Maternal Sepsis

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ACKNOWLEDGMENTS: MARY GOERING, DR WILLIAM WAGNER, DR SURESH AHANYA, DR SARAH PREBIL

Disclosures

I am an employee of Allina Health
Objectives

Discuss the prevalence of maternal sepsis in the ante/intra/postpartum periods.

Describe common risk factors that predispose pregnant and postpartum mothers to sepsis.

Identify signs and symptoms for early recognition of sepsis, and discuss screening for sepsis.

Identify the importance of implementing protocols for early recognition and management of maternal sepsis.

A Disturbing Trend:
Maternal mortality in the U.S. has been on the rise for 20 yrs.

http://www.cdc.gov/reproductivehealth/maternalinfanthealth/pmss.html
Overall, the leading causes of pregnancy-related death include seven causes accounting for 72.2% of all pregnancy-related deaths (Figure 4).

Report from Maternal Mortality Review Committees: A View Into Their Critical Role
January 20, 2017
All Cause Risk Factors: Advanced Maternal Age

Figure 3. Proportion of Pregnancy-Associated Deaths Determined to be Pregnancy-Related by Age at Death (in Years)

<table>
<thead>
<tr>
<th>Age Group</th>
<th>Proportion (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;20</td>
<td>31.1</td>
</tr>
<tr>
<td>20-24</td>
<td>26.6</td>
</tr>
<tr>
<td>25-29</td>
<td>23.6</td>
</tr>
<tr>
<td>30-34</td>
<td>40.2</td>
</tr>
<tr>
<td>35-44</td>
<td>41.9</td>
</tr>
</tbody>
</table>

Report from Maternal Mortality Review Committees: A View Into Their Critical Role January 20, 2017

All Cause Risk Factors: Race-African American highest risk

Figure 2. Proportion of Pregnancy-Associated Deaths Determined to be Pregnancy-Related by Race-Ethnicity

<table>
<thead>
<tr>
<th>Race-Ethnicity</th>
<th>Proportion (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hispanic</td>
<td>19.2</td>
</tr>
<tr>
<td>non-Hispanic black</td>
<td>46.1</td>
</tr>
<tr>
<td>non-Hispanic white</td>
<td>27.0</td>
</tr>
</tbody>
</table>

Report from Maternal Mortality Review Committees: A View Into Their Critical Role January 20, 2017
All Causes: When are women dying?

Report from Maternal Mortality Review Committees: A View Into Their Critical Role January 20, 2017

How Common is Maternal Sepsis?

Maternal sepsis is the leading cause of maternal death, accounting for 15% of maternal deaths worldwide

In the US and United Kingdom- maternal sepsis is considered to be the leading cause of death in the peripartum period

The rate of post delivery sepsis increased 148% between 1998-1999 and 2008-2009 (no significant difference seen pre del)
**OBSTETRICS**

**Preventability of severe acute maternal morbidity**

Beverley Lawton, FRNZCGP; Evelyn Jean MacDonald, FACHSHM; Selina Ann Brown, RN; Leona Wilson, FANZCA; James Stanley, PhD; John David Tari, FRCOG; Richard Alan Downsall, FRCOG; Carolyn Low Colles, MA; Stacie E. Geller, PhD

**OBJECTIVE:** We sought to assess potential preventability of severe acute maternal morbidity (SMM) cases admitted to intensive-care units (ICUs) or high-dependency units (HDUs) of women who were pregnant or within 42 days of delivery in 4 District Health Board areas (accounting for a third of annual births in New Zealand) during a 17-month period. Cases were reviewed by external multidisciplinary panels using a validated model for assessing preventability.

**STUDY DESIGN:** Inclusion criteria were admissions to ICUs or HDUs of women who were pregnant or within 42 days of delivery in 4 District Health Board areas (accounting for a third of annual births in New Zealand) during a 17-month period. Cases were reviewed by external multidisciplinary panels using a validated model for assessing preventability.

**CONCLUSION:** The majority of SMM cases were potentially preventable or required improvement in care. Themes around delay-related causes related to delay in diagnosis and treatment for postpartum hemorrhage and sepsis. These findings inform clinical education, patient care improvements, and promote improved maternal outcomes. This study has now been expanded to a national New Zealand SMM cases admitted to an ICU/HDU.

