deterioration, maternity unit

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### Introduction

The term early warning score (EWS) refers to a system that allows health services to quickly assess a patient's level of illness. This is based on vital signs such as body temperature, blood pressure, pulse/heart rate, oxygen saturation, and respiratory rate (Samani & Rattani, 2023). The score was created in the late 1990s. Studies at the time showed that in-hospital cardiac arrest and deterioration were often followed by a period of increasing abnormalities in vital signs (Alias & Mohamed Ludin, 2021). Moreover, failure to recognize early detection signs and respond to the patient's condition in a timely manner can lead to the death of the patient. This impact not only affected patient morbidity and mortality but also led to differences in survival failure rates between hospitals (Suphatrakul, Donlao, & Mahawan, 2020). The lack of tools to help signal healthcare providers to initiate treatment can impact caregivers who cannot fully rely on clinical judgment (Hwang & Kim, 2021).

According to National Health Services (2020), a variety of vital signs monitoring tools have been introduced across the United Kingdom, incorporating early warning scoring (EWS) systems designed to track signs of deterioration and trigger a rapid response to improve patients' safety. However, there are different types of EWS, including modified Early Warning Signs (MEWS), Pediatric Early Warning Signs (PEWS), and Modified Early Obstetric Warning Signs (MEOWS) (Samani & Rattani, 2023). This shows that patient safety cannot be guaranteed if nurses and other medical staff cannot provide the right treatment at the right time.

Early warning signs (EWS) for non-obstetric populations cannot be directly applied to obstetric populations due to the natural physiological changes associated with pregnancy (Paternina-Caicedo et al., 2017). Thus, MEOWS was developed taking into account the typical physiological changes during pregnancy. MEOWS aims to improve early intervention by facilitating the identification of pregnant women at risk of clinical worsening (Nair, Dockrell & Colgain, 2018). In theory, triggering the MEOWS system could enable early detection of diseases such as cardiovascular disease, sepsis, thromboembolic disease, hemorrhage, and pre-eclampsia that can increase maternal morbidity and mortality (Norfolk University and Norwich University Hospital MEOWS Guidelines, 2022). It is well known that pregnant women are at risk of obstetric emergencies at all stages of life, including before, during, and postpartum (Xu et al., 2022). To prevent adverse maternal outcomes due to delays or errors in maternal management, it is important that all midwifery staff understand 'early warning signs' and be able to assess maternal clinical status using the MEOWS tool (Umar et al., 2019). But for it to be successful, it requires genuine engagement with vulnerable communities. To achieve this objective, the research hospital introduced the Modified Early Obstetric Warning Score (MEOWS) as one of its approaches to identifying abnormal physiological parameters in women receiving care in the maternity ward.



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Physiological Parameters (Calculated Breakdown)								
SCORE	3	2	1	0	1	2	3	
Temperature		<35	35-35.9	36-37.4	37.5-37.9	38.0-38.9	≥39	
Systolic Bp	<69	70-79	80-89	90-139	140-149	150-159	≥160	
Diastolic Bp			<49	50-89	90-99	100-109	≥110	
Pulse		<40	40-49	50-99	100-109	110-129	≥130	
Respiratory Rate	≤10			11-19	20-24	25-29	≥30	
Urine output mls/hr	<10	<30		Not measured				

Table 1. Physiological Parameters for MEOWS

'MEOWS' is now extensively used in obstetric practice, but the systems in use vary significantly (Khergade et al., 2020). The physiological parameters commonly included in MEOWS are pulse rate, respiratory rate, systolic pressure, diastolic pressure, temperature, and urine output ml/hr (Table 1). Other specific parameters such as blood loss characteristics, urine output, urine protein, and CTG baseline are included, either in the score or recorded on the computer system BESTCare chart. Table 1 is an example of various physiological parameters recorded as normal (grey color) need no response, yellow (mild) need primary nurse to inform team leader, orange (moderate) needs team leader/nurse manager/physician response, or red (high) risk which need primary nurse to active critical care response team and physician, depending on how abnormal the value is compared to normal pregnancy physiology.

Table 2 gives an example of an escalation protocol for appropriate interventions for triggering pregnant women based on the score obtained.



