



## DIAGNOSTIC ACCURACY OF MATERNAL EARLY WARNING TOOLS (MEWTS) IN PREDICTING MATERNAL MORBIDITY IN TERMS OF ICU ADMISSION

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### Abstract

**Introduction:** Several tools for early warning are being used right now. The National Council for Patient Safety in the US recently suggested using maternal early warning tools (MEWTs), and the Modified Early Obstetric Warning System (MEOWS) has been suggested in Great Britain.

**Objectives:** To determine the diagnostic accuracy of maternal early warning tools (MEWTs) in predicting maternal morbidity in comparison with ICU admission as reference standard.

**Materials & Methods:** The research was done at the PIMS Hospital in Islamabad from December 23, 2017, to June 22, 2018, in the Department of Obstetrics and Gynecology. It used a descriptive, cross-sectional, and validative methodology. A total of 499 pregnant women between the ages of 18 and 40 who were more than 20 weeks along (on LMP) were included. We didn't include women who had valve heart disease, chronic high blood pressure, or coagulopathies. Then, the researcher herself looked at all the women using maternal early warning tools (MEWTs) to guess how likely they were to end up in the intensive care unit (ICU) after giving birth, and the final decision was made 24 hours later.

**Results:** In total, 84 (16.83%) patients were admitted to the intensive care unit (ICU), while 415 (83.17%) patients were not admitted to the ICU. Out of the MEWT-positive cases, 69 were real positives and 31 were false positives. There were 399 patients who did not have a MEWT. Of these, 384 were true negatives and 15 were fake negatives (p-value = 0.0001). That's 82.14% for sensitivity, 92.53% for specificity, 69.0% for positive predictive value, 96.24% for negative predictive value, and 90.78% for diagnostic accuracy of maternal early warning tools (MEWTs) in predicting maternal illness.

**Conclusion:** This study concluded that diagnostic accuracy of maternal early warning tools (MEWTs) in predicting maternal morbidity is quite high.

**Keywords:** maternal early warning tools, maternal morbidity, ICU admission.

## Introduction

Early detection of serious sickness in pregnant women is hard because these situations don't happen very often and because pregnancy and childbirth cause changes in the body that might be seen as abnormal when the woman is not pregnant.<sup>1</sup> It's important to notice problems early on because they can get worse very quickly, with terrible results. It's hard to find a balance between finding women who need help and "over-medicalizing" a process that is normally natural.<sup>2</sup> Any death of a mother is sad for the family and the medical team. There has been a general drop in maternal mortality due to better ways to avoid, recognize, and treat thromboembolism, hypertensive disorders, hemorrhage, and sepsis, which are some of the main causes of direct maternal deaths.<sup>3,4</sup>

Morgan, Williams, and Wright created the Early Warning System (EWS) in 1997. It is made up of five physiological parameters: the patient's heart rate, respiratory rate, systolic blood pressure, temperature, and level of consciousness. The EWS can predict outcomes and act as a track and trigger system to notice early signs of worsening.<sup>5</sup> After that, EWS was changed to the Modified Early Warning System (MEWS) in the UK. In 2007, the National Institute for Health and Clinical Excellence (NICE) said that MEWS should be used to keep an eye on all adult patients who were being brought to acute care settings. This way, if a patient got worse, care could be escalated right away. Anomalies are given points to help guide actions and keep track of how well they're working. These systems took the place of old-fashioned charts that showed values on graphs but didn't say what amounts of intervention were needed.<sup>6</sup>

Several tools for early warning are being used right now. The National Council for Patient Safety in the US recently suggested using maternal early warning tools (MEWTs), and the Modified Early Obstetric Warning System (MEOWS) has been suggested in Great Britain.<sup>7</sup> A lot of the time, the early warning signs and symptoms of a mother's approaching serious illness or collapse are not noticed.<sup>8,9</sup> Using a Modified Early Obstetric Warning System (MEOWS) to record and keep track of vital signs on a daily basis was the most popular suggestion in the UK.<sup>8</sup> A study found that early warning tools (MEWTs) were 96.9% sensitive for maternal mortality, 99.9% specific, had a 12.0% positive predictive value, and were 99.99% negative predictive value.<sup>10</sup>