**TABLE 3**

<table>
<thead>
<tr>
<th>Reason for morbidity</th>
<th>Preventable, n (%)</th>
<th>Not preventable but improvement needed, n (%)</th>
<th>Not preventable, n (%)</th>
<th>Total, n (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blood loss &gt;1500 mL</td>
<td>20 (0.4)</td>
<td>13 (1.3)</td>
<td>11 (1.2)</td>
<td>44 (4.9)</td>
</tr>
<tr>
<td>Septicemia</td>
<td>4 (4.1)</td>
<td>4 (4.1)</td>
<td>9 (9.2)</td>
<td>17 (1.7)</td>
</tr>
<tr>
<td>Uncontrolled hypertension</td>
<td>3 (3.1)</td>
<td>1 (1.1)</td>
<td>5 (5.1)</td>
<td>9 (0.9)</td>
</tr>
<tr>
<td>Cardiovascular</td>
<td>1 (1.1)</td>
<td>1 (1.1)</td>
<td>2 (2.2)</td>
<td>4 (0.4)</td>
</tr>
<tr>
<td>HELLP syndrome</td>
<td>2 (2.2)</td>
<td>2 (2.2)</td>
<td>5 (5.1)</td>
<td>9 (0.9)</td>
</tr>
<tr>
<td>DIC</td>
<td>1 (1.1)</td>
<td>1 (1.1)</td>
<td>2 (2.2)</td>
<td>4 (0.4)</td>
</tr>
<tr>
<td>Other*</td>
<td>8 (1.6)</td>
<td>7 (0.7)</td>
<td>3 (0.3)</td>
<td>18 (1.8)</td>
</tr>
</tbody>
</table>

**Sepsis Syndrome**

- **Hypotension Despite Fluid Resuscitation OR Lactate > 3.9**

- **Severe Sepsis**

- **Septic Shock**

- **Severe Sepsis + Hypotension**

**SIRS**

- SIRS + Infection

**Lactate > 2.0**

**SBP <90 mmHg or MAP <70, Temp>38.0C or <36.0C, HR >110, RR >24, WBC >15 or <4 (Pregnancy/postpartum specific)**
Pregnant and Postpartum Women need to be included in our sepsis protocols!

Sepsis onset is insidious in our population and the patient may appear deceptively well before rapidly deteriorating.

- We are overly comfortable with high heart rates and low blood pressures that we attribute to the normal physiology of pregnancy …Or postpartum!
- We fail to count the Pulse and especially RR

Maternal Sepsis

We tend to identify and treat it late...

- Decreased vigilance since sepsis in our population, until fairly recently was relatively rare
- Failure to order appropriate labs, including lactate and blood cultures
- Reluctance to treat infections until source identified
- Young healthy patients can look well until they are almost dead
- Non-specific nature of sepsis presentation in this population
Maternal Sepsis

Source of infection was not apparent in 44% of the patients with septic shock.


Time from the first symptom of infection to “full-blown sepsis” was <24 h in 39% of patients

Time from the onset of infection to death < 24 h in 50% of patients.


The Bottom Line....

Maternal deaths from sepsis are largely

PREVENTABLE!
Common Sources of Infection in Pregnancy

Uterus: Chorioamnionitis/Intraamniotic Infection

Old Definition:
Maternal fever >38C (>100.4F) and at least TWO of the following:
- Maternal leukocytosis (>15,000 cells/cubic mm)
- Maternal tachycardia (>100 bpm)
- Fetal tachycardia (>106 bpm)
- Uterine tenderness
- Foul odor of the amniotic fluid

NEW- Intraamniotic Infection Definition-Allina:

- Presumptive Intraamniotic Infection:
  - Isolated maternal fever (oral temperature >=39C (102.2F) - OR -
  - Fever >=38 (100.4F but <39,0 C (102.2F) on two occasions 30 minutes apart without another clear source PLUS one or more of the following:
    - Maternal leukocytosis (>15,000 cells/cubic mm)
    - Purulent cervical drainage coming from the cervical os visualized by speculum exam
    - Fetal tachycardia (>160 bpm)

- Confirmed Intraamniotic infection: Positive amniotic fluid test result (+gram stain, low glucose level, or culture results consistent with infection), or placental pathology demonstrating histologic evidence of perinatal infection or inflammation or both in the placenta, fetal membranes, or the umbilical cord vessels (funisitis).

