Code Sepsis: Let’s Intervene Before It Hits!

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Disclosures

• Lori Olvera reports no conflict of interest with content of presentation and is compliant with the AWHONN Conflict of Interest Policy for presentations.
Objectives

• Describe the definition of Maternal Sepsis
• Understand the pathophysiology of sepsis that explains the rationale for interventions
• Understand the two-step method for screening and diagnosis of sepsis in pregnancy
• Describe the treatment and assessments for a women with sepsis
• AWHONN
Members making a difference

CMQCC
Megan died of SEPTIC SHOCK while in Labor..
LeeAnna
Septic Shock
Survivor......
Graciela: "I believe that we experience moments in our lives that define who we will become. For me, that moment happened when I coded 5 days after my C-Section from septic shock."

Primarily Obstetric Causes

- Infection: 12.7%
- Hemorrhage: 11.4%
- Hypertensive Disorders: 9.2%
- Amniotic Fluid Embolism: 7.4%
- Cardiovascular Conditions: 5.5%

Primarily Medical Causes

- Cardiomyopathy: 15.5%
- Cerebrovascular Accident: 11%
- Other Medical Conditions: 6.6%
- Infection: 14.5%
- Hemorrhage: 12%
- Hypertensive Disorders: 10.5%
- Amniotic Fluid Embolism: 8%
- Cardiovascular Conditions: 5.5%

Maternal Sepsis Facts

• CDC estimates US maternal deaths from Sepsis is 12.7%
• 63-73% of maternal deaths from sepsis are PREVENTABLE
• For each maternal death, there are 50 women experiencing life-threatening morbidity from sepsis
What does the literature say...

Maternal Sepsis is a significant cause of maternal mortality and is a preventable cause of maternal death.
Recommendation: Prompt Recognition and rapid treatment of maternal sepsis improves outcomes.
**SEPSIS:**

Currently no gold standard diagnostic test exists to confirm the presence of sepsis

Broadly defined as life-threatening organ dysfunction caused by a dysregulated host response to infection

**SEPTIC SHOCK:**

Subset of sepsis with circulatory and cellular/metabolic dysfunction associated with higher risk of mortality
Clinical Pearls

Sepsis and Septic Shock are medical emergencies, and we recommend that treatment and resuscitation begin immediately.

The unique needs of the Obstetric Population makes it difficult to use the National Sepsis Criteria?

- Physiological changes of pregnancy mask the signs of sepsis.
- Labor can further impact these physiologic parameters and significantly raise lactate levels.
- The pregnant women’s immune system is down-regulated to protect the growing fetus.
- ABX selection needs to consider what is safe for the fetus.
**Pathophysiology**

**Inflammatory mediators** (histamines, serotonin, cytokines) cause increase vascular permeability and vasodilation.

**Vascular Permeability**: Increase permeability of blood vessels; leaky vessels
- Migration of leukocytes to site of injury

**Vasodilation**: Widening of blood vessels, resulting in pooling of blood, causing a relative decrease in intravascular volume; plasma & molecules leak into extravascular space.
Leaky Vessels...

- Small molecules such as Na, H2O leak through leaky vessels
- Some larger molecules such as ALBUMIN will escape as well (loss of osmotic pressure)
- Loss of fluid from intravascular space (tank is dry)
Effects of Increased Vascular Permeability of Capillaries

- Reduced Circulating Volume

- Hypotension

- Tachycardia
Increased oxygen demand

Requires increase in oxygen delivery

Need to increase HR
Conversion to Anaerobic Metabolism

Pathophysiology of Anaerobic Respiration
If Oxygen Demand of the tissues is not met by oxygen delivery

Anaerobic Respiration Occurs
Lactic Acid is a by-product (serum lactate)

Metabolic Acidosis
Increased Respiratory Rate
Cardiac depression
Confusion
Disseminated Intravascular Clotting

Sepsis causes widespread clotting

This causes consumption of platelets, clotting factors and fibrinogen.