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MEOWS SCORE	FREQUENCY OF MONITORING	ALERT	Clinical Response OR
	and OBSERVATIONS	MEOWS Actions	MEOWS Actions as mentioned On BESTCare PEWS and MEWS
1-3	30-60 min then depend on the assessment		-Primary nurse to inform Team leader
			<ul> <li>Primary nurse must review the patient and if any immediate</li> </ul>
			clinical concern, escalate to resident On call.
			-If there is no clinical concern, repeat vital signs in 30-60 min
			depend on patient condition. -If the MEOWS score remains 1-3
			then escalate to resident On call To review the case within 30 min.
≥4 or score 3 in any parameter	30 minutes		-Primary nurse to inform Team leader
			<ul> <li>Review the patient and escalate to senior resident On call to review</li> </ul>
			within 30 min
			attend contact the
			assistant/associate consultant On call
			-commence 30 min observations
			-Commence fetal monitoring ( if more than 28 weeks) and fetal heart Doppler ( if 20-28 weeks)
26	15 minutes		-Primary nurse to inform Team
			- Review the patient and escalate to the assistant/associate
			consultant oncall and request
			-if the doctors unable to attend
			consultant oncall
			-Consider activation of CCRT and direct escalation to consultant if
			there is a clinical concern ,patient is
			patients deteriorates

Table 2. Escalation Protocol of Appropriate Interventions

Meanwhile, Dammam National Guard Hospital is one of the government hospitals in the Kingdom of Saudi Arabia that is committed to evidence-based, standardized, and safe nursing care practices for individuals, patients, and communities. Maternal and child health care services are one of the main focuses of nursing care offered at the study location. The data was recorded between October 2017 and October 2018, and it related to mothers who experienced deterioration with a score of 1-3 and a score > 5. A total of 128 mothers who received care in the Maternity Unit with a score of 1-3 and more >5 were escalated by nurses from 2017 until 2018. Records in the year 2017 found that a total of thirty-seven (n = 37) of the total maternal (N = 64) with a score of 1-3,



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twenty-seven (n = 27) with an escalated score > 5, and four (n = 4) from them were transferred to the ICU. The statistic also showed that a total of forty-one (n = 41) of the total maternal (N = 64) escalated with a score of 1-3, while a total of twenty-three (n = 23) escalated with a score > 5, and four (n = 4) of them were transferred to the ICU for further management (refer to Figure 1). These data indicate that there is a need for the development of specific and effective maternal early warning signs to identify deterioration among maternal receiving care at this study location to avoid the risk of complications due to delayed management.



Figure 1. Statistic of maternal admission and maternal escalation in 2017 to 2018

In relation to the issue, an educational program on maternal early warning signs was provided for six months to the nurses in the maternity unit, and the development of a 'Modified Early Obstetric Warning Score' (MEOWS) tool has been proposed so that it is included in the health care system (BESTCare) to be applied among nurses in the maternity unit at the location of this study. Therefore, the MEOWS tool was introduced in January 2019 in the BESTCare system and has gone through the development and validation phases of the tool as well as a trial phase for one year from June 2019 until October 2018 at the same study location. The DMAIC (Define, Measure, Analyze, Improve, and Control) problem-solving approach was used to improve throughout the process.



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Therefore, this action research was conducted to evaluate the effectiveness of the MEOWS tool in identifying maternal deterioration in women receiving care among nurses in the maternity unit at the study location. The findings of this study are to help management provide appropriate interventions to improve the quality of maternal nursing care, reduce the risk of complications in maternal circles, reduce maternal transfer to ICU statistics, and help improve nurses' knowledge and skills in critical thinking through the MEOWS application.

### Methodology

This quantitative design study of the action research type using the cross-sectional method was conducted from October 2017 until July 2020 at the Maternity Unit, NGHA Dammam. The data collected is related to the number of mothers transferred to the ICU in the absence of training and education-related MEWS tools in the health care system from October 2017 until October 2018. The data related to the number of mothers transferred to the ICU due to deterioration has been collected and compared with the data on the number of mothers admitted to the ICU after the MEOWS tool was fully implemented in June 2019 until July 2020 to measure the effectiveness of the MEOWS tool in identifying maternal deterioration in women receiving care among nurses. A total of thirty-three (N = 33) nurses on duty at the study location participated in this survey. The purposive sampling technique is used with inclusion criteria for nurses that include work in the maternity unit that utilizes the MEOWS tool, be able to speak English or Arabic, and have working experience of at least six months in the maternity unit.