ACOG Committee Opinion No 712 Intrapartum Mgt of Intraamniotic Infection Aug 2017
Common Sources of Infection in Pregnancy

Uterus – Endometritis
Urinary tract (gram negative)
Respiratory tract - pneumonia
Abdomen
Infections in pregnancy are commonly polymicrobial

Albright C.M. et al. (2016) Sepsis in Pregnancy: Identification and Management. JPNN, 30(2), 95-105

The single most important risk factor for post-partum infection is caesarean section

Beta Streptococcus Group A (GAS)

GAS infection can cause endometritis, necrotizing fasciitis, and if severe - toxic shock syndrome

20 fold increased risk for invasive Group A streptococcal (GAS) infection compared to the non pregnant population

More than 85% of GAS infections occur postpartum within the first 4 days, and maternal mortality is highest within the first 2 days approaching 60% when shock develops

Risk factors: Upper respiratory tract infection- pharyngeal colonization prior to birth, contact with carriers of GAS


Group A Streptococcal Disease (GAS)

Transmission can occur from healthcare providers, other patients, or a community acquired source

14% are nosocomially acquired

Use of antipyretics can mask symptoms

Unexplained tachycardia?

GAS: Clinical Presentation

GAS usually develops within 24 hours of birth and becomes fulminate within 48-96 hours after birth

**Most common presentation:**
- **Fever** (note—may manifest hypothermia d/t decreased tissue perfusion)
- **Abdominal pain and tenderness.** (out of proportion to expected recovery. Note: pain and tenderness may be absent with nerve damage d/t necrotic tissue.)


Invasive GAS=Necrotizing Fasciitis

Rapidly spreading “flesh eating” bacterial infection of soft tissue resulting in tissue necrosis

**Typical signs**
- Erythema
- Progressive increase in severity of pain that becomes refractory to narcotic analgesics
- Extreme anxiety

**Late signs**
- Purplish discoloration of skin with bullae, edema, crepitus, black necrotic plaques
- Skin discoloration
- Multisystem organ failure


Surviving Sepsis Campaign

Protocolized “care bundles” for severe sepsis and septic shock=‘s decrease in mortality

Mgt: initial resuscitation phase, antimicrobial therapy (including blood cultures and source control), supportive therapies

Guidelines do not specifically address maternal sepsis

So What Can We Do About Maternal Sepsis?

Prevention is key, awareness of risk factors

Early recognition is key to successful treatment- awareness of maternal early warning signs, potential infection, screening for sepsis

Targeted therapy, prompt identification of the source

Education, screening, and simulation

Strong interdisciplinary teamwork

Communication strategies- OB Sepsis Code
Providers should not send RRT away before RRT completes their assessments.

**Tools**

- Maternal Early Warning Signs
- OB Sepsis Screening Tool (nursing)
- OB Infection order set
- Sepsis Order set
- AKN page
- Sepsis Accordion
- Simulation
Maternal Early Warning Signs

**Temp:** < 96.8 F (36C) or > 100.4 F (38C)

Pulse: persistent maternal HR <= 50 or > 120 *(note: >110 in pregnancy is a sepsis warning sign)*

Respiratory rate (RR): < 10 or > 24

BP: Systolic < 90 mmHg or >= 160 mmHg

Diastolic < 45 or >= 105

SaO2 < 95%

Oliguria: < 35 mL for 2 hours, or < 0.5 mL/Kg/hr for 2 hours

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Other General Markers

Altered mental status

Significant edema or positive fluid balance (> 20 mL/kg) over 24 hours

Hyperglycemia in the absence of diabetes

- Plasma glucose > 140 mg/dL

- It is more difficult during pregnancy to detect sepsis due to physiologic changes i.e. L&D when HR and RR increase
Mean Arterial Pressure (MAP)

MAP, or mean arterial pressure, is defined as the average pressure in a patient’s arteries during one cardiac cycle. It is considered a **better indicator of perfusion to vital organs than systolic blood pressure (SBP)**. True MAP can only be determined by invasive monitoring and complex calculations; however it can also be calculated using a formula of the SBP and the diastolic blood pressure (DBP).

To calculate a mean arterial pressure, double the diastolic blood pressure and add the sum to the systolic blood pressure. Then divide by 3. For example, if a patient’s blood pressure is 83 mm Hg/50 mm Hg, the MAP would be 61 mm Hg.