Impaired coagulation

Impaired risk of bleeding

CONSUMPTIVE COAGULOPATHY

CLOTTING  ⇔  BLEEDING
# Leading Causes of Maternal Sepsis

<table>
<thead>
<tr>
<th>Antepartum</th>
<th>Intrapartum/Immediate Postpartum</th>
<th>Post-discharge</th>
</tr>
</thead>
<tbody>
<tr>
<td>Septic abortion</td>
<td>Chorioamnionitis/ intraamniotic infection</td>
<td>Pneumonia/influenza</td>
</tr>
<tr>
<td>Chorioamnionitis/ intraamniotic infection</td>
<td>Endometritis</td>
<td>Pyelonephritis</td>
</tr>
<tr>
<td>Pneumonia/ influenza</td>
<td>Pneumonia/influenza</td>
<td>Wound Infection/ necrotizing fasciitis</td>
</tr>
<tr>
<td>Pyelonephritis</td>
<td>Pyelonephritis</td>
<td>Mastitis</td>
</tr>
<tr>
<td>Appendicitis</td>
<td>Wound Infection/ necrotizing fasciitis</td>
<td>Cholecystitis</td>
</tr>
</tbody>
</table>
STEP 1: All patients with suspected infection should be screened:

- Temp ≥ 38 C/100.4 F or < 36 C/96.8 F
- HR > 110 beats/min
- RR > 24 breaths/min
- WBC > 15,000 mm³ or < 4,000 mm³ or > 10% immature neutrophils (bands)
- Altered Mental Status

Sepsis Screen Positive:
- 2 or more criteria with suspected infection
### Step 2: Criteria for End Organ Injury

**POSITIVE IF ONE OR MORE CRITERIA ARE MET**

<table>
<thead>
<tr>
<th>Category</th>
<th>Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Respiratory Function</strong></td>
<td>✓ Acute Respiratory Failure AEB acute need for invasive or non-invasive mechanical ventilation OR&lt;br&gt;✓ PaO2/FIO2 &lt; 300</td>
</tr>
<tr>
<td><strong>Coagulation Status</strong></td>
<td>✓ Platelets &lt; 100 X 10⁹/L OR&lt;br&gt;✓ International Normalized Ratio (INR) &gt; 1.5, OR&lt;br&gt;✓ Partial Thromboplastin Time (PTT) &gt; 60 seconds</td>
</tr>
<tr>
<td><strong>Liver Function</strong></td>
<td>✓ Bilirubin &gt; 2 mg/dl</td>
</tr>
<tr>
<td><strong>Renal Function</strong></td>
<td>✓ Creatinine &gt; 1.2 mg/dl, OR&lt;br&gt;✓ Doubling of serum creatinine, OR&lt;br&gt;✓ Urine Output less 0.5 ml/kg/hour (for 2 hours)</td>
</tr>
<tr>
<td><strong>Mental Status Assessment</strong></td>
<td>✓ Agitation, confusion, or unresponsiveness</td>
</tr>
<tr>
<td><strong>Cardiovascular Function</strong></td>
<td>✓ Persistent hypotension after fluid administration:&lt;br&gt;❖ SBP &lt; 85 mm Hg, OR&lt;br&gt;❖ MAP, 65 mm Hg, OR&lt;br&gt;❖ &gt; 40 mm Hg decrease in SBP</td>
</tr>
<tr>
<td><strong>Lactic Acid</strong></td>
<td>✓ &gt; 2mmol/L in absence of labor&lt;br&gt;✓ Lactic Acid not used for diagnosis in labor but remains important for treatment.</td>
</tr>
</tbody>
</table>
Performance of Two-Step System for Diagnosis of Maternal Sepsis  
(data extracted from clinical practice data sets, not formal research studies)

<table>
<thead>
<tr>
<th>Source</th>
<th>OB Vital Signs Screen</th>
<th>Sepsis (End Organ Injury)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Population Screened</td>
<td>Total with End Organ injury</td>
</tr>
<tr>
<td>Combined Systems*</td>
<td>14,752</td>
<td>33</td>
</tr>
<tr>
<td></td>
<td>199 (1.3%)</td>
<td>(16.6% of screen positives)</td>
</tr>
</tbody>
</table>

Notes:  
(1) Initial screen positive rate is 1.3%  
(2) Overall performance of the Two-Step System as shown above gives an approximate sensitivity of 97% (TP/TP+FN: 32/33); and an approximate specificity of 99% (14,552/14,552 + 166: TN/TN+FP).

