Putting the "Vital" Back into Vital Signs

What Every Provider and Nurse Needs to Know to Prevent Maternal Morbidity and Mortality

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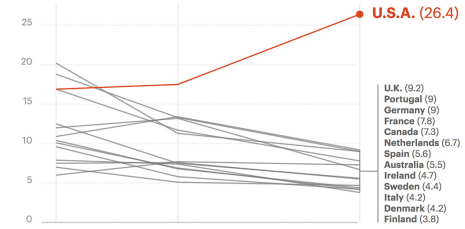
Objectives

- Identify trends in U.S. maternal morbidity and mortality rates
- Understand physiologic vital signs in the context of pregnancy
- Case Study: Conduct a review of a labor and delivery patient's vital signs and plan of care
- Evaluate the value of a maternal early warning system to recognize and respond to deteriorating vital signs

Maternal Mortality Is Rising in the U.S. as it Declines Elsewhere



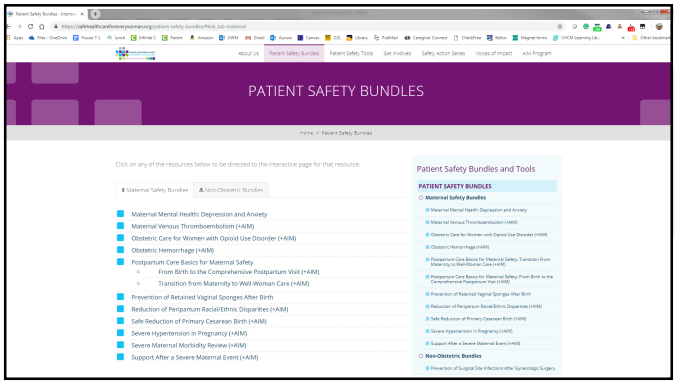
"Global, regional, and national levels of maternal mortality, 1990–2015: a systematic analysis for the Global Burden of Disease Study 2015." *The Lancet*. Only data for 1990, 2000 and 2015 was made available in the journal.
Source: The Lancet
Credit: Rob Weychert/ProPublica

Myths

- Mothers are young and therefore healthy
- "Delivery is the cure"
- Fatal maternal infections only occur in developing countries
- Routine fetal monitoring but not vital signs by mother

- Not a myth- up to 50% of maternal deaths are preventable (Joint Commission on Accreditation of Healthcare Organizations, 2010)

- "We worry a lot about vulnerable little babies," said Barbara Levy, vice president for health policy/advocacy at the American Congress of Obstetricians and Gynecologists (ACOG) and a member of the Council on Patient Safety in Women's Health Care. Meanwhile, "we don't pay enough attention to those things that can be catastrophic for women."



Maternal Early Warning Signs Protocol
Bedside evaluation within 10 minutes

- Systolic BP <90 (>30 minutes after epidural placement) >160
- Diastolic BP >100
- Heart Rate <50 or >120
- Respiratory Rate <10 or >30
- Oxygen Sat <95%

- Oliguria <35 mL/hr x 2 hours
- Maternal agitation, confusion or unresponsiveness
- Patient with hypertension reporting a non-remitting headache or shortness of breath

https://safehealthcareforeverywoman.org/wp-content/uploads/2017/02/MEWS-Protocol.pdf

Vital Signs

- Vital signs indicate how well organs are functioning
- Although abnormal vital signs are "normal" in labor, there is a threshold of abnormality that signals organ disfunction
- To prevent maternal death "identify specific triggers to responding to changes in mother's vital signs and develop and use protocols and drills for responding to changes, such as hemorrhage and pre-eclampsia…" (Joint Commission on Accreditation of Healthcare Organizations, 2010)
- Why do we dismiss vital signs in labor?

Respiratory Rate: The neglected vital sign

- Documentation of respiratory rate is often not recorded in multiple mortality reviews (Albright, Ali, Lopes, Rouse, & Anderson, 2014; Bauer et al., 2014; Cretikos et al., 2008; Easter et al., 2017; Mohamed-Ahmed, Nair, Acosta, Kurinczuk, & Knight, 2015)
- Substantial evidence indicates abnormal respiratory rates are predictive of potentially serious clinical events (Kenzaka et al., 2012)
- Increased blood volume by 32-34 weeks creates an altered Frank-Starling curve, creating susceptibility to respiratory distress syndrome (Padilla & Palanisamy, 2017)
- Chronic respiratory alkalosis--diminished oxygen reserve
  - PaCO2 28-32 mmHg
- Key point: Respiratory rate is a stable vital sign in pregnancy and labor