**Goal: Maintain MAP >=70**

Common Symptoms of Sepsis in OB

<table>
<thead>
<tr>
<th>Table 2. Common symptoms of sepsis in the puerperium</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fever, rigors (persistent spiking temperature suggests abscess)</td>
</tr>
<tr>
<td>Abdominal pain and tenderness</td>
</tr>
<tr>
<td>Throat infection – spreading cellulitis or discharge</td>
</tr>
<tr>
<td>Urinary symptoms</td>
</tr>
<tr>
<td>Nausea, vomiting</td>
</tr>
<tr>
<td>General – non-specific signs such as lethargy, reduced appetite</td>
</tr>
</tbody>
</table>

1. Fever, rigors (persistent spiking temperature suggests abscess) |
2. Abdominal pain and tenderness |
3. Throat infection – spreading cellulitis or discharge |
4. Urinary symptoms |
5. Nausea, vomiting |
6. General – non-specific signs such as lethargy, reduced appetite |
Clinical “red flags”

- Fever >38°C
- Sustained tachycardia
- Shortness of breath (RR >24 in pregnancy)
- Abdominal or chest pain
- Diarrhea and/or vomiting
- Uterine or renal angle pain/tenderness
- Pt feels unwell, anxious or distressed

OB Sepsis Screening Tool

<table>
<thead>
<tr>
<th>Question</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Does this patient have hypotension?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>* Systolic BP &lt;90 mmHg</td>
<td></td>
<td></td>
</tr>
<tr>
<td>* Mean Arterial Pressure (MAP) &lt;70</td>
<td></td>
<td></td>
</tr>
<tr>
<td>* No - go to question 2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>* Yes - go to question 3</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Question</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>2. Does this patient have 2 or more of the following sepsis screening</td>
<td></td>
<td></td>
</tr>
<tr>
<td>criteria that are not chronic?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>* Heart Rate &gt;120 bpm or &lt;50 bpm</td>
<td></td>
<td></td>
</tr>
<tr>
<td>* Respiratory Rate &gt;24 bpm or &lt;10 bpm or SpO2 &lt;90% (on room air)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>* Temperature &gt;100°F (38.3°C) on two occasions 30 minutes apart or</td>
<td></td>
<td></td>
</tr>
<tr>
<td>* SLPF (38°C)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>* Fetal Tachycardia &gt;160 bpm baseline</td>
<td></td>
<td></td>
</tr>
<tr>
<td>* WBC &gt;15 x 10^3 /L</td>
<td></td>
<td></td>
</tr>
<tr>
<td>* ANC count drawn. Date: ___, Time: ____,</td>
<td></td>
<td></td>
</tr>
<tr>
<td>* Acutely altered mental status</td>
<td></td>
<td></td>
</tr>
<tr>
<td>* No - go to question 3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>* Yes - take steps to screen the patient</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Question</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>3. Do you suspect that this patient has a new or worsening infection</td>
<td></td>
<td></td>
</tr>
<tr>
<td>based on your assessment? Only one of the symptoms below is needed for</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&quot;suspected infection&quot;</td>
<td></td>
<td></td>
</tr>
<tr>
<td>* Nausea, vomiting, diarrhea</td>
<td></td>
<td></td>
</tr>
<tr>
<td>* Hypotension and/or tachycardia</td>
<td></td>
<td></td>
</tr>
<tr>
<td>* Respiratory: cough, SDB, increasing oxygen needs, decreasing CO2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>* Urinary: pain with uremia, flank pain, indwelling Foley catheter in</td>
<td></td>
<td></td>
</tr>
<tr>
<td>* GI: new abdominal pain, new diarrhea</td>
<td></td>
<td></td>
</tr>
<tr>
<td>* High risk for infection [PPROM, Prolonged C/S, recent surgery,</td>
<td></td>
<td></td>
</tr>
<tr>
<td>* Neurocognitive impairment, indwelling catheter (continued)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>* Shock: increased interstitial, redness, or rash</td>
<td></td>
<td></td>
</tr>
<tr>
<td>* Bone/Joint symptoms: new red, warm, or swollen-joint</td>
<td></td>
<td></td>
</tr>
<tr>
<td>* PICC or central line in place for more than 48 hrs</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Question</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>If &quot;Yes&quot; in Questions 1 and 2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>* &quot;Positive Sepsis Screen&quot;</td>
<td></td>
<td></td>
</tr>
<tr>
<td>* Call Rapid Response Team</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Question</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>If &quot;Yes&quot; in Questions 2 and 3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>* &quot;Positive Sepsis Screen&quot;</td>
<td></td>
<td></td>
</tr>
<tr>
<td>* Call Rapid Response Team</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Data/Time RRT was called: ____________________
Notify Charge Nurse if Positive screen – floor patient label on completed form
OB Sepsis Screening Tool