* Data from Dignity Health and Sutter Health
Initial Sepsis Screen (Step 1)

**Step 1: Initial Sepsis Screen**
- Oral temp < 36°C (96.8°F) or > 38°C (100.4°F)
- Heart rate > 110 beats per minute
- Respiratory rate > 24 breaths per min
- WBCs > 15,000/mm³ or < 4,000/mm³ or > 10% bands

Positive if any 2 of 4 criteria met

**Action**: If suspected infection, start source-directed antibiotics and 1-2 L of IV fluids; increase monitoring and surveillance. Move to confirmation evaluation.

**NOTE**: A MAP < 65 mm Hg (confirmed) with infection directly defines SEPTIC SHOCK
Labs to Confirm Sepsis (Organ Dysfunction)

**Laboratory Assessment**
- Complete Blood Count (including % immature neutrophils, platelets)
- Coagulation status (prothrombin time/International normalized ratio/partial thromboplastin time)
- Comprehensive metabolic panel (bilirubin, creatinine)
- Venous lactate

**Bedside Assessment**
- Urine output
- Pulse Oximetry
- Mental Status Assessment
Confirmation of Sepsis Evaluation

(Step 2)

Step 2: Confirmation of Sepsis Evaluation

- Respiratory: New need for mechanical ventilation or PaO2/FiO2 < 300
- Coagulation: Platelets < 100 x 10^9/L or INR > 1.5 or PTT > 60 secs
- Liver: Bilirubin > 2 mg/dL
- Cardiovascular: SBP < 85 mm Hg or MAP < 65 mm Hg or > 40 mm Hg decrease in SBP (after fluids)
- Renal: Creatinine ≥ 1.2 mg/dL or doubling of creatinine or urine output < 0.5 ml/kg/hr x 2 hrs
- Mental Status: Agitated, confused, or unresponsive
- Lactic Acid: > 2 mmol/L in absence of labor

Confirmed if 1 or more criteria met

All Criteria NEGATIVE

≥ 1 Criterion POSITIVE defines SEPSIS

Elevated lactate ONLY in Labor

MAP < 65 mm Hg (with confirmation) defines SEPTIC SHOCK

Action: This group remains at high risk for sepsis and requires close supervision and reevaluation.

Action: At a minimum, maintain close surveillance; consider additional fluids to reduce lactic acid level; repeat lactate. (See Discussion of the Role of Lactic Acid in the Peripartum Period in the toolkit for more detail.)

Action: Start source-directed antibiotics, broad spectrum antibiotics if source unclear; increase fluids to 30 ml/kg within 3 hours; collect blood cultures if not already obtained, maintain close surveillance, e.g. RRT, and repeat lactate. Escalate care as needed.

Action: As above for Sepsis, admit to ICU. If hypotension persists after 30 ml/kg fluid load, assess hemodynamic status and consider vasopressor use.
Sepsis Evaluation Flow Chart

**Step 1: Initial Sepsis Screen**
- Oral temp < 36°C (96.8°F) or > 38°C (100.4°F)
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**Step 2: Confirmation of Sepsis Evaluation**
- Respiratory: New need for mechanical ventilation or PaO2/FiO2 < 300
- Coagulation: Platelets < 100 x 10⁹/L or INR > 1.5 or PTT > 60 secs
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- Mental Status: Agitated, confused, or unresponsive
- Lactic Acid: > 2 mmol/L in absence of labor

**Confirmed if 1 or more criteria met**

**Action:**
- Start source-directed antibiotics, broad spectrum antibiotics if source unclear; increase fluids to 30 ml/kg within 3 hours; collect blood cultures if not already obtained, maintain close surveillance, e.g. APACHE II, and repeat lactate. Escalate care as needed.

**NOTE:**
- A MAP < 65 mm Hg (confirmed) with infection directly defines SEPTIC SHOCK

**All Criteria NEGATIVE**
- Action: This group remains at high risk for sepsis and requires close supervision and reevaluation.

