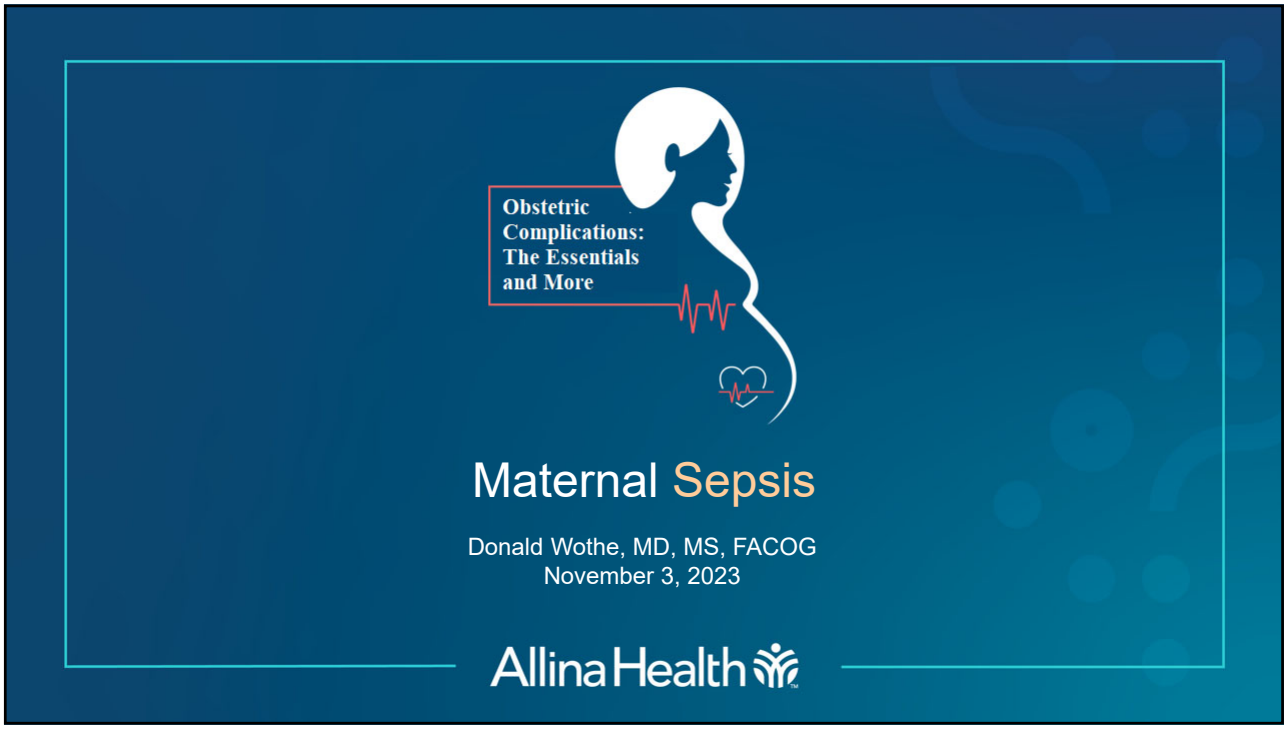

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DISCLOSURES

- I have no conflicts of interest to disclose.
- This conference is sponsored by Allina Health.

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OBJECTIVES

At the conclusion of this presentation on Maternal Sepsis you will be able to:

- Distinguish between Sepsis and Septic Shock.
- Employ tools for early recognition of Sepsis.
- Describe the key steps to treat Sepsis in the first hour.
- Outline the strategies for subsequent treatment of Sepsis.

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THE ESSENTIALS

History
The Challenge
The Response
More-New from the SCCM
A Summary

5

Obstetric Complications:
The Essentials and More

- History

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IGNAZ SEMMELWEIS (1818-1865)

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THE OBSTETRICIAN

- Born in 1818 in Hungary.
- In 1834 Semmelweis arrives at the University of Vienna for training. In Law. In 1837 he switched to Medicine.
- In 1844 he graduated from the University of Vienna with a Doctorate and began a Masters in Midwifery.
- In 1846 he became assistant to the head obstetrician of the Vienna General Hospital.
- The death rate in 1846 from childbed fever at the first Division of the Vienna General Hospital was 9.8% and the rate at the second Division was 3.6%.
- The first Division was staffed by physicians who learned anatomy and pathology by dissection and the second by midwives who learned from mannequins.