Heart Rate

- Cardiac output increases, resulting in reduced system vascular resistance and mean arterial pressure with an increased heart rate (Cunningham, 2010)
- Heart rate at rest increases from a normal pre-pregnancy rate of about 70 beats per minute to 80 or 90 beats per minute
- Tachycardia--cardiovascular output
  - Heart rate increases 17% as early as 4 weeks gestation
  - 20 bpm higher at 32 weeks gestation
- Tachycardia pumps less efficiently- blood flow to the body and heart are reduced
- Key point- heart rate is increased with work of labor, but should not exceed 110

Blood Pressure and MAP

- Cardiac output increases, resulting in reduced system vascular resistance and mean arterial pressure with an increased heart rate (Cunningham, 2010)
- MAP at 36-38 weeks gestation is between 85-95 mmHg
- SYSTOLIC BP remains ***unchanged*** in pregnancy (Cunningham, F. G. et al., 2014)
- Epidural anesthesia produces a sympathetic blockade that diminishes regulation of vascular tone.
- Key point: Maternal systolic hypotension is only normal in the first 30 minutes of epidural placement!
- MAP is a better indicator of perfusion

Temperature

- Intrapartum fever is common in labor

- Key point: Clinicians should suspect infection rather than dismissing low-grade fevers

White Blood Cells

- Leukocytosis occurs normally in pregnancy and can be as high as 25K in late labor and postpartum

- Key point: Immature neutrophils are never a part of normal pregnancy and indicate an immune response

Intake and Output

- Prerenal oliguria from decreased blood flow
- In the presence of abnormal vital signs-initiate I&O to determine kidney function

Case Study

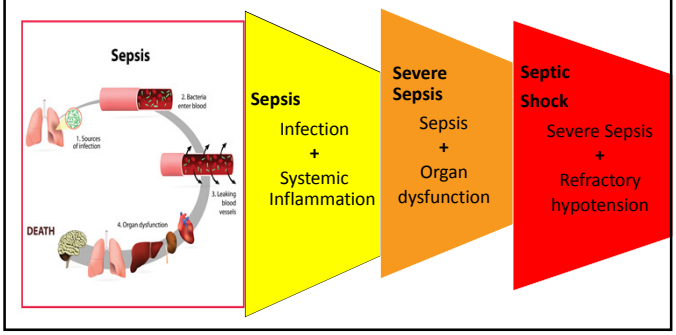
What can we learn from this patient?

- Labor and Delivery vital signs must include respiratory rate and MAP
- In the presence of abnormal vital signs, reassessment must be more frequent
- Maternal patients deteriorate rapidly-awaiting consults is ill advised
- Nurses fear provider retaliation from frequent notifications and escalation to STAT team
- STAT team should be called with organ dysfunction

- ACOG recommends "high-intensity ICU physician staffing" as a superior model compared to when an intensivist is consulted. "Delay in diagnosis and involvment of intesivist care teams has been recognized as suboptimal care that directly contributes to maternal death."(Padilla & Palanisamy, 2017)

Delay in treatment

- Women who die in pregnancy related to sepsis are more likely to have never had antibiotics during hospitalization OR=22.7, 95% CI[3.64-141.6] (Mohamed-Ahmed et al., 2015)



System barriers to evidence-based practice

- Miscalculation of maternal deaths from sepsis
- Lack of national data due to incorrect coding
- Preventing maternal death is not a strategic initiative
- No accepted criteria for screening sepsis in mothers

- Sepsis is the number 3 cause of pregnancy related deaths (17.2%)

2017 World Health Organization Consensus Definition

- "Maternal sepsis is a life-threatening condition defined as organ dysfunction resulting from infection during pregnancy, childbirth, post-abortion, or postpartum period" (World Health Organization, 2017).
- The authors deliberately termed the syndrome "maternal sepsis" and not "obstetric sepsis," recognizing the need for multidisciplinary providers in the treatment of sepsis for this population, with the expertise for sepsis largely outside of the obstetric field.

World Health Organization. (2017). *Statement on maternal sepsis*. Retrieved from http://apps.who.int/iris/bitstream/10665/254608/1/WHO-RHR-17.02-eng.pdf?ua=1

Physician barriers to evidence-based practice

- WHO released the first definition of maternal sepsis in September 2017
- ACOG has not released practice bulletin on maternal sepsis
- Failure to recognize that sepsis progresses to septic shock
- Discount the significance of worsening vital signs in labor
- View sepsis incidence through the lens of their own practice
- Hesitant to consult during labor due to reliance on delivery to solve clinical issues
- Unaware of the threshold at which vital signs indicate sepsis, rather than a healthy mother laboring
- Difficult to diagnose- compensatory ability of a young healthy body
  - Physiology of pregnancy impacts maternal reserves so compensation quickly turns to rapid decompensation