Positive Sepsis Screen/Code Sepsis RRT RN Audit Tool

1. Confirme positive sepsis screen: _Yes _No _N/A _Unknown
   _Note:_ Patient admitted for infection (may not have fever)
   _Note:_ Do not include trauma or non-infectious causes

2. New Hypotension: _Yes _No _N/A _Unknown
   _Note:_ Define as SBP <90 or MAP <70 or ePAP decrease >10 mmHg
   _Note:_ Do not include trauma or non-infectious causes

3. Order Lactate, Blood Culture, CMP, CBC, LFT, RFT, CRP
   _Note:_ Lactate >0.91 or meets other criteria for severe sepsis or septic shock
   _Yes _No _N/A _Unknown
   _Note:_ Do not include trauma or non-infectious causes

4. Code Sepsis is called _No _Yes _N/A _Unknown
   _Time:_ MD (hospitalist, OBW, or nurse officer) called back

6. Severity of sepsis:
   _Severe Sepsis:_ Sepsis plus one or more acute organ dysfunction criteria (signs must be separate from the primary site of infection and not known to be chronic)
   _Note:_ Need for invasive or noninvasive mechanical ventilation
   _Note:_ Need for vasoactive drug lines or vasoactive drug lines for more than 2 hours
   _Note:_ Lactate >2 mmol/L or SBP <70
   _Note:_ TBW: total body weight
   _Note:_ MAP: mean arterial pressure
   _Note:_ HR: heart rate
   _Note:_ RR: respiratory rate
   _Note:_ SO2: arterial oxygen saturation

   _Severe Sepsis:_ Sepsis plus one of the following:
   _SBP <90 or MAP <50 after adequate fluid resuscitation (30-50 ml/kg of NS or LR)
   _Lactate >2 mmol/L
   _Note:_ Adequate fluid resuscitation: 30-50 ml/kg NS or LR

7. Disposition:
   _Stay in current level of care
   _Transfer to ICU

**Code Sepsis Action Steps**

1. Start IV fluid bolus (30-50 ml/kg NS or LR)
2. Lactate drawn
3. Blood cultures drawn x 2 (at least 1 drawn prior to antibiotics)

EMR Version

**OB SEPSIS SCREEN**

- To be filled out at least once per shift if any abnormal vital signs are present. Keep raw information open.

- SBP <90 or MAP <70
- 2 or more sepsis screening criteria present
- Signs/symptoms/risks factors for now or worsening
- Patient on Oxygen
- Pain Scale Used
- PAIN ASSESSMENT
  - Pain Left
  - Pain Right
- REFLEXES
  - Corneal
  - Patellar Left
  - Patellar Right
  - Clonus
  - Ankle Left
  - Ankle Right
- CERVICAL ASSESSMENT
  - Cervical Assessment indicated?

**SEPSIS SCREENING CRITERIA**

- Heart Rate > 120 beats per minute or less than or equal to 50 beats per minute
- Respiratory Rate equal to 24 breaths per minute, < 10 or SpO2< 95% (on room air)
- Temperature >100.4 °F (39 C) or < 95.9 (36 °C)
- Fetal Tachycardia > 160 beats per minute baseline
- WBC >15.0 or < 4.0
- Acutely altered mental status

Select Single Option: (F5)
- 0=No
- 1=Yes

Comment (F5)

Raw Information A

- Time:
  - (TIME ZERO) + 1 hour
  - Start time: 0700

10/17/2017
**Organisms seen with Sepsis**

<table>
<thead>
<tr>
<th>Non pregnant</th>
<th>Pregnant</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Gram Positive</td>
<td>• Endotoxin producing Gram-negative rods (60-80%)</td>
</tr>
<tr>
<td>– Line related</td>
<td>– E. coli</td>
</tr>
<tr>
<td>• Gram Positive (4-16%)</td>
<td>– Enterococci</td>
</tr>
<tr>
<td>– Beta hemolytic Streptococci</td>
<td>– Beta hemolytic Streptococci</td>
</tr>
<tr>
<td>– Anaerobes (usually mixed infections)</td>
<td>– Anaerobes (usually mixed infections)</td>
</tr>
<tr>
<td>• Peptostreptococci</td>
<td>• Peptostreptococci</td>
</tr>
<tr>
<td>• Peptococci</td>
<td>• Peptococci</td>
</tr>
<tr>
<td>• Bacteroides</td>
<td>• Bacteroides</td>
</tr>
</tbody>
</table>