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THE DISCOVERY

- In 1847 he proved that hand washing prevented transmission of childbed fever (puerperal sepsis). The rate in the First Division declined to 1.3%.
- He then showed that infections were transmitted to patients from the cadavers of women who died of childbed fever and published it in December 1847.
- He was released from The Lying in Hospital of Vienna in 1848.
- Using his methods, over the next 15 years the death rate from childbed fever was under 1%, first at the Szent Rokus hospital and then at the University of Pest in Budapest.
- He published a book on his findings in 1861.
- His work was not accepted for many reasons, among them that it implied that doctors were the cause of their patient's illness.
- He was placed in an insane asylum in 1865 and died from sepsis two weeks later.

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MATERNAL SEPSIS IN 2023

- Now maternal sepsis is rare, occurring in .04% of deliveries.(Hensley)
- Yet it is among the 4 leading causes of maternal death.
- It accounts for 13-23% of all maternal deaths.
- For each maternal death 50 women experience severe illness and morbidity.
- Some estimates are that 63% of maternal deaths from Sepsis could be prevented.
- Strep pyogenes infections are seen in only 2-4 per 100,000 patients.
- While our understanding of sepsis has advanced, there remains room for progress.

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THE CHALLENGE

Early Diagnosis of Sepsis

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THE ESSENTIAL CHALLENGE:
EARLY DIAGNOSIS OF MATERNAL SEPSIS

Outline:

- What is Sepsis?
- Why is it hard to spot Sepsis in pregnancy?
- Septic Shock in pregnancy.
- What makes Sepsis and Septic Shock more common in pregnancy?

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ESSENTIALS: WHAT IS SEPSIS?

- Sepsis is your body locked in mortal combat with a bacterial pathogen.
- Only one survivor, you or the bacteria.
- The body's initial response to infection is to isolate and destroy the pathogen.
- During this stage, a localized inflammatory response occurs. We see this as redness, swelling, warmth, pain, and loss of function.
- When infection escapes the local area, or even if inflammatory mediators escape confinement, a systemic response is triggered.

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ESSENTIALS: WHAT IS SEPSIS?

- This systemic response is common to many insults so the cause could also be allergy, anesthesia, organ dysfunction or trauma.
- The response includes activation of systemic immune and inflammatory cascades leading to organ damage.
- When this Inflammatory Response gets out of control as a response to infection you have Sepsis.

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MORE: SEPSIS DEFINITION CHANGES.

- 1991-2001 Consensus Conference definitions surrounding Sepsis:
  - **SIRS:** Systemic Inflammatory Response Syndrome, 4->18 different indicators.
  - **Sepsis:** Two or more SIRS criteria positive in the presence of infection.
  - **Severe sepsis:** Sepsis associated with organ dysfunction.
  - **Septic Shock:** Sepsis induced hypotension despite adequate fluid resuscitation with the presence of perfusion abnormalities such as oliguria, lactic acidemia, or alteration in mental status.

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MORE: SEPSIS DEFINITION CHANGES.

- 2017 New Consensus Conference definitions surrounding Sepsis:
  - ~~**SIRS:** Systemic Inflammatory Response Syndrome, 18 different indicators.~~
  - **Sepsis:** A life-threatening organ dysfunction secondary to a dysregulated host response to infection.
  - ~~**Severe sepsis:** Sepsis associated with organ dysfunction.~~
  - **Septic Shock:** Sepsis in which underlying circulatory and cellular/metabolic abnormalities are profound enough to substantially increase mortality risk.

HIDING IN PLAIN SIGHT

- A big problem for diagnosis: pregnancy and sepsis share common signs.
  - Elevated heart rate
  - Higher respiratory rate
  - Elevated WBC count
  - Blood Pressure changes
  - In Labor
    - WBC can go even higher, as high as 20,000.
    - Lactic acid can be elevated, especially with second stage.

SEPSIS MIMICS

- Even the postpartum state mimics sepsis.
  - Hypovolemia is common, elevating HR, decreasing BP
  - Low grade fever from lactation
  - Post anesthesia changes

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SEPSIS IN PREGNANCY

- Pregnant patients are generally healthy and young, and often have great reserve.
- During pregnancy there are multiple occult entry points for infection, the lungs, renal system, reproductive system.
- The physiology of sepsis remains the same but early detection is more complex.