Nurse barriers to evidence-based practice

- Under recognition of sepsis as a cause of maternal morbidity/mortality
- Retrospective chart reviews lack documentation of vital signs
- Vital signs are not obtained at intervals based on established perinatal standards
- View pregnancy and labor as healthy states
- Preoccupied with fetal monitoring rather than maternal monitoring
- Fear of retaliation if asking for consult during labor

Pregnancy is opportunistic for some infections

- Pregnancy is an immune compromised state
- Suppression of killer cells and cytokines protect the fetus
- Excessive activation of the non-specific immune response creates proinflammatory cytokine production with a corresponding decrease production of anti-inflammatory cytokine IL-10
- E-coli lipopolysaccharide induces a dysregulated inflammatory response, significantly increasing risk of sepsis and sepsis shock (Vizi et al., 2001)
- Changes in vaginal flora create pathways for opportunistic bacteria

Bacteria that frequently cause maternal sepsis

- Endotoxin-producing Enterobacteriacaea, typically E.coli
- Aerobic and anaerobic strains of streptococci
- Bacteriods species
- Clostridium species
- Group A β-hemolytic streptococci and Staphylococcus aureus
  - Can produce a super-antigen that activates I cells to rapidly cause all features of sepsis
- Septic shock in pregnancy is most often caused by pyelonephritis (Morgan & Roberts, 2012)

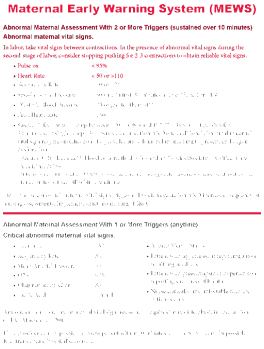
Maternal Sepsis Screening

- Only done on patients with suspected or confirmed infection
- ACOG-
  - Isolated maternal fever- defined as maternal temperature between 38.0℃ and 38.9℃ (100.4°F-102.02°F) that persists after 30 minutes, or single temp >39℃ (absent an obvious alternative source, these patients should be considered suspected intraamniotic infection).
  - **Suspected intraamniotic infection- maternal intrapartum fever and one or more of the following**
    - Maternal leukocytosis
    - Purulent cervical drainage
    - Fetal tachycardia
  - Confirmed intraamniotic infection
    - Positive amniotic fluid test result (gram stain, glucose level, or culture results consistent with infection) or placental pathology demonstrating histologic evidence of placental infection or inflammation.
      - Almost always made after delivery based on histopathologic studies
      - **In labor settings all patients, suspected or confirmed should be managed the same**

This part is key-reassessment

https://journals.lww.com/greenjournal/Fulltext/2016/10000/Practice_Bulletin_No__170___Critical_Care_in_60.aspx

Maternal Early Warning System (MEWS)



Abnormal Maternal Assessment With 2 or More Triggers (sustained over 10 minutes)
Abnormal maternal vital signs.

In labor, take vital signs between contractions. In the presence of abnormal vital signs during the second stage of labor, consider stopping pushing for 2 to 3 contractions—then reliable vital signs.

- Pulse ox — < 93%
- Heart Rate — < 80 or >110
- [illegible]

Abnormal Maternal Assessment With 1 or More Triggers (anytime)
Critical abnormal maternal vital signs.

- [illegible]

[illegible]

Frequency of Abnormal Vital Sign Triggers

Severe Group-Single triggers	% of patients
HR>130	0.60%
Nurse uncomfortable	0.01%
RR >30	0.01%
MAP <55 mmHG	0.01%
Altered Mental Status	-

Nonsevere group-2 or more triggers	% of patients
HR >110	1.51%
Temp >38°C	1.50%
Fetal HR >160	0.90%
RR >24 or <10	0.15%
SpO2% <93%	<0.1%

When vital signs persist over 20 minutes- higher specificity.
Frequent reassessment!

Adapted from: Shields, L. E., Wiesner, S., Klein, C., Pelletreau, B., & Hedriana, H. L. (2016). Use of Maternal Early Warning Trigger tool reduces maternal morbidity. *American Journal of Obstetrics and Gynecology, 214*(4), 527.e521-526. doi:10.1016/j.ajog.2016.01.154
Used with permission.