The major pathogens causing sepsis in the puerperium are:
- GAS, also known as *Streptococcus pyogenes*
- *Escherichia coli*
- *Staphylococcus aureus*
- *Streptococcus pneumoniae*
- * meticillin-resistant S. aureus (MRSA), Clostridium septicum and Morganella morgani.*  

**OB Infections order set**

For use for infection without signs of severe sepsis or septic shock

- Chorioamnionitis
- Endometritis
- Pneumonia
- Pyelonephritis
Sepsis Order Set

One order set for ED and one for IP: 60665 PROT ED SEPSIS/30854 PROT IP SEPSIS

Organized by “panels” of orders: (may be used more than once)
- Diagnostic section
- Treatment section

Standardizes approach to treatment:
- **Antibiotics**: Nine sets of site-specific antibiotics (marked STAT) & recommended by AH ID Task Force
  - Should cover most circumstances; start with these antibiotics initially
- **Fluids**: will facilitate ordering the recommended amount (30 mL/kg)

Lactate: initial and a reminder to do a repeat
Vasopressors: when needed

Order set comparison

<table>
<thead>
<tr>
<th>Target patient population</th>
<th>OB Infection</th>
<th>60665 PROT ED SEPSIS or 30854 PROT IP SEPSIS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patients who the provider suspects may have or are at high risk for an infection</td>
<td>Patients who have a positive sepsis screen</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Targeted conditions</th>
<th>OB Infection</th>
<th>60665 PROT ED SEPSIS or 30854 PROT IP SEPSIS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Simple sepsis due to Chorioamnionitis, Endometritis, pyelonephritis, community acquired pneumonia (Patient does NOT meet severe sepsis or septic shock criteria)</td>
<td>Severe sepsis and septic shock</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Antibiotics</th>
<th>OB Infection</th>
<th>60665 PROT ED SEPSIS or 30854 PROT IP SEPSIS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ampicillin/sulbactam, Ceftriaxone Ceftriaxone + Azithromycin Ertapenem</td>
<td>Vancomycin + Zosyn Vancomycin + Imipenem Vancomycin + Zosyn + Clindamycin MetroNIDAZOLE + Vancomycin</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>CMS Measure</th>
<th>OB Infection</th>
<th>60665 PROT ED SEPSIS or 30854 PROT IP SEPSIS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Does NOT meet CMS criteria for treatment of sepsis</td>
<td>Meets CMS criteria for treatment of severe sepsis and/or septic shock, if followed</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Locations</th>
<th>OB Infection</th>
<th>60665 PROT ED SEPSIS or 30854 PROT IP SEPSIS</th>
</tr>
</thead>
<tbody>
<tr>
<td>All OB units, all birthing hospitals</td>
<td>All units, all hospitals</td>
<td></td>
</tr>
</tbody>
</table>
Diagnostic Criteria-Allina

**Severe Sepsis:** **Sepsis** and *acute organ dysfunction* not known to be *chronic* (patient may have severe sepsis with <2 sepsis criteria)

- **Cardiovascular failure:** New hypotension (one reading) SBP < 90 or MAP < 65 which resolves with ≤ 30 mL/kg IV fluid resuscitation with NaCl 0.9% or lactated ringers
- **Lactate:** ≥ 2.1 and < 4.0 (venous)
- **Acute respiratory failure:** New need for non-invasive or invasive mechanical ventilation
- **Acute Kidney Injury:** Cr ≥ 2.1 or urine output <0.5 mL/kg/hour for 2 hours
- **Liver failure:** Bilirubin >2
- **Hematologic failure:**
  - Platelets < 100,000
  - INR > 1.5 or aPTT > 60 seconds (prolonged INR on Coumadin is a *chronic* condition)
- Provider documentation of severe sepsis in a note or on the problem list

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**Diagnostic Criteria**

**Septic shock:** **Sepsis + ONE of the following**

1. Persistent hypotension (2 consecutive readings) of SBP < 90 or MAP < 65 within 1 hour *after* initial IV fluid bolus of 30 mL/kg (NS or LR) is complete
2. Lactate ≥ 4.0
3. Provider documentation of septic shock in a note or on the problem list
Severe Sepsis / Septic Shock Goals