Figure 2. The Survey Framework



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### **Study Instrument**

The questionnaires consist of two parts. Part A involves socio-demographic data on age, marital status, number of years in service, highest qualification, whether or not attending a post-basic or advanced course certificate, basic life support (BLS) training attendance, and early warning signs (EWS) training. Part B of the questionnaires contained queries regarding knowledge and skills related to maternal early warning signs. Knowledge assessments in the questionnaires comprise seven items constructed in a table form for the respondents to answer. The table has six (6) physiologic parameters, such as temperature, systolic blood pressure, diastolic blood pressure, pulse rate, respiratory rate, and urine output. The nurse needs to escalate the score range of readings on every parameter that shows a risk of deterioration. There were also eight items on self-perceived knowledge related to maternal early warning signs. Six items to assess the nurse's attitude and three items of skills to examine were self-perceived competence, in which they needed to rate themselves with 'YES' (score 2) and 'NO' (score 1). The questionnaire items were adopted and modified from Nair, Dockrell & Colgain (2018) and Donilon (2013) in Alias & Ludin (2021). The questionnaire for this study has also been proven valid and reliable (Cronbach alpha = 0.75; r > 0.40). The nurses' level of knowledge is divided into three levels, namely: Good: 68%–100% of right answers; adequate: 34%–67% of right answers; and poor: 0–33% of right answers.

### Data Analysis

Descriptive analyses were done for the socio-demographic characteristics of the nurses. Frequencies and percentages for each category were shown. A percentage score was used to grade the entire mark for knowledge, attitude, and practice level, and the results were sorted into an arbitrary grade (Table 3). The frequency and percentage of the respondents' responses were calculated using descriptive statistics to categorize them into good, adequate, and poor categories. In order to find a relationship between the independent and dependent variables, inferential analysis was used. The Pearson Correlation Coefficient was utilized to ascertain the relationships between socio-demographic information and the degree of MEWS knowledge held by nurses. The significant level findings were defined as a p-value of less than 0.05.

PERCENTAGE SCORE (%)	LEVEL
0-33	Poor
34-67	Adequate
68-100	Good

Table 3. Arbitrary grading based on percentage score



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### Results

Descriptive analyses were done for socio-demographic factors of the nurses. All categories were presented in frequencies and percentages. Table 4 shows that the majority of those involved are senior nurses aged between 18 and 40 years old (n = 16; 50%) and 41 and 60 years old (n = 16; 50%) and are married (n = 24; 75%). Most of them have a degree-level education (n = 25; 78.1%) and have served in nursing for more than 11 years (n = 28; 87.5%). All those involved have also received training education in basic MEWS (n = 32; 100%) and basic life support (n = 32; 100%).

VARIABLES	SCORE					
Age	F	%				
18-40 (early adult)	16	50				
41-60 (middle adult)	16	50				
Highest qualification						
Diploma	6	18.8				
Degree	25	78.1				
Master and above	1	3.1				
Post basic						
Marital status						
Single	5	15.6				
Married	24	75.0				
Divorced/single mother	3	9.4				
Years of work experience						
> 5 years	0	0				
6-10 years	4	12.5				
>11 years	28	87.5				
EWS training						
Yes	32	100				
No	0	0				
Basic Life support training						
Yes	30	100				
No	0	0				

### Table 4. Distribution of the respondent's profile

Table 5 shows that the majority of them have a high level of knowledge (87.5%–100%), attitude (96.9%–100%), and are able to practice (100%) effectively after 6 months of MEWS training given to nurses at the location of this study.



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Maternal Early Warning Score in identifying maternal		YES		)		
deterioration (N=32)	F	%	F	%	Μ	SD
Knowledge regarding Maternal Early Warning Score						
1. Obstetric hemorrhage, maternal sepsis, hypertensive disorders of pregnancy, abortion, cardiovascular diseases, amniotic fluid embolism and pulmonary embolism are the most common causes of maternal death.	32	100	0	0	2.00	0.000
2. The Maternal Early Warning Score (MEWS) is the single most reliable response tool to improve maternal outcomes in obstetrics.	28	87.5	4	12.5	1.88	0.336
3. The common indications for admission to the obstetric ICU were direct obstetric conditions like hemorrhage, sepsis, and preeclampsia.	29	90.6	3	9.4	1.97	0.180
4. Identification of abnormal physiological parameters and early intervention may prevent further deterioration and reduce maternal morbidity and mortality	32	100	0	0	2.00	0.000
5. Obstetric Warning Scores may help identify pregnant women at risk of deterioration.	31	96.9	1	3.1	1.97	0.180
6. The Maternal Early Warning Score (MEWS) is a commonly used example of a bedside screening tool that enables tracking of physiological parameters, and when a predefined threshold is reached, triggers bedside assessment by a healthcare professional.	32	100	0	0	2.00	0.000
7. The Maternal Early Warning Score (MEWS) has been advocated with the aim to reduce maternal morbidity and mortality, and improve clinical outcomes.	32	100	0	0	2.00	0.000
8. Triggers in the MEWS system theoretically lead to earlier recognition of conditions including cardiovascular disease, sepsis, thromboembolic disease, hemorrhage and pre-eclampsia	32	100	0	0	2.00	0.000
Attitude in practicing MEWS						
1. In my practice, I consistently apply what I learned about MEWS trigger tool to recognize and respond to changes in maternal clinical conditions.	32	100	0	0	2.00	0.000
2. I am seeing positive results from the MEWS education program among my colleagues in recognizing and responding to changes in maternal clinical conditions.	32	100	0	0	2.00	0.000
3. I have seen the impact of maternal patient care which is an improvement in the delivery of quality care by the nursing staff.	32	100	0	0	2.00	0.000
4. I am more confident in communicating MEWS parameters to the care provider	32	100	0	0	2.00	0.000



