ORIGINAL ARTICLE

Predicting Maternal Morbidity in Peripartum Period: Validity of Modified Early Obstetric Warning System

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ABSTRACT

Objective: To determine the effectiveness of a modified early obstetric warning system (MEOWS) in determining the probability of maternal morbidity during the Peripartum Period.

Study Design: Cross-sectional observational study.

Place and Duration of Study: This Study was conducted at the Department of Obstetrics and Gynecology, District Headquarters Hospital (DHQ) Rawalpindi, Pakistan from October 2022 to October 2023.

Methods: The study sample consisted of pregnant women, 127 each in 3 high-risk categories of postpartum hemorrhage, pre-eclampsia/eclampsia, and sepsis, detained in the high dependency area for observation on the risk of developing maternal deterioration from the 26th week onwards to delivery and discharge from hospital. The modified early obstetric warning signs (vital signs, i.e., temperature, blood pressure, heart rate, respiratory rate, oxygen saturation, and consciousness level) were used to measure the risk of deterioration. The data was collected on a pre-structured study proforma. The study outcome was assessed as the diagnostic accuracy of modified early obstetric warning system (MEOWS) in predicting peripartum maternal morbidity.

Results: The mean age (years) of the women was 31.76+8.58, and the range was from 18 to 42 years. The frequency and percentages of maternal morbidities include postpartum hemorrhage 73 (57.5%), preeclampsia 76 (59.8%), and sepsis 80 (63%). The sensitivity of MEOWS in detecting postpartum hemorrhage, pre-eclampsia, and sepsis is 89.86 % 80.52%, and, 87.37 % respectively.

Conclusion: The study indicates that during the peripartum period (labor and the early postpartum period), the modified early obstetric warning system (MEOWS) can efficiently detect women at risk of developing obstetric complications like postpartum hemorrhage, pre-eclampsia, and sepsis and hence initiate timely intervention.

Keywords: *Early Warning Score, High Risk, Peripartum Period, Pregnancy.*

How to cite this: *Naqvi RA, Batool I, Parveen S, Iram N. Predicting Maternal Morbidity in Peripartum Period: Validity of Modified Early Obstetric Warning System. Life and Science. 2025; 6(1): 65-70 . doi: http://doi.org/10.37185/LnS.1.1.564*

Introduction

The WHO Maternal Morbidity Working Group (MMWG) identifies maternal morbidity as any health problem caused by or worsened by pregnancy or childbirth that negatively affects a woman's well-being.[1] Direct obstetric causes of maternal morbidity and mortality, such as hemorrhage, hypertension, and sepsis, are responsible for nearly 73% of maternal deaths. Whereas the remaining 27.5% of deaths, indirect causes, are attributed to anemia, malaria, and heart disease. According to the data from 2003-2009, still relevant today, the top three causes of maternal mortality are

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Received: Dec 25, 2023; 1st Revision Received: Apr 08, 2024
2nd Revision Received: Nov 21, 2024; Accepted: Dec 05, 2024

hemorrhage (27.1%), hypertension (14%), and sepsis (10.7%). Postpartum hemorrhage accounts for two-thirds of all hemorrhage deaths.[2,3] Maternal mortality rates have declined significantly since then, but the top 3 causes of death remain the same. 8 out of 10 maternal deaths occur in sub-Saharan Africa and Southern Asia, with similar leading causes.[4] Hemorrhage is the leading cause of maternal death in Northern Africa, accounting for 36.9% of all deaths. However, it is much less common in developed regions, accounting for only 16.3% of deaths. More than one in ten vaginal births globally experience blood loss exceeding 500 ml, with nearly 3% facing the serious complication of severe hemorrhage (blood loss of 1000 ml or more).[5] Likewise, according to a recent systematic review, nearly 1 in 20 pregnancies is affected by preeclampsia, and nearly 1 in 70 pregnancies is affected by eclampsia.[6] Highest rates of preeclampsia and eclampsia were found in Sub-Saharan Africa. Hypertensive disorders result in maternal mortality of 22.1% in Latin America. In developing countries, especially Southern Asia, where it claims 13.7% of maternal lives, sepsis stands as a leading killer of mothers.[7] Even after childbirth, it poses a threat, with studies in India showing 1.2% to 1.4% of women experiencing sepsis post-partum.[8,9] Across the globe, 830 mothers die of a preventable disease every day. Since 2015, there has been a consistent decline in maternal mortality rates. Analyses of these deaths have consistently shown that delays in recognizing pregnancy complications are a major contributing factor.[10]