<table>
<thead>
<tr>
<th>Bundle Elements</th>
<th>2017 Sepsis Program</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>3 Hour Bundle Elements</strong></td>
<td></td>
</tr>
<tr>
<td>Initial Lactate</td>
<td>Lactate level was drawn (collected) within 3 hours following the presentation of severe sepsis or shock</td>
</tr>
<tr>
<td>Blood cultures</td>
<td>Order and collect 2 blood cultures. If difficulty obtaining, 1 blood culture required before antibiotics</td>
</tr>
<tr>
<td>Antibiotics</td>
<td>Antibiotics started ≤3 hours. Do not hold antibiotics &gt; 45 mins for blood culture collection</td>
</tr>
<tr>
<td>IV fluids</td>
<td>30 mL/kg of crystalloid fluids (NS/LR) were ordered and administered prior to, at the time of, or after the presentation of: initial hypotension, initial lactate ≥ 4, or documentation of septic shock</td>
</tr>
<tr>
<td><strong>6 Hour Bundle Elements</strong></td>
<td></td>
</tr>
<tr>
<td>Repeat lactate</td>
<td>If initial lactate elevated ≥ 2.1, repeat lactate sent within 2-3 hours of initial result and within ≤ 6 hours of severe sepsis/shock presentation</td>
</tr>
<tr>
<td>Vasopressors (for persistent hypotension only)</td>
<td>Administration of a vasopressor if there is persistent hypotension (2 consecutive readings) after the completion of 30mL/kg of crystalloid fluid administration</td>
</tr>
<tr>
<td>Shock Reassessment</td>
<td>Septic Shock Exam OR 2 of 4 of the following: US, PLR, CVP or ScvO2 within ≥8 hours of shock. Exam only needs to be statement that provider performed, attests to, or performed all aspects of exam within 6 hours of presentation (Sepsis Program 2017)</td>
</tr>
</tbody>
</table>

Sepsis 7-Part Bundle

1. Lactate
2. Two blood cultures before antibiotics
3. Broad spectrum or other appropriate antibiotics
4. IV fluids 30 mL/kg (NS or LR) for:
   - Hypotension (MAP < 65 or SBP < 90)
   - Lactate ≥ 4.0
5. Repeat lactate, if initial lactate was elevated
   - ≥ 2.1 (venous)

*Only needed if Septic Shock*

6. Vasopressors (for persistent hypotension)
7. Fluid Status Reassessment (persistent hypotension and lactate ≥ 4)

- Use septic shock form to easily document
PART 1. Lactate

Abnormal Lactate ≥ 2.1

Lactate is elevated in severe sepsis (2.1 – 3.9) and septic shock (≥ 4.0)
• Higher lactate levels portend higher mortality\textsuperscript{1} (\textit{newer studies: Lactate >4 with hypotension =’s mortality 46.1%})
• Intermediate lactate levels (2.1 - 3.9) are associated with an increased risk of death, independent of the presence of hypotension\textsuperscript{2,3}

Lactate may be normal and the patient may still have severe sepsis or septic shock
• This has been the trend in the ANW OB sepsis cases in 2016 and 2017

\textsuperscript{3}Howell, MD, etal. Occult hypoperfusion and mortality in patients with suspected infection. Inten Care Med, 2007;33:1892-1899.

Best practice for lactate specimen collection

No arm or hand flexing or fist clenching
No prolong tourniquet time more than 30 seconds
• Do not draw from IV start

Specimen must be tested immediately (iSTAT) or sent to lab on ice within 15 minutes.
Repeat Lactate

Lactate will normalize if resuscitation is effective!

Lactate clearance of 10% in ≥ 2 hours demonstrates an effective response to resuscitation\(^1\)

• Follow up lactates are *really* important for reassessing response to treatment!
• Goal is to draw repeat after IV fluids are complete


PART 2. Blood Cultures

2 blood cultures recommended

Importance: When blood cultures are positive, they are usually diagnostic of the pathogen(s) causing severe sepsis

Attempts to obtain blood cultures should NOT delay antibiotics!!!

• *Spend no more than 45 minutes obtaining blood cultures before giving antibiotics and document this in a provider note*

• Continue to try to draw blood cultures while administering antibiotics
PART 3. Antibiotics

Antibiotics are an emergency medication in patients with severe sepsis and septic shock. Mortality rises by the hour\(^1,2\).