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PATHOPHYSIOLOGY OF SEPSIS IN PREGNANCY

- Fever is an important sign of infection,
- The increased permeability leads to fluid in the tissues,
- Vascular permeability leads to lower intravascular volume and thus lower BP,

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PATHOPHYSIOLOGY OF SEPSIS IN PREGNANCY

- Fever is an important sign of infection, but 25% of women who DIE from sepsis never have a fever.
- The increased permeability leads to fluid in the tissues, but edema is common in pregnancy.
- Vascular permeability leads to lower intravascular volume and thus lower BP, but BP decreases in pregnancy, particularly in the second trimester.

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PATHOPHYSIOLOGY OF SEPSIS IN PREGNANCY

- With lower Blood Pressure heart rate increases
- Increases in metabolism and vascular permeability in the lungs cause the respiratory rate to increase to compensate.
-
- White Blood count is increased by infection,

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PATHOPHYSIOLOGY OF SEPSIS IN PREGNANCY

- With lower Blood Pressure heart rate increases but increased blood volume and decreased systemic vascular resistance increase heart rate in pregnancy.
- Increases in metabolism and vascular permeability in the lungs cause the respiratory rate to increase to compensate.
- But in pregnancy a decrease in the functional residual capacity leads to an expected increase in RR.
- White Blood count is increased by infection, but WBC is increased in pregnancy, sometimes as high as 20,000.

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SEPTIC SHOCK IN PREGNANCY

- Progression to Septic Shock is often subtle
  - Physiologic reserve masks signs
  - Signs are not specific to sepsis.
  - Multiple other problems in the differential.
  - Small changes in signs are explained away as pregnancy related.

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CAUSES OF SEPTIC SHOCK RELATED TO PREGNANCY

- Acute Pyelonephritis/Urinary tract infections
- Pneumonia
  - Bacterial
  - Viral
    - Influenza
    - COVID-19
- Retained products of Conception
- Neglected chorioamnionitis or endometritis
- Necrotizing fasciitis
  - Abdominal incision
  - Perineal lacerations or incisions
- Mastitis

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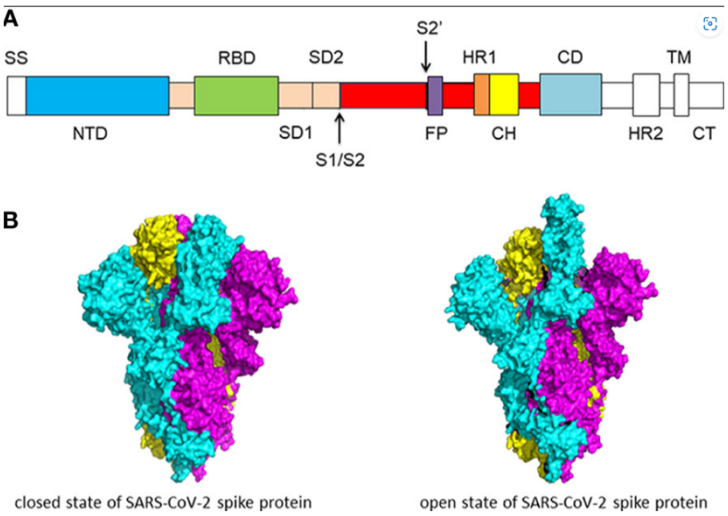
SARS-COV-2 (COVID-19 VIRUS)



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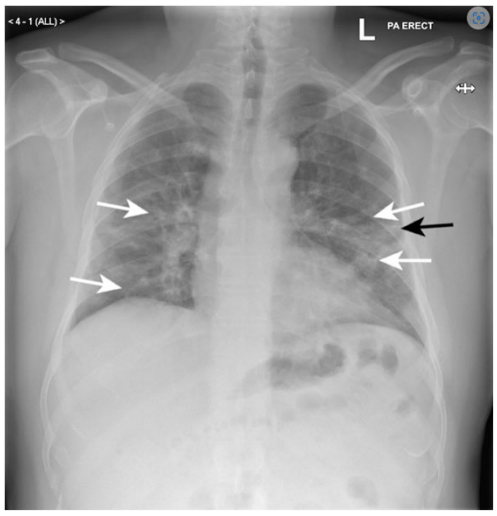
COVID-19 CHEST XRAY



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MATERNAL MORTALITY RATE (PER 100,000)