As we looked through the literature, we only found a small amount of information on this early warning tool that can be used in the general population to help pregnant women get care sooner so that they don't get sick. Also, none of these early warning tools are currently used in the health care system of Pakistan. That's why I wanted to find out how well maternal early warning tools (MEWTs) can diagnose and predict maternal morbidity in the local community. The study's results will not only add to the local data, but they will also be useful additions to what has already been written. Also, if its diagnostic accuracy is high, it can be used routinely on all pregnant patients in our general practice to predict the mother's morbidity. This will help doctors make the right decisions before surgery to lower the mother's morbidity and mortality. This study's goal was to find out how well maternal early warning tools (MEWTs) can diagnose and predict maternal morbidity compared to using ICU admission as a measure..

## Materials & Methods

**Study Design:** A descriptive, cross-sectional, and validative study was conducted.

**Setting:** The study took place at the Department of Obstetrics & Gynecology, PIMS Hospital, Islamabad.

**Duration of Study:** The study spanned a specific period from December 23, 2017, to June 22, 2018.

**Sample Size:** With a confidence level of 95% and a targeted precision level of 5%, a sample size of 499 cases was chosen. We looked at a sensitivity of 96.9%, a specificity of 95%, and a predicted ICU admission rate of 18.08%.

**Sample Technique:** Non-probability consecutive sampling was employed.

**Sample Selection:** Inclusion Criteria:

1. All pregnant women assessed via ultrasonography.
2. Patients aged 18-40 years.
3. Gestational age >20 weeks (assessed on LMP) up to 6 weeks postnatally.

**Exclusion Criteria:**

1. Women with valvular heart disease (assessed through history and medical records).
2. Women with a history of chronic hypertension and coagulopathies.

**Data Collection Procedure:** After getting permission from the ethical review committee, 499 pregnant women in the Obstetrics and Gynecology Department at PIMS Hospital in Islamabad who met the standards for inclusion and exclusion were chosen. The researcher used maternal early warning tools (MEWTS) to predict who would need to go to the intensive care unit after giving birth after getting informed consent. At 24 hours, the final results were looked at and written down on a special form.

**Statistical Analysis:** SPSS version 20.0 was used to examine the data that was gathered. For quantitative factors like age, gestational age, height, weight, and BMI, the mean and standard deviation were found. Qualitative variables, such as parity, mode of birth (vaginal or cesarean), and ICU admission based on MEWTS, were broken down into frequencies and percentages. We used a 2x2 contingency table to find out the sensitivity, specificity, positive predictive value, negative predictive value, likelihood ratios, ROC, and diagnostic accuracy of MEWTS in determining maternal morbidity (admission to the intensive care unit). Through stratification, factors that changed the effects, like age, body mass index (BMI), gestational age, number of children, and type of birth (c-section vs. vaginal), were managed. We used post-stratification 2x2 contingency tables to find the sensitivity, specificity, positive predictive value, negative predictive value, and diagnostic accuracy of MEWTS for forecasting maternal morbidity (admission to the intensive care unit).

## Results

Out of the 499 people who took part in the study, most (76.55%) were between the ages of 18 and 30 (Table 1). The mean number of weeks of pregnancy was  $34.52 \pm 4.27$  weeks, and the mean number of babies was  $3.03 \pm 0.76$ . There were a total of 84 admissions to the intensive care unit (16.83%), but 415 patients were not seen (83.17%). Table 2 shows that of the MEWTS positive cases, 69 were real positives and 31 were fake positives. On the other hand, out of the MEWTS negative cases, 384 were true negatives and 15 were fake negatives (p-value = 0.0001). Overall, the mother early warning tools had a sensitivity of 82.14%, a specificity of 92.53%, a positive predictive value of 69.0%, a negative predictive value of 96.24%, and a diagnostic accuracy of 90.78%, which is very good. The strong ability of MEWTS to predict maternal morbidity was further confirmed by stratification analyses based on age, gestational age, parity, method of delivery, and BMI.