Although most of these deaths can be prevented, not enough attention has been paid to tracking how often women experience these life-threatening complications. This information is essential for planning the services needed to improve maternal survival. However, a fundamental difficulty in assessing the prevalence of these obstetric problems is the fact that most pregnancies are terminated outside of the facilities where such statistics are routinely collected. Since deliveries often occur at home, collecting the necessary population-based data must rely on self-reporting any complications experienced. The accuracy of such accounts is highly dependent on both problem recognition and recall. One way to reduce maternal morbidity and mortality is to use clinical tools to identify early on which patients are likely to need lifesaving interventions or referral to a higher level of care. This can be done by using tools like risk assessment calculators, clinical decision support systems, and early warning systems.[11,12] A systematic review found that there is no direct evidence that obstetric early warning systems (EWS) improve patient outcomes.[13] However, several recent studies have shown that EWS can be a valuable screening tool for preventing obstetric morbidity.[14,15] Additionally, a study in the US found that the use of an obstetric EWS trigger tool significantly lowered the prevalence of severe maternal morbidity and composite morbidity.[16] Our understanding of how to prevent pregnancy complications in low-resource settings is often based on self-reporting and retrospective studies. This approach is not a reliable way to measure the true prevalence of specific morbidities. In a study, 30% of the women were at risk of developing serious complications based on their symptoms; it highlights the importance of using early warning systems to identify women who need timely and effective care.[17] The later weeks of pregnancy and the initial postpartum period pose potential health risks for both mothers and their newborns. Many of these risks are preventable, but only if healthcare providers routinely monitor vital signs and recognize the signs of deterioration. These signs help healthcare workers to quickly and effectively develop a treatment plan. There has been sensitization to routinely use a modified early obstetric warning system (MEOWS) for all pregnant or postpartum women who are admitted to the obstetric department. Previous research found that early warning systems for

obstetric morbidity had poor sensitivity. This may be due to the nature of the physiological parameters that are monitored, or to the choice of trigger thresholds or the available data were insufficient to identify the best track and trigger. In MEOWS, a trigger is a single observation that is very abnormal or a combination of two observations that are mildly abnormal at the same time. These triggers prompt healthcare workers to assess the patient urgently. Early warning systems show promise in improving patient outcomes, potentially even reducing mortality rates. However, their effectiveness can vary depending on the clinical setting and patient population. More research is needed to fully unlock their potential across different healthcare contexts. Most studies on the effectiveness of early warning systems for pregnant women have been conducted in general hospital wards, not in critical care units. Only a few studies have been conducted on peripartum and postpartum women admitted to critical care units. By screening women for specific morbidities, it is easy to target and streamline the best available therapeutic modalities using ideal health services and care. This study aims to determine the diagnostic accuracy of MEOWS in the early detection of maternal morbidity in women around their late antepartum and postpartum period admitted in high dependency areas (HDA). So, this can help in decreasing of high dependency unit admissions and prevent severe maternal ailment and loss by timely intervention. Diagnostic accuracy tells the capacity of a test to discriminate between the morbid condition and wellbeing. This discriminative potential can be measured by the measures of diagnostic accuracy such as sensitivity and specificity, predictive values which we were calculated in our study.

Methods

This Study was conducted at the Department of Obstetrics and Gynecology, District Headquarters Hospital (DHQ) Rawalpindi, Pakistan, from October 2022 to October 2023 after approval from the hospital's Ethical Review Committee on 2nd December 2022 vide letter no: IERC/OBS/2022.

The study population included all pregnant women from 20 weeks onwards and post-natal women who were detained in the high dependency area for observation on the risk of developing maternal deteriorations like postpartum hemorrhage, pre-eclampsia, and sepsis.

The women with established preeclampsia, eclampsia, PPH, sepsis and the women who were without the high risk of morbidity. Women with associated chronic illnesses like heart disease and renal disease and who refused to consent to enter the study were excluded. The patients in the study were chosen by convenient non-probability sampling technique. The sample size is estimated using the WHO sample size calculator with a sensitivity of 89.0% and specificity of 79.0%, taking a confidence interval level of 95% and an anticipated prevalence of 30%; with the desired precision of 10%, a sample size of 127 is calculated.[1-2]

Informed written consent was administrated to all women, fulfilling study criteria. The enrolled women at risk of developing any morbidity were assessed with MEOWS during the hospital stay in a high dependency area. The MEOWS was recorded once at the time of enrollment. The women were followed up until the time of discharge from hospital.

All of the vital signs that were measured, including temperature, blood pressure, heart rate, respiratory rate, oxygen saturation, and pain score, were recorded, along with other relevant information. The patient was monitored during hospitalization to check whether the patient actually developed any morbidity. The data was collected on a pre-structured study proforma. The study outcome was assessed as the diagnostic accuracy of MEOWS in predicting maternal morbidity.

Data was analyzed in the computer using SPSS software version 16.0. The categorical variables like MEOWS and morbidity were analyzed as frequency and percentages, while the continuous numerical variables like age, parity,

and gestational age were measured for means, standard deviation, and ranges. A 2x2 table calculated sensitivity, specificity, PPV, and NPV as follows. (Table-1).