**Elevated lactate ONLY in Labor**
- **≥ 1 Criterion POSITIVE defines SEPSIS**
- Action: As above for Sepsis, admit to ICU. If hypotension persists after 30 ml/kg fluid load, assess hemodynamic status and consider vasopressor use.

**MAP < 65 mm Hg (with confirmation) defines SEPTIC SHOCK**
- Action: Start source-directed antibiotics, broad spectrum antibiotics if source unclear; increase fluids to 30 ml/kg within 3 hours; collect blood cultures if not already obtained, maintain close surveillance, e.g. APACHE II, and repeat lactate. Escalate care as needed.

**NOTE:**
- A MAP < 65 mm Hg (confirmed) with infection directly defines SEPTIC SHOCK

**Suspected Infection**
- **Routine Vital Signs / WBC Screening**
Differentiating Chorioamnionitis with Sepsis

**Chorioamnionitis**
- Temp 102 F (isolated fever)
- Temp 100.4-102F (repeated elevation 30 min apart)

**Suspected Chorio:**
- FEVER +
  - leukocytosis
  - foul smelling vaginal drainage
  - Fetal Tachycardia

**Confirmed Chorio:**
- +Amniotic Fluid Test (gram stain, glucose level, culture result)
- Placental pathology: inflammation

**Maternal Sepsis**
- Temp ≥ 100.4 F
- HR > 110 BPM
- RR > 24
- WBC > 15,000

- Organ Dysfunction Involvement
- Treatment is the same
- Monitor Closely
Lactate measurement does not perform well in laboring women. Elevations may be seen in labor, especially when there is maximal skeletal muscle contraction. Outside of labor, the lactate parameters used for the non-pregnant population can be used. Elevated lactate for laboring women should always include trending lactate, treatment, and close surveillance.
Fluid Resuscitation

✓ Resuscitation from sepsis-induced hypoperfusion is 30 ml/kg of IV crystalloid fluid within 3 hr.

✓ Following initial fluid resuscitation, additional fluids be guided by frequent reassessment of hemodynamic status.

✓ Reassessment should involve clinical examination by MD (heart rate, BP, arterial O2 sats., RR, Temp, urinary output, cap refill, etc.)

✓ Noninvasive monitoring as available
Blood Cultures

• Blood cultures to be drawn prior to ABX administration when possible

• Blood cultures must be drawn within 3 hours following a diagnosis of sepsis

• For patients with chorioamnionitis, the blood cultures are normally negative.

• CMS allows blood cultures to be delayed under certain conditions

• Rhodes, 2016
Administration of IV antimicrobials be initiated as soon as possible after recognition within 1 hr. for both sepsis and septic shock

- Recommend 1 or 2 broad-spectrum ABX

- Assess delays for ABX administration. Use of STAT for administration.

- Improve communication between MDs, nursing, and pharmacy

- Address delays in obtaining blood cultures

- Administer ABX that can be infused rapidly FIRST (versus lengthy infusion)-rapid achievement of therapeutic levels.

- Use of 2nd IV for infusion of ABX and IV boluses
## Considerations for Pregnant Women with Sepsis

<table>
<thead>
<tr>
<th>Consideration</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Vasopressors</strong></td>
<td>Norepinephrine is the pressor of choice in pregnancy and used if MAP &lt; 65 mm Hg and if unresponsive to IV fluids</td>
</tr>
<tr>
<td><strong>Inotrope</strong></td>
<td>Dobutamine is recommended for myocardial dysfunction or hypoperfusion despite IV fluids and vasopressors as it ↑ cardiac output</td>
</tr>
<tr>
<td><strong>Glucose Control</strong></td>
<td>Avoid hyperglycemia &gt; 180 mg</td>
</tr>
<tr>
<td><strong>Maternal Temperature Control</strong></td>
<td>Reduce fetal oxygen consumption and fetal tachycardia using acetaminophen and cooling blankets</td>
</tr>
<tr>
<td><strong>Fetal Lung Maturity</strong></td>
<td>Consider steroids for fetal lung maturity if 23-36 weeks of pregnancy</td>
</tr>
<tr>
<td><strong>DVT Prevention</strong></td>
<td>Pharmacologic VTE prophylaxis and mechanical prophylaxis whenever possible.</td>
</tr>
</tbody>
</table>
Escalation of Care: Consideration for transfer to higher level of care

Hypotension “MAP below 65mmHg” despite 30ml/kg fluid resuscitation

Persistent Hypoxia **SpO2 < 92% on room air**

Altered Mental Status
All members of the clinical team should maintain a high index of suspicion and embrace non-hierarchical communication to detect impending sepsis.