**Table 1: Patient Characteristics (n=499)**

Characteristics	No. of Patients	%age
<b>Age (in years)</b>		
18-30	382	76.55
31-40	117	23.45
<b>Gestational Age (weeks)</b>		
21-32 weeks	142	28.46
>32 weeks	357	71.56
<b>Parity</b>		
0-2	125	25.05
3-4	374	74.95

Mean Age  $\pm$  SD = 29.05  $\pm$  3.62 years

Mean Gestational Age  $\pm$  SD = 34.52  $\pm$  4.27 weeks

Mean Parity  $\pm$  SD = 3.03  $\pm$  0.76

**Table 2: Diagnostic accuracy of maternal early warning tools (MEWTs) in predicting maternal morbidity in comparison with ICU admission as reference standard.**

		ICU Admission		P-value
		Positive	Negative	
MEWTs	Positive	69 (TP)*	31 (FP)***	<b>0.0001</b>
	Negative	15 (FN)**	384 (TN)****	

\*-TP=True positive \*\*-FP=False positive \*\*\*-FN=False negative \*\*\*\*-TN=True negative

As a measure, ICU admission is used in Table 2 to show how well Maternal Early Warning Tools (MEWTs) predict maternal morbidity. Out of all the cases, MEWTs correctly identified 69 cases where someone was admitted to the ICU (True Positives), but they wrongly identified 31 cases as positive when they were not admitted to the ICU (False Positives). Also, MEWTs missed 15 cases where the patient was actually admitted to the ICU (False Negatives), but they correctly identified 384 cases where the patient was not admitted to the ICU (True Negatives). The specificity of MEWTs is 92.53%, which means they are accurate at finding negative cases. The sensitivity of MEWTs is 82.14%, which means they can correctly spot positive cases. According to the Positive Predictive Value (PPV), 69.0% of cases that MEWTs marked as "positive" ended up in the intensive care unit (ICU). On the other hand, 96.24% of cases that MEWTs marked as "negative" did not end up in the ICU. The likelihood ratios give a more precise measure of the chances of getting positive or negative reports about the status of admission to the intensive care unit. In general, MEWTs are 90.78% accurate at diagnosing and predicting maternal illness.

**Table 3: Stratification of Diagnostic Accuracy**

Stratification Criteria	No. of Cases	ICU Admission	P-value	Diagnostic Accuracy
Age 18-30 years	382		0.001	91.10%
Age 31-40 years	117		0.001	89.74%
Gestational Age 21-32 weeks	142		0.001	89.44%
Gestational Age >32 weeks	357		0.001	91.32%

The diagnostic accuracy levels in Table 3 give a quick look at how well the Maternal Early Warning Tools (MEWTs) can identify maternal morbidity based on certain factors. In people between the ages of 18 and 30, MEWTs had a strong link with being admitted to the intensive care unit (91.1%) (P-value=0.001). In the same way, MEWTs had a great Diagnostic Accuracy of 89.74% (P-value=0.001) for people ages 31 to 40. When grouped by gestational age, MEWTs showed strong ability to predict for both 21–32 weeks (Diagnostic Accuracy: 89.44%, P-value=0.001) and >32 weeks (Diagnostic Accuracy: 91.32%, P-value=0.001). These results show that MEWTs are

consistently and significantly good at making predictions, proving that they can reliably find maternal morbidity across a wide range of age and gestational groups.

**Table 4: Diagnostic Accuracy Stratified by Parity and Delivery Mode**

Stratification Criteria	No. of Cases	ICU Admission	Diagnostic Accuracy
Parity 0-2	125	0.001	92.0%
Parity 3-4	374	0.001	90.37%
Vaginal Delivery	160	0.001	91.25%
Cesarean Delivery	339	0.001	90.56%

Table 4 shows how well Maternal Early Warning Tools (MEWTs) can diagnose different groups of women. When it came to parity 0–2, MEWTs had a strong Diagnostic Accuracy of 92.0%. When it came to parity 3–4, they still had strong predictive skills with a Diagnostic Accuracy of 90.37%. MEWTs worked well during vaginal deliveries, with a Diagnostic Accuracy of 91.25%. They also worked well during cesarean deliveries, with a Diagnostic Accuracy of 90.56%. It's clear from these results that MEWTs are very good at predicting outcomes in a wide range of obstetric situations. This shows how important they are for predicting maternal illness.

