Maternal Early Warning Signs

An International System Implemented To Decrease Maternal Mortality

Amy Sullivan, MD
Maternal-Fetal Medicine
OBSTETRIC MEWS

• Prompted by the surviving sepsis campaign (2002)
  – Society of Critical Care Medicine
  – European Society of Intensive Care Medicine

Goal: Reduce mortality from sepsis by 25% in five years

Early recognition and treatment
OB MEWS: Rationale

• Maternal mortality reviews in UK, France, USA suggest 50% of maternal deaths are preventable (2009)

• Delay in recognition, diagnosis, treatment of:
  – Hemorrhage
  – Hypertension
  – Infection
  – Thrombosis
UK Validation Studies


• C Carle, P Alexander, M Columb. *Design and internal validation of an obstetric early warning score.* Anaesthesia 2013.
Maternal Mortality Ratio: maternal deaths / 100,000 births

Maternal Mortality trends USA: 1987-2010
“Lifetime risk of maternal death is greater in the USA than in 40 other countries including almost all other industrial nations”

Maternal Mortality 2015
Institute of Health Metrics and Evaluation

Per 100,000 births

Italy  Japan  Vietnam  China  Russia  Romania  Iran  USA

University of Utah Health Care
## Contributing Factors

<table>
<thead>
<tr>
<th></th>
<th>Preeclampsia or Eclampsia</th>
<th>Obstetric Hemorrhage</th>
<th>Cardiovascular Disease</th>
<th>Venous Thromboembolism</th>
<th>Amniotic Fluid Embolism</th>
</tr>
</thead>
<tbody>
<tr>
<td>Delayed Response to Triggers</td>
<td>92%</td>
<td>85%</td>
<td>63%</td>
<td>75%</td>
<td>67%</td>
</tr>
<tr>
<td>Ineffective Care</td>
<td>69%</td>
<td>75%</td>
<td>45%</td>
<td>45%</td>
<td>50%</td>
</tr>
<tr>
<td>Misdiagnosis</td>
<td>42%</td>
<td>40%</td>
<td>31%</td>
<td>50%</td>
<td>-</td>
</tr>
<tr>
<td>Failure to Consult</td>
<td>8%</td>
<td>25%</td>
<td>10%</td>
<td>25%</td>
<td>6%</td>
</tr>
<tr>
<td>Lack of Continuity of Care</td>
<td>39%</td>
<td>30%</td>
<td>27%</td>
<td>25%</td>
<td>-</td>
</tr>
</tbody>
</table>

Legend:
- **Green**: > 15% to 30
- **Orange**: > 30% to 60%
- **Pink**: > 60%
The maternal mortality ratio is viewed as an important measure of the status of women, the status of health care, and the social and political determinants of health in a country. Since 1987, the Centers for Disease Control and Prevention has documented a persistent increase in the maternal mortality ratio from pregnancy-related causes in the United States, continuing, unfortunately, as reported by Creanga et al (see page 5) in this month’s issue. The ratio is now 16.0 per 100,000 live births, up from 14.5/100,000 live births from 1998 to 2005, 11.5/100,000 live births from 1991 to 1997, and 9.1/100,000 live births from 1987 to 1990. This is shown by year from 1987 to 2010 in Figure 1, a disturbing graph.

In the 2006–2010 epoch, there were 3,358 pregnancy-related deaths and 5,028 pregnancy-associated deaths in the United States, and there is no sign of reversal of the rising ratios.1 How can a health care provider, administrator, U.S. citizen, or politician not be alarmed by this?

While writing this editorial, I’ve vacillated between sadness, anger, disbelief, and a desire to say something remotely useful about these data. I have opted to have two goals: 1) to emphasize steps that we as individual clinicians, administrators, and politicians might take to decrease the risks
National Partnership For Maternal Safety

- Multidisciplinary working group that defined “Maternal Early Warning Criteria”

- List of abnormal parameters that indicate the need for urgent bedside evaluation
Organizations in USA

- District II: Safe Motherhood Initiative (2013)


- Association of Women’s Health, Obstetric, Neonatal Nurses “AWHONN” 2013
What are early warning signs?