Use the Order Sets:
- 60665 PROT ED SEPSIS
- 30854 PROT IP SEPSIS
- OB Infection order set

\(^1\) Kumar et al. Crit Care Med 2006; 34:1589-1596

Antibiotic selection

- Broad spectrum coverage for patients with severe sepsis or septic shock
  - Vanco and Zosyn if source is unclear
- Narrow as culture data returns and patient improves
PART 4. IV Fluids

Patients that require 30 mL/kg fluid bolus (NS or LR)
- Sepsis + new hypotension 1 reading (SBP < 90 or MAP < 65)
- Sepsis + Lactate ≥ 4
- Septic Shock documented in a provider note

TAKE HOME POINT: 30 mL/kg is a starting point for septic patients with hypotension and/or septic shock

PART 5. Repeat Lactate

- Repeating the lactate (after fluid resuscitation) is really important
  - Lactate will normalize if fluid resuscitation was effective
  - Recommend repeat lactate to be drawn 2-3 hours after initial lactate reported
    - Clearance of 10% demonstrates an effective response to resuscitation
  - Repeat lactate must be drawn within 6 hours of onset of severe sepsis/septic shock
  - BPA to alert providers if repeat lactate not ordered

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PART 6. Vasopressors

For patients with septic shock that remain hypotensive after 30 mL/kg, start vasopressors.

Norepinephrine is the drug of choice

Maintain MAP >65 mmHg

Others are acceptable:
- Vasopressin
- Epinephrine
- Dopamine (not used for renal perfusion)
- Neo-Synephrine (less commonly used)

Start vasopressors earlier if clinically appropriate

Vasopressors may be given through a peripheral IV for short periods (4 hours) if central line not (yet) in.

IV fluid may still be needed → continue to reassess and give fluid as needed.

PART 7. Fluid Status Reassessment

Objective of fluid status reassessment

The goal in IV fluid resuscitation is NOT to push patients to the limit with volume.

The goal is to achieve adequate tissue perfusion using fluids +/- vasopressors.
Source control

Source identification and control needs to be established within 6 hours
- Consider CT imaging
- Surgical intervention - effective intervention percutaneous or surgical drainage
- If intravascular device is possible source for consideration – remove after establishing new vascular access

ICU Admission Guidelines-Allina OB

Persistent hypotension (MAP < 65 or SBP < 90) after initial fluid resuscitation
- Patient needs a central line, e.g. on a vasopressor

Severe sepsis or septic shock

Mechanical ventilation
Fetal Implications of Sepsis and Septic Shock

Sympathetic nervous system activation
Vasoconstriction in some organs

Endothelial damage
Inc. capillary permeability
Vasodilation
Platelet aggregation
Activation of coagulation cascade

Decreased Maternal Cardiac Output
Decreased end organ perfusion-cellular hypoxia/acidosis
Decreased uteroplacental perfusion—fetal hypoxia/acidosis

Fetal Outcome and Maternal Sepsis


Table 3. Fetal outcome following maternal sepsis in the three trimesters

<table>
<thead>
<tr>
<th></th>
<th>Live born and discharged home</th>
<th>Early neonatal death</th>
<th>Stillbirth</th>
<th>Miscarriage</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>First trimester: 7 cases</td>
<td>3</td>
<td>0</td>
<td>4</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>Second trimester: 23 cases</td>
<td>3</td>
<td>2</td>
<td>0</td>
<td>18</td>
<td>23</td>
</tr>
<tr>
<td>Third trimester: 240 cases</td>
<td>232</td>
<td>1</td>
<td>7</td>
<td>Not applicable</td>
<td>240</td>
</tr>
</tbody>
</table>

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Considerations for Birth

Maternal condition should be stable before birth is considered

Obstetric conditions dictate the mode of birth

The Importance of Patient/Family Discharge Education-suggested r/t sepsis

Clinical signs of infection may include:
- Fever or chills (>100.4F) or low temperature (<96.8F)
- Rapid heart rate (persistently over 110)
- Difficulty breathing (Call 911)
- Rapid breathing (over 24/min)
- Hard red painful area of the breast, along with fever or chills
- Constant back, abdominal, pelvic pain, or vaginal pain
- Bad smelling or greenish vaginal discharge
- Stitches that separate, or pain, redness or pus like drainage at the site of your stitches.
- Pain or burning when passing urine or change in how often you pass urine or not being able to empty your bladder.

Any of these symptoms should be reported to your provider.
OB Patient in the ED

Work with your Emergency Department to make sure pregnant or postpartum are seen by a pregnancy care provider

Questions? Thank You!
sandy.hoffman@allina.com
References


Singer M et al. The Third International Consensus Definitions for Sepsis and Septic Shock. (Sepsis-3) JAMA 2016; 315 (8) 801-810