All team members should feel empowered to speak up and know that their input is valued by the care team.
Considerations….

Tamiflu 75 mg BID X 5 days for patients with the FLU

Early antiviral therapy (within 2 days) results in 84% reduction in admissions to ICU (Somanz)

Women without fever can be septic

There does not need to be a source of infection in order to screen positive for sepsis.

MAP is the driving pressure for tissue perfusion
✓ 40.2 weeks prime
✓ Admitted for Ucs at 0314; intact BOW
✓ Epidural at 0858
✓ Pitocin started 0946
✓ AROM 1357-mec
✓ Initial WBC 18.9
✓ Temp 98.4, BP 108/64, HR-116 Map 81, 97%

1247
+ Sepsis Screen
RRT Aware
Mat. HR 115-116
WBC 18.9
Obtain BC
Let's look at what happens....

- Temp 99.7, HR 124-140's,
- Resp not documented. BP 130/90.
- Oxygen sat 99%
  - Urinary output > 30ml/hr
- Foul smelling fluid noted

+ Sepsis Screen
+ MD/RRT Aware
+ No infection, ↑HR, ↑WBC

Pitocin off at 1938
Oxygen initiated 10L per mask
10 cm/pushing initiated
MD-Report given
Patient is pushing...
2nd stage of labor with Cat 2 tracing

- Pushing stopped at 2132
- Pain ++
- Epidural topoff
- 500ml bolus

MD notified of T-100F Tylenol 1000mg IV
Allowing baby to recover

✓ Resumed pushing
MD at BS
IV bolus, oxygen, repositioned
Pitocin started at 1 mu
❖ MD Notified + Sepsis screen (per Charge RN)
❖ Triple ABX,
❖ CBC, lactate, no BLD Cx
❖ RRT Called
❖ Suspect Chorioamnionitis
Sense of urgency to deliver

✓ MD notified of decels
✓ MD at BS

Baby del at 0023
Delivery

Del at 0023, 6lb 14 oz

Apgar's 5/8

Arterial Cord gas 7.171 (BD 8.3)
Postpartum Pitocin 20mg given
Methergine 0.2 IM
Cytotec 800mcg PR
TXA 1 mg/100ml over 10 min
Hemabate 250 mcg
Uterus boggy
Uterine Tamponade placed (BT Cath)
Hypotension-56/39- HR not detectable. **CODE BLUE**
Did not lose Consciousness
MTP Called- given 3 units PRBC and 1 FFP
3 Liters of LR
EBL 2000ml
Transferred to ICU
<table>
<thead>
<tr>
<th>Test</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lactate</td>
<td>5.2</td>
</tr>
<tr>
<td>WBC</td>
<td>27.2</td>
</tr>
<tr>
<td>Hgb</td>
<td>9.2</td>
</tr>
<tr>
<td>HCT</td>
<td>28.4</td>
</tr>
<tr>
<td>Fibrinogen</td>
<td>332</td>
</tr>
<tr>
<td>PT, PTT, INR</td>
<td>Normal</td>
</tr>
</tbody>
</table>
Applying the CMQCC Algorithm....

Let's Go Back and Apply the CMQCC Algorithm to Scenario....
Patient was (+) Sepsis Screen at 1247-no infection documented by RN (Is this accurate?)

Recommended treatment NOT followed (fluids, labs)

ABX not started initially (OK)-however, should have been started at 1900 when fever was apparent.

Escalation apparent by Charge RN-Good work!

Tylenol (especially 1000mg IV) will mask fever-Caution!!

Where is the early recognition in this scenario? Was early treatment followed?


Let’s Begin the Campaign to promote Early Recognition and Management of Maternal Sepsis