…a set of predetermined “calling criteria” (based on vital signs) as indicators of the need to:

– Escalate monitoring of the patient
– Call for assistance

# OB Maternal Early Warning Signs (OB MEWS)

## FIRST Priority - Stat Response
- Maternal agitation, confusion or unresponsiveness
- Signs & Symptoms of a stroke (FAST)
- Severe pain (not responding to ordered analgesia if indicated)

## SECOND Priority - 15 Minute Response Recommended
RN/APRN caring for the patient needs to be notified ASAP and any abnormal assessments requires a re-check in 10 minutes

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Lower Limit</th>
<th>Upper Limit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Systolic BP</td>
<td>&lt; 85</td>
<td>&gt; 160</td>
</tr>
<tr>
<td>Diastolic BP</td>
<td>&lt; 40</td>
<td>&gt; 110</td>
</tr>
<tr>
<td>Heart Rate</td>
<td>&lt; 50</td>
<td>&gt; 120</td>
</tr>
<tr>
<td>Respiratory Rate</td>
<td>&lt; 10</td>
<td>&gt; 30</td>
</tr>
<tr>
<td>Temperature</td>
<td></td>
<td>&gt; 40</td>
</tr>
<tr>
<td>Oxygen Saturation (while awake):</td>
<td></td>
<td>&lt; 92%</td>
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<tr>
<td>or any patient who requires oxygen or has increasing oxygen requirements to maintain this saturation rate</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Oliguria</td>
<td></td>
<td>&lt; 35mL/2H</td>
</tr>
<tr>
<td>Uncontrolled pain (not responding to ordered analgesia)</td>
<td></td>
<td></td>
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<tr>
<td>New onset vaginal bleeding (preterm inpatient antepartum patient)</td>
<td></td>
<td>Nurse must visualize the bleeding (if pt. reports flushing it- please examine perineum for evidence of bleeding if not visible place a pad on the patient.</td>
</tr>
</tbody>
</table>

## THIRD Priority - ≤ 30 Minute Response

**ROUTINE MATTERS**
Use of Maternal Early Warning Trigger tool reduces maternal morbidity

Laurence E. Shields, MD; Suzanne Wiesner, RN, MBA; Catherine Klein, RN, CNM; Barbara Pelletreau, RN, MPH; Herman L. Hedriana, MD

BACKGROUND: Maternal mortality in the United States has increased unabated for the past 20 years. Maternal morbidity is also affecting an increasingly large number of women in the United States. A number of national and state organizations have recommended the use of maternal early warning tools as a method to combat this problem. There are limited data suggesting that the use of these types of clinical assessment tools can reduce maternal morbidity.

OBJECTIVE: We sought to determine if maternal morbidity could be reduced with the implementation of a clinical pathway-specific Maternal Early Warning Trigger (MEWT) tool.

STUDY DESIGN: The tool was developed internally and prospectively implemented as a pilot project in 6 of 29 hospitals within a large hospital system. The primary goal was early assessment and treatment of patients suspected of clinical deterioration. The tool addressed the 4 most common areas of maternal morbidity: sepsis, cardiopulmonary dysfunction, preeclampsia-hypertension, and hemorrhage. To be considered positive, triggers needed to be sustained for >20 minutes and were defined as severe (single abnormal value): maternal heart rate (HR) >130 beats/min (bpm), respiratory rate >30/min, mean arterial pressure <55 mm Hg, oxygen saturation <90%, or nurse concern; or nonsevere (required 2 abnormal values): temperature >38 or <36°C, blood pressure >160/110 or <85/45 mm Hg, HR >110 or <50 bpm, respiratory rate >24 or <10/min, oxygen saturation <93%, fetal HR >160 bpm, altered mental status, or disproportionate pain. Within each group, recommended management or assessment was also provided. Outcome measures were Centers for Disease Control and Prevention (CDC)-defined severe maternal morbidity, composite maternal morbidity, and intensive care unit (ICU) admissions. Two time intervals were used to analyze the effect of the MEWT tool: a 24-month baseline control period and a 13-month MEWT study period. To determine that the findings noted were not simply changes that would have occurred without the utilization of the early warning tool, we also compared a control population from nonpilot sites during the same baseline and 13-month time periods.

RESULTS: There were 36,832 deliveries at the pilot sites (24,221 pre- and 12,611 post-MEWT testing) and 146,359 at the nonpilot sites (95,718 pre- and 50,641 post-MEWT testing) during the 2 study time periods. Use of the MEWT tool resulted in significant reductions in CDC severe maternal morbidity ($P < 0.01$) and composite morbidity ($P < 0.01$). ICU admissions were unchanged. At nonpilot sites CDC severe maternal morbidity, composite morbidity, and ICU admissions were unchanged between baseline and the post-MEWT testing time period.

CONCLUSION: The use of the MEWT tool in this study, designed to address 4 of the most common causes of maternal morbidity, as well as provide assessment and management recommendations, resulted in significant improvement in maternal morbidity. The variation in hospital delivery services at the pilot sites suggests that this maternal early warning tool would be suitable for use in the majority of maternity centers in the United States.