- 2018 17.4
- 2019 20.1
- 2020 23.8
- 2021 32.2
- 2022 20.1 (preliminary)

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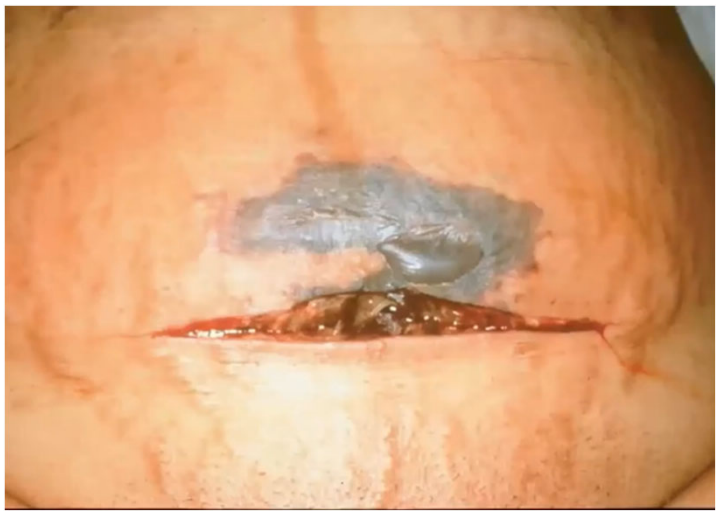
NECROTIZING FASCIITIS



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NECROTIZING FASCIITIS

- Characteristics
  - Post surgical
  - Clostridium Perfringes
  - Pain out of proportion to appearance
  - Septic Shock
- Treatment
  - Debridement
  - Antibiotics-Penicillin
  - Treat Shock

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RISK FACTORS BY PREGNANCY STAGE

Antepartum

- Obesity
- Lack of PNC
- Anemia
- Impaired immunity
- Hx of GBS colonization/infection
- Invasive procedures
- Multiple Gestation
- Diabetes
- Chronic Hypertension
- Use of ABX 2 weeks prior to presentation

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Intrapartum

- Protracted Active Labor, esp in Nullips
- Prolonged PROM
- More than 5 Vaginal exams
- Perineal manipulation during the 2nd stage
- Instrumentation
- Unscheduled C/S

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RISK FACTORS BY PREGNANCY STAGE

Antepartum

- Obesity
- Lack of PNC
- Anemia
- Impaired immunity
- Hx of GBS colonization/infection
- Invasive procedures
- Multiple Gestation
- Diabetes
- Chronic Hypertension
- Use of ABX 2 weeks prior to presentation

Intrapartum/Postpartum

- Protracted Active Labor, esp in Nullips
- Prolonged PROM
- More than 5 Vaginal exams
- Perineal manipulation during the 2nd stage
- Instrumentation
- Unscheduled Cesarean Delivery
- Retained placental fragments
- Cracked nipples
- Operative Delivery
- Cesarean Delivery

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Obstetric Complications:
The Essentials and More

- The Solution

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THE SOLUTION-TO EARLY DETECTION OF SEPSIS

Two Step Process:

- Screening for signs
- Confirmatory step detecting organ dysfunction

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THE ESSENTIAL CHALLENGE: A STRUCTURED APPROACH TO EARLY DETECTION

Outline:

- Resources to diagnose Sepsis.
- Adaptation for pregnancy.
- The two-step approach to Sepsis in pregnancy.
- Bundles: The Golden Hour Bundle.

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DIAGNOSING SEPSIS IN ADULTS

- The Society of Critical Care Medicine and others started a program in 2004 to promote recognition of and response to infection- the Surviving Sepsis Campaign, which provides best of practice recommendations.
- They provide 88 specific recommendations to improve sepsis care. (2021)
- The first recommendation is to “use a performance improvement program for sepsis, including sepsis screening for acutely ill, high-risk patients and standard operating procedures for treatment.”
- This performance inprovement program of sepsis screening, education, measurement of sepsis bundle performance, with attention to outcomes, and acting on identified opportunities is key to decreasing mortality from Sepsis.
- CMS has since 2015 required each Hospital to have a program for identifying early warning signs of Sepsis.