Table-1: Maternal Morbidity x MEOWS (2x2 table)

MEOWS	Maternal Morbidity	
	+ ve	-ve
+ve	TP (a)	FP (b)
-ve	FN (c)	TN (d)

Sensitivity = a/a+c x 100, Specificity = d/b+d x 100, PPV = a / a+d x 100, NPV = d / c+d x 100
Diagnostic accuracy = a+d/a+b+c+d x 100

Table-2: Study population descriptive statistics

Variable	Minimum	Maximum	Mean	S.D
Age(years)	15	45	31.76	8.56
Parity	1	4	2.39	1.04
Gestational age (weeks)	25	36	29.53	3.34

**S.D Standard Deviation*

Table-3: MEOWS in peripartum conditions (Maternal Morbidity)

Peripartum conditions	MEOWS	Morbidity		Sensitivity %	Specificity %	PPV %	NPV %	Diagnostic Accuracy %
		True	False					
PPH	Positive	62	11	89.86	81.03	84.93	87.04	85.83
	Negative	7	47					
PE/eclampsia	Positive	62	14	80.52	72.00	81.58	70.59	77.17
	Negative	15	36					
Sepsis	Positive	69	11	87.37	77.08	86.25	78.72	83.46
	Negative	10	37					

PPH Postpartum Hemorrhage, PE Pre-eclampsia

Results

Out of the 127 selected patients, the average age (years) was 31.76+8.58, with a range of 18-45 years. The mean parity was 2.39+1.04, whereas the mean duration of pregnancy (weeks) was 29.53+3.34, as shown in table-2. The frequency and percentages of peripartum maternal morbidities during the study period include postpartum hemorrhage 73 (57.5%) , preeclampsia 76 (59.8%), and sepsis 80 (63%) and the calculated diagnostic accuracy for (MEOWS), as sensitivity, specificity, PPV and NPV as shown in table-3.

Discussion

During COVID-19 pandemic, many studies have emphasized the efficacy of the Modified Early Warning Score MEWS score in predicting clinical deterioration, prompting timely transfer for intensive care units, triaging, transferring, and discharge from hospital of COVID-19 patients.[18,19] The average age of the women in our study was 31.76 years, while in other study, it was recorded as 27.80 years. The frequency of pre-eclampsia and sepsis was 59.8%, 63%, which is comparable to a similar study where 54% had eclampsia and 69% had sepsis.[20]

In our study, (MEOWS) demonstrated a strong diagnostic potential for detecting severe maternal morbidity, in terms of sensitivity and specificity for postpartum hemorrhage (89.86%, 81.03%.), pre-eclampsia/eclampsia (80.52%, 72.02%), and sepsis (87.37%, 77.08%). In other studies, similar results of diagnostic accuracy,

with MEOWS sensitivity, were found between 78%-88% for PPH and sepsis.[21,22] Similarly, a survey by Fullerton et al. suggested that MEOWS, particularly when used in conjunction with clinical judgment, can be a valuable tool for identifying patients at risk of adverse outcomes with a sensitivity of 72.4%) and a specificity of 84.8%.[23]

Our study is limited to one hospital and predicted maternal morbidity by only using MEOWS. In contrast, a recent study by Arti M Wasnik et al. demonstrated the integration of MEOWS with supplementary tools like maternal morbidity screening (MMS) tool for enhanced validity.[21] Moreover, recall of events at postnatal follow up was not recorded in our study as in a study in the Philippines where the women were able to accurately recall 70% of hemorrhage events, 44% of eclampsia events and 89% of sepsis events.[24]

MEOWS can effectively recognize high risk cases but may lead to false positives. Standardizing MEOWS parameters across settings to balance sensitivity and specificity. Making MEOWS more sensitive by adjusting its criteria might detect more women truly at risk (reducing false negatives), but it could also trigger the alarm for women who are healthy (increasing false positives), potentially unnecessary interventions, and increased anxiety. The challenge lies in balancing MEOWS sensitivity with maintaining a good "specificity," meaning correctly identifying women who are not at risk. Healthcare provider's training should be enhanced to minimize false positives and optimize intervention timings.

Conclusion

The study indicates that during the peripartum period (labor and the early postpartum period), the MEOWS can efficiently detect women at risk of developing obstetric complications like postpartum hemorrhage, pre-eclampsia, and sepsis and hence initiate timely intervention.

Acknowledgment: None

Conflict of Interest: The authors declare no conflict of interest

Grant Support and Financial Disclosure: None

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Authors Contribution

RAN: Idea conception, study designing, data collection, data analysis

IB: Idea conception, study designing, data collection, data analysis

SP: Study designing, data analysis, results and interpretation, manuscript writing and proofreading

NI: Data analysis, results and interpretation, manuscript writing and proofreading