Key words: critical vital signs, maternal decompenstation, maternal mortality
Maternal Early Warning Trigger (MEWT) tool.

bil, bilirubin; BNP, brain natriuretic peptide; BP, blood pressure; CBC, complete blood count; CT, computerized tomography; DBP, diastolic blood pressure; DIC, disseminated intravascular coagulation; EKG, electrocardiogram; gm, grams; HR, heart rate; ICU, intensive care unit; LFTs, liver function testing; MAP, mean arterial pressure; MTP, maternal transfusion protocol; OB, obstetrician; O2 Sat, oxygen saturation; PIH, preeclampsia laboratory assessment; Powerplan, electronic medical record preeclampsia order set; Pulse Ox, pulse oximetry; RR, respiratory rate; RRT, rapid response team; SBP, systolic blood pressure; Temp, temperature.

OB Hypertension Safety Bundle
Safety Action Series
Severe Hypertension Patient Safety Bundle

• Hypertensive disorders in pregnancy affect 5%-10% of pregnancies in the United States.
• Preeclampsia is the leading cause of maternal morbidity and mortality, with an estimated 50,000 – 60,000 preeclampsia related deaths per year, worldwide.
• For every preeclampsia-related death in the United States, there are 50-100 other women who experience “near miss” events that stop short of death, but result in significant health risk and health care costs.
Readiness

• Education
  – Diagnostic criteria, monitoring, treatment
  – Simulation and team training
• Rapid access to medication
• Plan for obtaining consult if patient deteriorates
Recognition

- Well defined standards for:
  - Monitoring BPs
  - Recording BPs
  - Confirming abnormal results
  - Alerting Provider
Response

• Standardized protocols
  – Treatment
    • Timely triage
    • order sets and algorithms for labs, medication administration, fetal assessment
  – Rapid access to first line anti-hypertensive meds
  – System plan for escalating
<table>
<thead>
<tr>
<th>Communication Orders</th>
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| **Notify provider - hemodynamic Parameters - Elevated BP range [NUR183]** | Routine, Continuous  
Temperature greater than: 38  
Temperature less than: 36.5  
Systolic BP greater than: 160  
Systolic BP lower than: 96  
Diastolic BP greater than: 100  
Diastolic BP less than: 60  
Heart rate greater than: 120  
Heart rate less than: 60  
Respiratory rate greater than: 20  
Respiratory rate less than: 12  
SpO2 less than: 92  
Urine output less than 30 mL per hour or less than 240mL for 8 hours, antepartum |
| Communication MD to HUC - Order US OB Fetal Non Stress Test Every Monday and Thursday [NUR304628] | Routine, As Directed  
Please place order for US OB Fetal Non Stress Test every Monday and Thursday |
| Communication MD to HUC - Order US OB Fetal Non Stress Test Every Tuesday and Friday [NUR304628] | Routine, As Directed  
Please place order for US OB Fetal Non Stress Test Every Tuesday and Friday |
| Communication MD to HUC - Order Daily US OB Fetal Non Stress Test [NUR304628] | Routine, Nightly For 1 Occurrences  
Please place order for US OB Fetal Non Stress Test daily |
| Communication MD to HUC - Order Daily US OB Follow Up [NUR304628] | Routine, Nightly For 1 Occurrences  
Please place order for US OB Follow up |
Severe range BP = systolic ≥ 160 OR diastolic ≥ 110

Verified severe range BP must be immediately reported to the OB provider

VS Evaluation

Accurate Assessment

Correct Cuff Size
Correct Pt. Position

Severe Range BP

Check BP Q 10 minutes for 20 minutes. If two severe range BP’s occur in this time, treatment for hypertension is indicated

IV access
No IV access

Initiate Labetalol algorithm
Initiate Nifedipine algorithm

Contraindication to Labetalol: use Hydralazine Algorithm
- Pulse <60
- Moderate to severe asthma defined as requiring daily inhaled steroids

Severe Range BP’s
Verified severe range BP must be immediately reported to the OB Provider

Administer Labetalol 20mg IV

Repeat BP 10 minutes after dose

If SBP ≥160 or DBP ≥110, administer Labetalol 40mg IV

Repeat BP 10 minutes after dose

If SBP ≥160 or DBP ≥110, administer Labetalol 80mg IV

Repeat BP 10 minutes after dose

If SBP ≥160 or DBP ≥110 at 20 minutes, administer Hydralazine 10mg IVP if below threshold, continue to monitor BP closely

Repeat BP Q 10 minutes after dose

If SBP ≥160 or DBP ≥110 at 20 minutes, administer Hydralazine 10mg IVP and obtain emergency consultation from MFM or Anesthesia

Once BP is controlled (SBP <160 and DBP <110) serial BP’s need to be assessed:
- Q 15 minutes for 2 hours
- Q 30 minutes for the next hour
- Then as standard guideline dictates

Contraindications to Labetalol are moderate to severe asthma defined as requiring daily inhaled steroids
- Max dose for IV Labetalol is 300 mg in 24 H

Labetalol Algorithm
Verified severe range BP must be immediately reported to the OB provider