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SSC RECOMMENDATIONS AND PREGNANCY

- The SSC tools for sepsis screening don't work well in pregnancy.
  - SOFA, qSOFA and SIRS criteria.
  - Predict in hospital mortality.
  - Physiology is altered in pregnancy.
  - Low specificity to signs.
  - Young patients can be quite ill with few signs.
  - Pregnancy complicates the use of those tools.
- A modified strategy is needed.
  - California Maternal Quality Care Collaborative (CMQCC).
  - Two step process
    - Universal screening.
    - Confirmatory Step detecting organ dysfunction.

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UNIVERSAL SCREENING

- Since sepsis can be obscured by pregnancy, we will screen everyone with a simple bedside tool.
  - The SOFA and other screening tools from the Surviving Sepsis Campaign have low specificity for pregnant patients.
  - OB specific tools such as MOEWS, omqSOFA and S.O.S. have their own limitations.
  - Adjustments in HR, RR, WBC, and mental status changes are needed.
  - For example, The Surviving Sepsis Campaign suggests a positive screen would include HR>90, RR>20, and WBC>12,000.
  - ACOG suggests HR>110, RR>24, and does not even utilize WBC.
  - CMQCC suggests HR>110, RR>24, and WBC >15,000 or <4,000 as positive screen values.
  - The goal is to maximize sensitivity while minimizing false positive results.

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ALLINA TWO STEP PROCESS TO IDENTIFY SEPSIS

- Step 1: Screen for sepsis when patient admitted and every shift.
  - Four questions:
  - Does your patient have:
    - 1. Unexplained hypotension: SBP<90 or MAP<65?
    - 2. Temperature >= 39 degrees C?
    - 3. Two or more Signs of Sepsis?
    - 4. A Suspected infection based on your assessment?
  - Any Yes is a Positive Screen->Activate Bundle(Step 2).

SIGNS OF SEPSIS: VITAL SIGN SCREENING

- HR > 120 bpm or <50 bpm.
- Respiratory Rate >= 24 bpm or <10 bpm or O2 requirement to keep SpO2 > 95% on room air.
- Temp. > 100.4 F (38.0 C).
- Fetal Tachycardia >160 bmp at baseline.
- WBC > 15,000 or <4,000, OR >10% immature neutrophils.
- Acutely altered mental status.

SUSPECTED INFECTION

- Generalized symptoms: shaking, chills, weakness, lethargy, new onset headache or neck stiffness.
- Uterine tenderness and/or foul-smelling amniotic fluid/vaginal discharge.
- Prolonged rupture of membranes (with s/s infection).
- Respiratory: cough, SOB, increasing oxygen needs, decreasing O2 sats.
- Urinary: pain with urination, flank pain.
- GI: new abdominal pain, new diarrhea.
- High risk for infection (PROM, prolonged IOL, immunocompromised) with s/s infection.
- Known or suspected chorioamnionitis.

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SUSPECTED INFECTION

- Skin/wound: new drainage, redness, or rash.
- Bone/joint symptoms: new warm, or swollen joint.
- Manual removal of placenta (with s/s infection).
- Other.

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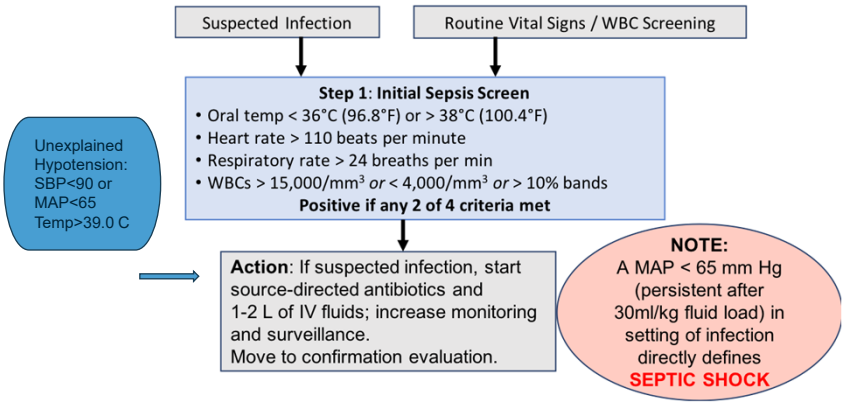
INITIAL SEPSIS SCREEN (CMQCC)



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ACTION: SEPSIS BUNDLE (STEP 2)

- Act to begin treatment and verify sepsis diagnosis from a positive screen.
  - Notify Provider and RRT.
  - RRT/Provider to confirm positive screen and not another illness.
    - Fluids 30 cc/kg crystalloid.
    - Blood Cultures.
    - Source directed antibiotics.