**Table 5: Diagnostic Accuracy Stratified by BMI**

Stratification Criteria	No. of Cases	ICU Admission	Diagnostic Accuracy
<b>BMI ≤30 kg/m<sup>2</sup></b>	262	0.001	90.84%
Positive (TP)	36	17	
Negative (TN)	202		
Negative (FN)	07		
<b>Sensitivity</b>	83.72%		
<b>Specificity</b>	92.24%		
<b>PPV</b>	67.92%		
<b>NPV</b>	96.65%		
<b>BMI &gt;30 kg/m<sup>2</sup></b>	237	0.001	90.72%
Positive (TP)	33	14	
Negative (TN)	182		
Negative (FN)	08		
<b>Sensitivity</b>	80.49%		
<b>Specificity</b>	92.86%		
<b>PPV</b>	70.21%		
<b>NPV</b>	95.79%		
<b>Diagnostic Accuracy</b>	90.72%		

Table 5 shows how well Maternal Early Warning Tools (MEWTs) can diagnose different groups of women based on their Body Mass Index (BMI). For BMI ≤30 kg/m<sup>2</sup>, MEWTs had a great Diagnostic Accuracy of 90.84%, showing how reliable they are at predicting maternal mortality in this BMI range (P-value=0.001). Also, MEWTs were very good at predicting for BMIs higher than 30 kg/m<sup>2</sup>, with a Diagnostic Accuracy of 90.72% (P-value=0.001). These results show that MEWTs work consistently and significantly across a range of BMI groups, proving that they can be used to measure the risk of maternal morbidity.

## DISCUSSION

The maternal mortality rate in the UK is 8.5 per 100,000 births, according to the MBRRACE-UK study 2016.11 More than half of the deaths of mothers could have been avoided.12 For every death of a mother, nine more become seriously ill while they are pregnant.13Evolving illness can be hard

to spot in obstetric patients because their bodies change so much during labor and delivery. Bad results happen when it takes longer to notice that a patient is getting worse and start treatment.<sup>12</sup> Since 1999, Early Warning Systems (EWS) have been used with all patients to find out when their health is getting worse.<sup>14</sup> The Maternal Early Warning System (MEWS) has been pushed as a way to lower the number of illnesses and deaths among mothers and improve their health.<sup>11</sup> The MEWS keeps track of physiological parameters and changing morbidity. When a certain level is reached, it calls for a review by a medical professional. The health care worker decides if more testing, treatment, or action is needed. A lot of different kinds of maternal EWS are used right now, like the Irish Maternal Early Warning System (IMEWS), the Modified maternal Early Warning System (MOEWS), and the Maternal Early Warning Trigger tool (MEWT).

The study find out how well maternal early warning tools (MEWTs) can diagnose and predict maternal morbidity when compared to admission to the intensive care unit (ICU) as a measure.<sup>84</sup> (16.83%) of the patients in my study were admitted to the ICU, while 415 (83.17%) of the patients were not admitted. Out of the MEWT-positive cases, 69 were real positives and 31 were false positives. There were 399 patients who did not have a MEWT. Of these, 384 were true negatives and 15 were fake negatives ( $p$ -value = 0.0001). Most of the time, maternal early warning tools (MEWTs) were able to accurately identify maternal morbidity 82.14% of the time, 92.53% of the time, 69.0% of the time, 96.24% of the time, and 90.78% of the time.

The Maternal Early Warning Trigger (MEWT) is an alternative to MEWS that was tested in a prospective study that took place at several sites in a big hospital system.<sup>10</sup> When the tool was introduced and used in more than 180,000 births, the Centers for Disease Control and Prevention found that overall maternal morbidity dropped by 14% ( $p = 0.01$ ) and serious maternal morbidity dropped by 18% ( $p = 0.01$ ).<sup>10</sup> Early warning tools (MEWTs) sensitivity for maternal illness was 96.9% in this study. They also had 99.9% specificity, 12.0% positive predictive value, and 99.99% negative predictive value.<sup>10</sup>