- Administer Hydralazine 10 mg IV
  - Repeat BP Q 10 minutes after dose
  - If SBP ≥160 or DBP ≥110 at 20 minutes, administer Hydralazine 10 mg IV over 2 minutes
    - Repeat BP Q 10 minutes after dose
    - If SBP ≥160 or DBP ≥110 at 20 minutes, administer Nifedipine 10 mg PO
      - Repeat BP Q 10 minutes after dose
      - If SBP ≥160 or DBP ≥110 at 20 minutes, administer Nifedipine 20 mg PO
        - Repeat BP Q 10 minutes after dose
        - If SBP ≥160 or DBP ≥110 at 20 minutes, administer Nifedipine 20 mg PO, and obtain emergency consultation from MFM or Anesthesia

Once BP is controlled (SBP <160 and DBP <110) serial BP's need to be assessed:
- Q 15 minutes for 2 hours
- Q 30 minutes for the next hour
- Then as standard guideline dictates

Maximum cumulative IV - administered dose of Hydralazine should not exceed 25mg in 24H

Hydralazine Algorithm
Verified severe range BP must be immediately reported to the OB provider

**Oral Nifedipine 10mg**

- Repeat BP 10 minutes after dose

  => Switch to Labetalol algorithm as soon as IV access is obtained

- If SBP ≥160 or DBP ≥110 at 20 minutes, administer oral Nifedipine 20mg

  Repeat BP 10 minutes after dose

  - If SBP ≥160 or DBP ≥110 at 20 minutes, administer oral Nifedipine 20 mg
    - IV access must be obtained at this time (if not already done) and start the Labetalol algorithm

Once BP is controlled (SBP <160 and DBP <110) serial BP’s need to be assessed:
- Q 15 minutes for 2 hours
- Q 30 minutes for the next hour
- Then as standard guideline dictates

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**Oral Nifedipine Algorithm**
Eclamptic Seizure Algorithm

Call for Help

Airway Protection/Patient Safety
- Lateral Position
- Open Airway / Bite Block
- Oxygen via FM @ 10L
- Pulse Oximeter
- Suction Available/On
- Bed Pads
- Ambu Bag in room
- Check BP/Pulse/O2 Sat
- IV Access
- PIH Labs

OB Team
- Attending
- OB Residents
- Anesthesia
- L&D CN

Responders
- Airway
- Medications
- Baby
- Equipment

Magnesium Sulfate
If patient has IV access:
- Give 6 grams magnesium sulfate IV over 20 minutes
- Start maintenance dose of 2 g/hr IV after bolus

If patient does not have imminent IV access:
- Give 10 grams Magnesium sulfate IM (5g to each buttock)
- Start IV ASAP. If difficult peripheral IV, consider central line or intraosseous access
- Once IV access in place give 4 grams Magnesium sulfate IV
- 4 hours later start maintenance 2 grams/hr IV
- If unable to obtain IV access of any kind give 3 grams Magnesium sulfate IM q 4 hours

Recurrent Seizure
- Consider 2nd bolus Mg 2 g IV over 3 minutes
- Pump settings: rate 600/volume 50

Recurrent or Persistent Seizure
≥ 5 minutes
- Midazolam (versed) - 1-2 mg IVP
- Lorazepam (Ativan) – 4 mg slow IVP
- Diazepam (Valium) – 5-10 mg slow IVP
- Phenytin - 1000 mg IV over 20 min

Post-Seizure Care
- Assess neurologic state:
  - Mental status
  - Reflex check
  - Weakness/injury

Delivery Planning
- Assess patient
- Stabilize mom first
- Think about baby second
- Once mom stabilized determine route of delivery
  - Vaginal
  - Cesarean section

J. Fisher / Sept 2015 V2
SNL Update
Hypertension Verified in <=10 min. (All)

- January: 40%
- February: 56%
- March: 48%
- April: 50%
- May: 57%
- June: 45%
- July: 50%
- August: 50%
- September: 56%
- October: 45%
Reporting / Data Collection

• Quality Question:
  – Was a severe range BP \((\text{SBP} \geq 160 \text{ OR } \text{DBP} \geq 110)\) identified and verified within 10 minutes?
  
  – If a severe range BP was verified did the patient receive the correct dose of a first line antihypertensive within 30 minutes?
Promoting a Culture of Safety

All care providers are to be rewarded, not punished or ignored when they call for a bedside evaluation, regardless of the clinical outcome.
Steps for success

- Education (all units)
- Facility-wide acceptance or “buy in”
- Outcome audits
- Multidisciplinary review of complex cases
Summary

1. Delays in recognition and treatment precede a majority of events that result in severe maternal morbidity and mortality
2. HTN, PPH, thrombosis, and sepsis, are the most common causes of morbidity and mortality
3. Early warning signs have been validated to identify patients at risk
4. Safety bundles empower all providers, standardize care, and decrease maternal morbidity