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ACTION: SEPSIS BUNDLE (STEP 2)

- Bundled orders are implemented.
  - Laboratory Tests, monitor vital signs.
  - Fluid Bolus.
  - Antibiotics.
  - Lactate levels.
  - Search for organ dysfunction.
  - Vasopressors as needed.
  - Steroids as needed.
  - Source identification and control.

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LABORATORY TESTS

- Evaluation
  - I &O
  - Oximetry
  - Blood Cultures
  - CBC and Diff
  - Coagulation panel
  - Metabolic panel
  - Lactate, Venous

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FLUID BOLUS

- 500 cc bolus to see if patient responds, diagnostic test.
- If sepsis is confirmed, then 30 cc/kg is standard, but the evidence of benefit is mixed.
- The new recommendations suggest the 30cc/kg can be given over 3 hours with active evaluation of fluid responsiveness.
- No Hespan.

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BEGIN ANTIBIOTICS

- Early administration of antibiotics, ideally within one hour of presentation, is critically important in sepsis.
- The initial choice of antibiotics in critically-ill patients is generally empiric and broad spectrum to cover most or all likely pathogens.
- Assessment for source control (such as surgical/percutaneous drainage or debridement) should be initiated in a timely fashion using the least invasive approach possible.

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CHOICE OF ANTIBIOTICS

- First Line
  - Chorioamnionitis (IAI)
    - Ampicillin-Sulbactam 3 g IV q 6 hours
  - Septic Shock (Ob related)
    - Piperacillin-tazobactam 4.5 g IV x 1 over 30 minutes
- Second Line
  - Chorioamnionitis (IAI)
    - Ertapenem 1 g IV q 24
  - Septic Shock
    - Imipenem-cilastin 500 mg IV q6 hours
- Antibiotic Reference Guide for your Hospital

LACTATE LEVELS

- If initial lactate is <2.0 it doesn't support sepsis.
- If initial lactate is >4.0 presume septic shock.
- Follow lactate to guide fluid therapy and treatment.

LACTATE CONSIDERATIONS IN PREGNANCY

- Lactate can be elevated by metabolic changes
  - Decreased metabolism in the liver occurs with sepsis before LFT changes.
  - Production can be increased by:
    - Catecholamine effects.
    - Adrenergic caused aerobic glycolysis.
    - Insulin resistance.
    - Muscle proteolysis creating pyruvate.
    - Impairment of pyruvate dehydrogenase.

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ORGAN DYSFUNCTION

- Pulmonary:
  - Increased O2 requirements to maintain an SpO2 of >90%.
  - Lactate greater than 2.
- Renal:
  - Low urine output less than 0.5 ml/kg/hr for >2 hours.
  - Creatinine greater than 2.0 mg/dL.
- Central Nervous System:
  - Altered mental status.
- Cardiovascular:
  - SBP less than 90 mmHg or 40 mm Hg below the baseline or MAP <65 mm Hg.
- Hematologic:
  - Platelet count less than 100,000.
- Liver:
  - Bilirubin greater than 2.0 mg/dL.
  - Coagulopathy, INR> 1.5 or PTT greater than 60 sec.

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VASOPRESSORS

- Norepinephrine is the preferred vasopressor
- No benefit to higher MAP than 65.
- Can use Norepinephrine peripherally early.
- Change to central by 24 hours
- If Norepinephrine is not enough:
  - Vasopressin
- If cardiac dysfunction is noted:
  - Dobutamine
  - Or change to epinephrine

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STEROIDS

- Decadron vs. Betamethasone
- IF fetus is viable and less than 37 weeks use Betamethasone.
- If you think you might want to give steroids, give them

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IDENTIFY THE SOURCE

- Source control is critical.
- Delivery can be delayed if the source can be treated.
- Obstetric vs non-obstetric sources.
  - Exam
  - Lab tests
  - Imaging