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5. I have seen an increase in my patients and family	31	96.9	1	3.1	1.97	0.180
satisfaction levels						
6. The MEWS triggers education program has changed the	32	100	0	0	2.00	0.000
behaviors of my colleagues in hand over/endorsing an						
abnormal findings to the care providers.						
Practice in identifying maternal deterioration using MEWS						
1. If the score > 6 is red alerts, I will immediately call for	32	100	0	0	2.00	0.000
review by obstetrician and repeat observations in 15 minutes						
or continuous monitoring.						
2. For the score 4 to 5, 1 will call the obstetrician and repeat	32	100	0	0	2.00	0.000
observations in 30 minutes						
3. If the score showed 1-3, I will repeat the vital sign every 30	32	100	0	0	2.00	0.000
minutes						

Table 5. Frequency and percentage of nurse's knowledge, attitude and practice in identifying maternal deterioration using MEOWS post education program

However, to categorize good and poor attitudes and practices, the researchers decide to use the mean score of the attitudes score as a reference. Thus, respondents scoring less than the mean score will be categorized as poor, and those above the mean score will be categorized as having a moderate to high level of knowledge, attitude, and practice. Based on the result, the overall analysis found that the majority of respondents achieved a mean score between 1.88 and 2.00. More than three-quarters of respondents showed good knowledge regarding maternal early warning signs, with a mean score of 1.98 (SD = 0.402) and a mean score of 1.99 (SD = 0.179), which portrays good attitudes towards the practice (mean score = 2.00; SD = 0.000).

Mean	Level
0.00-0.66	Low
0.67-1.33	Adequate
1.34-2.00	Good

Table 6. Arbitrary level based on mean score

Aspect	М	Level
Knowledge	1.99	Adequate
Attitude	1.98	Adequate
Practice	2.00	Good

Table 7. Mean score of level of knowledge, attitude and practice in identifying maternal deterioration using MEWS among nurses



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The Pearson correlation test result for the relationship between a nurse's demographic characteristics and the nurse's level of knowledge in recognizing maternal deterioration using MEWS is shown in Table 8. The p value obtained was greater than the predetermined significance level, which is p > 0.05. Thus, the results showed that none of the variables tested, including age, highest qualification, marital status, and years of work experience, had a significant relationship with their level of knowledge in identifying maternal deterioration using MEOWS.

Demographic variables (N=32)	Pearson Correlation	Р	Significant		
Age	0.076	0.681	No significant		
Highest qualification	0.016	0.930	No significant		
Marital status	0.238	0.189	No significant		
Years of work experiences	0.029	0.877	No significant		

**Table 8.** Pearson correlation test for association between demographic data and level of nurse's knowledge in identifying maternal deterioration using MEWS

Figure 3 below shows a comparison of maternal statistics that were transferred to the ICU after MEOWS tools were established after January 2019. Out of the total number of maternal admissions, which is 1766, a total of 64 mothers experienced deterioration detected on a scale of 1-3 and a score > 5, but only 2 mothers were transferred to the ICU after using the MEOWS tool. Likewise, with the statistics recorded in 2020, where there were a total of 1501 maternal admissions, it was found that only n = 2 maternal out of n = 64 maternal were found to have deterioration that had to be transferred to the ICU. This shows a decrease in maternal transfers to the ICU after the MEOWS tool was established in the BESTCare system.



**Figure 3.** Comparison statistics of mothers transferred to the ICU pre and post educational program and MEOWS tool established (2017-2020)



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### **Discussion and Implications**

It was revealed that a total of 33 nurses passed the exam. This result may indicate their mastery of EWS assessment and their ability to detect deterioration in maternal health. As members of the healthcare team, nurses must learn how to prevent medical errors and promote improvements in patient care, which is a serious concern. The results of this study echo previous research by Ludin (2018), which found that nurses who participated in this study lacked the expertise to recognize potential deterioration in patient health. The study recommends that nurses continue to improve their skills in determining the likelihood of a mother's condition worsening while also improving these skills.