The goal of the study by Hedriana et al.<sup>15</sup> was to find out "whether predefined maternal early warning triggers (MEWT) can predict pregnancy morbidity" (p. 337). The study also looked at how to use raw clinical vital signs, values, and clinical symptoms over time, since there isn't a set best-practice early warning system. A case-control study looked back at 50 obstetric patients who were brought to intensive care units in seven pilot hospitals in the United States and another 50 obstetric patients who had normal deliveries. Patients who were eligible were either full-term or preterm, and they were reviewed in triage before being admitted for treatment before, during, or after giving birth. The patients were taken to the ICU because they were bleeding from the uterus, had high blood pressure, abdominal pain, were in labor, had their membranes burst, had a fever, had stomach problems, or had other symptoms that needed to be looked at. Heart rate, mean arterial pressure, breathing rate, oxygen saturation, temperature, and changes in mental states were the six MEWTs that were looked at. Twelve percent of the fifty pregnant women who were admitted to the ICU had been identified with pre-eclampsia.<sup>15</sup>

Results showed that if there were two or more MEWTs, the patient should be evaluated further or the obstetrician should be notified more quickly. The writers came to the conclusion that MEWTs seemed to tell the difference between normal pregnant women and those who needed to be admitted to intensive care for further evaluation. This suggests that their use might lower the number of women who become seriously ill during pregnancy.<sup>15</sup> The best thing about this study is that it can tell the difference between normal vital sign values and abnormal values. This is shown by the fact that there were five times fewer false-positives in the control group and 50 patients who had a normal birth. The study has some flaws, such as a small sample size, a nonrandomized design, and no future data analysis.<sup>15</sup>

The study's results showed important information about how well Maternal Early Warning Tools (MEWTs) can identify maternal morbidity.<sup>16</sup> The total diagnostic accuracy of MEWTs was found to be 90.78%, which is in line with earlier studies that found diagnostic accuracy of 89% and 91% in similar obstetric populations. The MEWTs' sensitivity of 82.14% and specificity of 92.53% were

similar to what a meta-analysis found in a number of different maternal health settings.<sup>17</sup> The 69.0% Positive Predictive Value (PPV) was in line with the results of a prospective study. This shows how well MEWTs can find real positive cases.<sup>18</sup> Also, dividing the study into groups based on age, gestational age, parity, method of delivery, and BMI gave more detailed information, which supports the idea that risk factors for maternal morbidity should be looked at in a more complete way. The ROC curve study, which shows how well MEWTs can tell the difference between things, was consistent with other studies. This proved that the tool was accurate at predicting bad outcomes. Overall, the study's results add to the growing body of research that shows MEWTs work and can be used in a variety of maternal healthcare situations.<sup>19</sup>

The study took place in the labor rooms of Guru Teg Bahadur Hospital in Delhi, India, from October 2012 to April 2014. On the MEOWS chart, physiological parameters of 1065 study participants were entered. These included pregnant women in labor for more than 28 weeks and women who had just given birth up to 6 weeks ago. A trigger was either one very strange observation (a red trigger) or two slightly strange observations happening at the same time (two yellow triggers). 184 of the women who looked at these charts (26.6% of them) were interested in the odd zones. Among those who met the standards for obstetric morbidity, 177 (16.61%) were women. The MEOWS chart was 86.4% sensitive, 85.2% specific, and had a positive predictive value of 53.8% and a negative predictive value of 96.9% for predicting maternal morbidity. Some parts of the MEOWS chart were also significantly linked ( $p < 0.05$ ) to maternal morbidity.<sup>20</sup>

## Conclusion

The conclusion of this study is that maternal early warning tools (MEWTs) are very good at predicting maternal illness. Therefore, we suggest that it be used regularly on all pregnant women in our general practice to predict the mother's illness. This will help the doctors decide how to treat the mother before surgery so that she has less illness and death.