Physician documentation/note

- Differential diagnosis
- Planned frequency of monitoring and re-evaluation
- Criteria for immediate physician notification
- Diagnostic or therapeutic interventions

- If MEWS conditions persist after corrective measures are taken
  - MFM consult, Hospitalist or Rapid Response Team

Maternal-Fetal Minimum Assessment/Documentation Guidelines

Maternal-Fetal Assessment and Documentation Minimum Guidelines- Increase frequency when values are abnormal

3/21/2018

	Latent Labor	Active Labor (6 cm or greater)	Oxytocin	Epidural	Cervidil/ Cytotec	Second-Stage Labor	First Hour of Magnesium Sulfate and Any Change in Dose	Magnesium Sulfate Maintenance Dose	All Other patients
Maternal Vital Signs	P, R, BP every 4 hr. T every 4 hr unless ROM, then every 2 hr, every 1 hr if febrile	P, R, BP every 1 hour; T every 4 hr unless ROM, then every 2 hr, every 1 hr if febrile	P, R, BP every 1 hr; T every 4 hr unless ROM, then every 2 hr, every 1 hr if febrile	P, R, BP, prior to placement; every 5 min after initiation for 1st 30 min, then P, BP, every 15 min. R every 1 hr, T every 4 hr unless ROM, then every 2 hr, every 1 hr if febrile	P, R, BP every 4 hr; T every 4 hr unless ROM, then every 2 hr, every 1 hr if febrile	P, R, BP every 1 hr; T every 4 hr unless ROM, then every 2 hr, every 1 hr if febrile	P, R, BP every 15 min; T every 4 hr unless ROM, then every 2 hr, every 1 hr if febrile	P, R, BP every hr; T every 4 hr unless ROM then every 2 hr, every 1 hr if febrile. High-risk assessment every 2 hr	P, R, BP, T every 4-8 hours based on risk status; at least every 8 hours

Success!

Provider recognition:
CBC 12:57
WBC: 21.8
AbNeut: 18.7
Lactate ordered
Antibiotics

Nurse Assessment/Reassessment:
Respiratory every hour
Frequent vital signs

36 y/o, G2P1, GBS +, BMI 42, GDM, primary hypertension

Time	Temp	Pulse	RR	BP	MAP	LAB	Had PEN for GBS MEDS
10:04	99.2	78		139/66			
15:15		76		135/76			
10:30		75		135/76			
11:00		66		153/91	116		
11:15		74		155/91	121		
12:00	100	64	24	139/73			
12:30		68		142/87	110		
12:45		71		145/87	111		
13:10	100	78	20	147/88	112		
14:00	99.7		18			Lactate 1.5	
14:11		75		135/63	90		
14:23		77		136/63	90		Labetalol
14:40		74		151/82	107		
14:46							Ampicillin
14:54		73		138/70	98		
15:00		78	20	141/72	99		
15:05	99.5	72		139/73	99		
15:08		69		130/73	100		
15:11		67		128/70	94		
15:14		64		132/63	94		
15:17		75		132/69	91		
15:33		75		123/61	89		
15:49		71		132/63	88		
16:00			18				
16:30	99.6	89		132/63	91		
16:50		89		131/59	85		
17:03		93	24	132/62	89		
17:15		90		147/66	95		
17:30	100.1	96		132/72	95		
17:45		102		130/71	93		
18:15		96		132/72	105		
19:00	100.9	85		140/71	97		
19:30		113	18	145/85	106		
19:43		83	16	143/86	107		
20:31							Labetalol
23:47							Gentamicin

Patient D/C order

12:38 PM	
Visit Vitals	
BP	(!) 89/55
Pulse	115
Temp	98.8 °F (37.1 °C) (Oral)
Resp	22
Ht	5' 6" (1.676 m)
Wt	64.4 kg
LMP	10/12/2017 (Exact Date)
SpO2	100%
BMI	22.92 kg/m²

Assessment: 24 y.o. G1P0 at 25+3 weeks gestation with left sided abdominal and left flank pain, urinalysis suspicious for UTI. Fetal tracing reassuring. Anemia noted on screening labs. Pt reports feeling better with IV hydration, tolerating oral intake. Plan: IV hydration given, as well as 1 gm IV Rocephin. Plan discharge to home on Amoxicillin. Start ferrous sulfate supplement for anemia. Follow up this week in office.

Success!

Dr. XXX updated on patient status. Temp is back up to 99.7 orally and RR 28. BP and MAP have decreased slightly since admission. HR is rising, now in the 130s. Patient requesting Tylenol for fever and body aches. RN requesting to extend observation before discharging patient, d/t risk for sepsis. Orders received. Repeat lactic acid to be drawn STAT.

Patient transferred to ICU for severe sepsis and ADRS.

Recommendations

- Hospitals must have written policies for maternity units that include
  - Frequency of vital sign documentation
  - Escalation in the frequency of vital sign documentation when abnormal patterns are recorded
  - Policies for escalating levels of care for patients to prevent morbidity and mortality
- Early, goal-directed treatment within 1-hour of recognition of sepsis
  - Complete blood count
  - Obtain blood cultures and lactate levels
  - Initiate broad spectrum antibiotics

References