The main objective of this study is to evaluate the effectiveness of implementing a maternal early warning signs tool to detect maternal deterioration, provide appropriate treatment to patients, and avoid complications. The implemented educational program aims to reduce maternal transfers to intensive care units and provide quality maternal care services through the implementation of the MEOWS tool in maternity wards. Morse (2023) conducted a study at Walden University using a literature review method and found that nurses' awareness of and response to MEWS triggers was improved, resulting in preventable maternal mortality and morbidity at the micro level. Nevertheless, Matt and Emmanuel (2018) argue that NEWS simply relies on nurses' clinical judgment to initiate a response, as it is likely to reduce the discrepancy between nurses' expectations and physicians' responses and have found that it reduces the need for dependence.

In this study, the majority of nurses believed that they had a positive opinion about nursing practice. Researchers are reassured by this, as posture plays a huge role in how nurses care for patients. Competent nurses provide high-quality care. However, this is inconsistent with nurses' attitudes, with previous research suggesting that nurses' attitudes are low when it comes to identifying patients at risk of deterioration (Matt & Emmanuel, 2018). According to Jensen, Skår, and Tveit (2019), the perception of EWS fundamentally depends on the professional competency of hospital nursing staff. They relied too much on MEWS data because they believed it was insufficient or still incomplete to detect maternal decline. Additionally, nurses said they thought MEWS could overestimate the mother's condition. However, they still agree that MEWS is a useful tool for nursing staff, especially new nurses, to detect abnormalities early and that it can help nursing staff be better aware of patient conditions.

Nurses who received good knowledge evaluations in this study also recognized their own abilities (practice) as good practice. To prevent deterioration of the mother's condition, the nurse must be confident in her ability to manage the patient using her MEOWS score. Although it had only five (n = 5) respondents who disagreed with her claims about the knowledge area and one (n = 1) respondent who disagreed with the statements about the attitude areas surveyed, This may be due to busy schedules, an apparent lack of expertise in using MEWS, or a lack of risk awareness. Another study by Friedman et al. (2018) consistently demonstrated that nurses did not use their MEWS in accordance with best practices because the nurses revealed that the reason they did not closely monitor the patient as per protocol was due to their busy schedules and that the patient was listed on the MEWS score.



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### Conclusion

The early warning sign innovation aimed to enhance maternal outcomes by educating and training nurses. Through this training, nurses will be able to spot small changes and quickly notify the Critical Care Response Team (CCRT) or code blue. According to the research's findings, which indicate that the nurses have high knowledge, attitudes, and practice (KAP) on MEWS scoring, they are skilled at identifying mothers using MEWS. The study also found no correlation between nurses' KAP in identifying mothers using MEWS and age, marital status, years of work experience, or highest qualification. This study also found that there was a positive effect on the decrease in the rate of maternal statistics transferred to the ICU after the education program was given and the MEOWS tool was introduced in the BESTCare system to be fully applied by nurses in the Maternity Unit.

This study also believed that EWS systems support nurses' patient risk assessment practices, providing useful information. There are a few recommendations to improve for future researchers who intend to further the study. It is recommended to further study in different wards that use different types of EWS according to the patient's condition or age, such as MEWS, PEWS, MEOWS, and others. In addition, it is important to improve the practice of the MEOWS tool among nurses in the maternity unit. The institution or management can provide training or further information or education on MEOWS continuously to monitor the nurses' competence and enhance knowledge tension. Besides, MEOWS can also be included in the midwifery program syllabus to ensure nursing students can theoretically and practically master the MEOWS tool. In short, it is important for the nurses to be introduced to knowledge and practice, or how to use the MEOWS tool, early in their nursing training to avoid errors while working in hospitals.

### Limitations of the Study

This pilot study of the action research type has been successfully conducted. However, some limitations may affect the overall findings of this study. This study took 1 year, during which maternal ealry wasrning signs scoring education and training were carried out on staff without the MEOWS tool that was established in the BESTCare system. It is possible that the understanding, attitude, and practice of maternal early warning sign scoring among nurses in the Maternity Unit will be different if MEWS is already established in the BESTCare system at the study location. In addition, this study only involved NGHA Dammam, where the small sample may affect the actual results of the analysis.

### **Conflict of Interest**

We declare no conflict of interest for this study.



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