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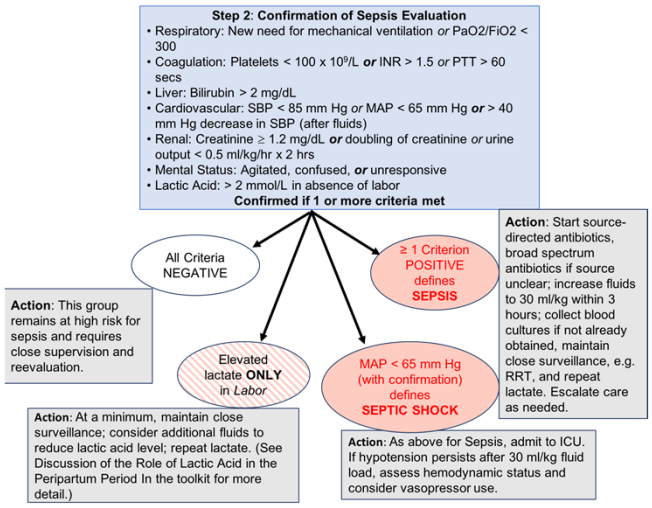
CONFIRMATION OF SEPSIS EVALUATION (CMQCC)



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THE GOLDEN HOUR BUNDLE

- Simultaneous treatment and evaluation.
- Golden Hour
  - Lactate
  - Bolus of Fluid
  - Blood Cultures
  - Antibiotics
  - Other tests
- Refine resuscitation and antibiotics as tests come back.
  - For example, decrease fluid as lactate normalizes to avoid pulmonary edema.
  - Narrow spectrum of antibiotics as cultures and sensitivities return.

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SEPSIS SCREEN POSITIVE BUNDLE

- Bundle starts with confirmation of screen positive.
- Then bolus of fluid (half will be fluid responsive).
- Evaluation:
  - I &O
  - Oximetry
  - CBC and Diff
  - Coagulation panel
  - Metabolic panel
  - Lactate, Venous
  - Blood Cultures
- Treatment:
  - IV antibiotics.

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SEPTIC SHOCK BUNDLE

- Bundle starts with confirmation of Septic Shock
  - Persistent hypotension within one hour of fluid bolus.
  - Lactate >= 4.0.
  - Need for vasopressors to keep MAP >65.
  - Provider documents septic shock
- Antibiotics (Blood cultures first if possible).
- Then Bolus of fluid.
- Evaluation:
  - I &O, Oximetry, CBC and Diff, PT, Metabolic panel, Lactate, Venous, Blood Cultures.
- Treatment:
  - IV antibiotics. Broad spectrum.
  - Pressors as required.
  - Transfer to ICU.

INSTITUTIONAL RECOMMENDATIONS IN SEPSIS MANAGEMENT

- Hospitals institute a standard screening and standard operating procedures to address Sepsis.
- Give antimicrobials ASAP ideally within 1 hour.
  - If probable sepsis give ABX immediately.
  - For possible sepsis without shock and other possible reasons, evaluate rapidly and if concern persists for possible infection after a time limited evaluation, start ABX within 3 hours.
  - For low likelihood of Sepsis without shock and positive SIRS criteria, suggest continuing evaluation and deferring antibiotics.
  - For hypotension early norepinepherine to achieve minimum MAP of 65 even if it has to be given peripherally for a short time. Balanced crystalloid is preferred over saline. Albumin is suggested in patients with substantial crystalloid administration.

Obstetric Complications:
The Essentials and More

- Summary

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SEPSIS ESSENTIALS

- Early Recognition and ACTION are key to saving moms with Sepsis
  - Have a high suspicion for Sepsis
  - Have a screening program with education, performance review and improvement plan.
  - Golden hour
    - Create bundled order sets to streamline early evaluation and treatment
    - Fluid bolus with active volume monitoring and replacement
    - Early antibiotics
  - Individualize treatment to patient as quickly as possible.
    - Fluid administration
    - Antibiotic choice.
    - ICU as needed

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AND MORE

- New in Sepsis:
  - No longer use SIRS
  - No longer use Severe Sepsis. Since Sepsis has a 10% mortality in hospital it is already "Severe"
  - Changed to include recommendation for 30 cc/kg crystalloid in the first 3 hours for sepsis or septic shock.
  - Use balanced crystalloid rather than normal saline (weak evidence)
  - Start vasopressors peripherally rather than waiting for central line access in patients with hypotension in order to restore MAP to desired levels.
  - Don't use vitamin C.
  - Suggest using IV corticosteroids in patients with ongoing shock requiring vasopressin.
  - For adult survivors of Septic Shock-recommend assessment and follow-up for physical, cognitive, and emotional problems after hospital discharge.

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THANK YOU FOR ATTENDING!

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