## References

1. Smith GB, Prytherch DR. Obstetric early warning scores: much more work required. *Anaesthesia*. 2013;68(7):778-9.
2. Isaacs RA, Wee MY, Bick DE, Beake S, Sheppard ZA, Thomas S, et al. A national survey of obstetric early warning systems in the United Kingdom: five years on. *Anaesthesia*. 2014;69(7):687-92.
3. Carle C, Alexander P, Columb M, Johal J. Design and internal validation of an obstetric early warning score: secondary analysis of the Intensive Care National Audit and Research Centre Case Mix Programme database. *Anaesthesia*. 2013;68(4):354-67.
4. Edwards SE, Grobman WA, Lappen JR, Winter C, Fox R, Lenguerrand E, et al. Modified obstetric early warning scoring systems (MOEWS): validating the diagnostic performance for severe sepsis in women with chorioamnionitis. *Am J Obstet Gynecol*. 2015;212(4):536.e1-8.
5. Morgan RJM, Williams F, Wright MM. An early warning scoring system for detecting developing critical illness. *Clin Intens Care*. 1997;8:100.
6. Kyriacos U, Jelsma J, Jordan S. Monitoring vital signs using early warning scoring systems: a review of the literature. *J Nurs Manag*. 2011;19:311-30.
7. Mackintosh N, Watson K, Rance S, Sandall J. Value of a modified early obstetric warning system (MEOWS) in managing maternal complications in the peripartum period: an ethnographic study. *BMJ Qual Saf*. 2014;23(1):26-34.
8. Smith GB, Prytherch DR, Meredith P, Schmidt PE, Featherstone PI. The ability of the National Early Warning Score (NEWS) to discriminate patients at risk of early cardiac arrest, unanticipated intensive care unit admission, and death. *Resuscitation*. 2013;84:465-70.
9. Singh S, McGlennan A, England A, Simons R. A validation study of the CEMACH recommended modified early obstetric warning system (MEOWS). *Anaesthesia*. 2012;67:12-8

10. Shields LE, Wiesner S, Klein C, Pelletreau B, Hedriana HL. Use of maternal early warning trigger tool reduces maternal morbidity. *Am J Obstet Gynecol.* 2016;214(4):527.e1-6.
11. Knight M, Nair M, Tuffnell D, et al. on behalf of MBRRACE-UK. Saving Lives, Improving Mothers' Care - Surveillance of maternal deaths in the UK 2012-14 and lessons learned to inform maternity care from the UK and Ireland Confidential Enquiries into Maternal Deaths and Morbidity 2009-14. Oxford: National Perinatal Epidemiology Unit, University of Oxford 2016.<https://www.npeu.ox.ac.uk/downloads/files/mbrrace-uk/reports/MBRRACEUK%20Maternal%20Report%202016%20-%20website.pdf> [last accessed 20/05/18]
12. Centre for Maternal and Child Enquiries (CMACE). Saving Mothers' Lives: reviewing maternal deaths to make motherhood safer: 2006–08. The Eighth Report on Confidential Enquiries into Maternal Deaths in the United Kingdom. *Br J Obstet Gynaecol* 2011;118 (Suppl. 1):1–203
13. Nelligan PJ, Laffey JG. Clinical review: Critical care in pregnancy. *Crit Care* 2011;15:1014
14. Goldhill DR, White SA, Sumner A. Physiological values and procedures in the 24 h before ICU admission from the ward. *Anaesthesia* 1999;54:529 – 534.
15. Hedriana HL, Wiesner S, Downs BG, Pelletreau B, Shields LE. Baseline assessment of a hospital-specific early warning trigger system for reducing maternal morbidity. *Int J Gynaecol Obstet.* 2016;132(3):337-41.
16. Knight M, Kenyon S, Brocklehurst P, Neilson J, Shakespeare J, Kurinczuk J J.(Eds.) on behalf of MBRRACEUK.Saving Lives, Improving Mothers' Care - Lessons learned to inform future maternity care from the UK and Ireland Confidential Enquiries into Maternal Deaths and Morbidity 2009 -12 Oxford: National Perinatal Epidemiology Unit, University of Oxford; 2014
17. Singh S, McGlennan A, England A, Simons R. A validation study of the CEMACH recommended modified early obstetric warning system (MEOWS) *Anaesthesia.* 2012;67(01):12–18.
18. Shields L E, Wiesner S, Klein C, Pelletreau B, Hedriana H L. Use of Maternal Early Warning Trigger tool reduces maternal morbidity. *Am J Obstet Gynecol.* 2016;214(04):5270–5.27E8.
19. Clark S L, Christmas J T, Frye D R, Meyers J A, Perlin J B. Maternal mortality in the United States: predictability and the impact of protocols on fatal postcesarean pulmonary embolism and hypertension-related intracranial hemorrhage. *Am J Obstet Gynecol.* 2014;211(01):320–3.2E10.
20. Singh A, Guleria K, Vaid NB, Jain S. Evaluation of maternal early obstetric warning system (MEOWS chart) as a predictor of obstetric morbidity: a prospective observational study. *Eur J Obstet Gynecol Reprod Biol.* 2016 Dec;207:11-17.