Sepsis

Maternal 911 Education Systems, LLC
475 West Center St.
Ithaca, MI 48867
www.maternal911.com

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Course Description:

Sepsis is one of the top four causes of maternal mortality. This module describes maternal sepsis, how to recognize it and how to respond.

Approximate Time to Complete: 25 minutes

Click here to download a print version of this course.

Hi! My name is Meghan. My colleagues and I will be guiding you through this module on sepsis. Our job is to point out helpful information you need to know.

I'm Tamara and I will walk you through how to identify maternal sepsis and what to do for maternal safety when we suspect sepsis.

I'm David and I'll talk about how to respond to maternal sepsis and some of the necessary calculations for medication.

- The **Home** button will take you to the beginning of this course.
- The **Help** button will show you the features of this module
- The **X** will close this course

Course Objectives

- Develop sound clincial judgement in the delivery of health care when sepsis occurs.
- Discover learning theories and instructional implications regarding health of a woman with sepsis.
- Identify the importance of implementing protocols for early recognition and management of perinatal sepsis.
- Recognize when an actual event occurs, so you can successfully bring the development, evaluation, and health care implemented from this practice setting to reality. This will allow for early recognition of an actual event.
- Gain knowledge into actual health care delivery, allowing for rapid implementation of necessary steps needed when sepsis is suspected.
- Identify the barriers to implementation of sepsis bundles in early recognition and management of perinatal sepsis, and be determined to overcome them.
- Convert proven learning into actual health care delivery.

Here are some facts about maternal sepsis.

- In the United States and the United Kingdom, maternal sepsis is considered to be the leading cause of death in the peripartum period [1].
- Maternal sepsis is the leading cause of maternal death, accounting for 15% of maternal deaths worldwide [2].
- Sepsis is not a specific illness; rather it is a syndrome that encompasses an uncertain pathobiology [3].
- The organisms responsible for sepsis along with the site of infection evolve throughout pregnancy, delivery, and postnatally [4].

Maternal Population associations for sepsis [6]

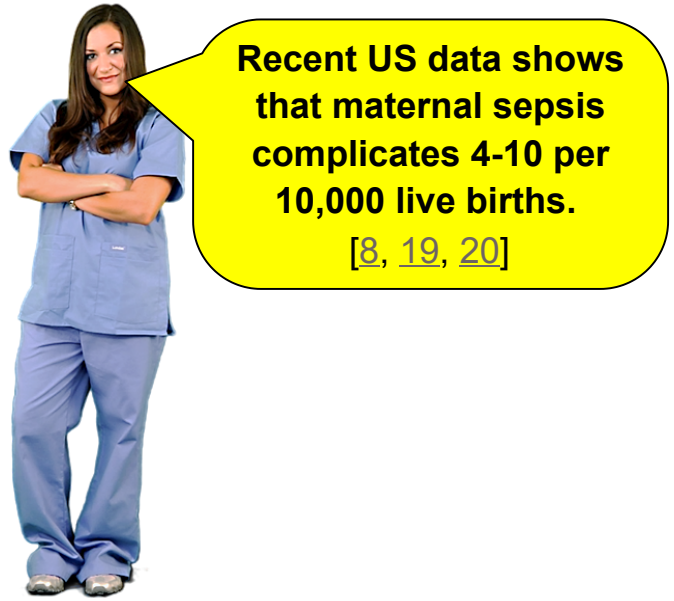
Demographics
- **Advanced maternal age**
- **African-American**
- **Medicaid insurance**

History
- **Preterm delivery**
- **Postpartum hemorrhage**
- **Stillbirth**
- **Cesarean section**
- **Endometritis**
- **Cerclage**
- **Retained products**
- **Multiple gestation**

[5]

More than 50% of the women who die from sepsis have one or more chronic comorbid conditions. These conditions may include:
- Chronic renal disease
- Chronic liver disease
- Congestive heart failure

Maternal Sepsis Incidence



- Incidence of Maternal Sepsis in the United States Stratified National Inpatient Sample (NIS) 1998-2009 [7]
- 50 million obstetric visits were reviewed:
  - No significant change pre-delivery
  - Rate of post-delivery sepsis increased 148% between 1998-99 and 2008-09

Incidence of Pregnancy and Sepsis [9]

- Septic shock is rare in pregnancy and has an incidence of 0.002-0.01%
- Of all septic patients, 0.3-0.6% are pregnant

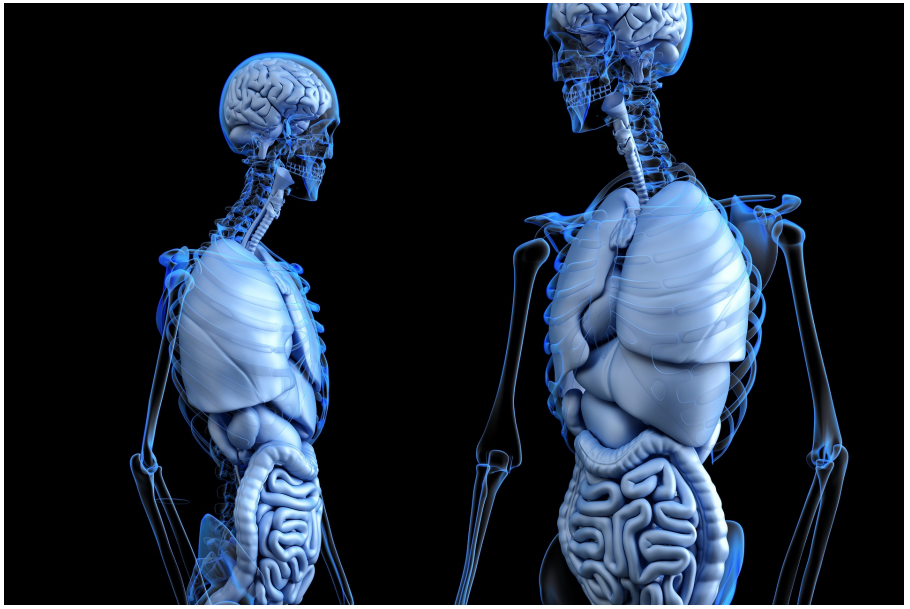
The incidence of severe sepsis and septic shock have increased overall due to changes in the demographics of pregnant women, such as:

- Advance maternal age
- Obesity
- Diabetes
- Assisted reproductive technology
- Placenta abnormalities
- Emerging infectious diseases
- Placental abruption

Etiology[3]

Infection occurs with a disregulated host response resulting in organ damage and virtually any organ system can be affected, thus resulting in sepsis.

- The excessive inflammation responding to these conditions causes extravasation of albumin and fluid resulting in intravascular hypovolemia.
- Cytokines are released, leading to decreased systemic vascular resistance and increased cardiovascular output.
  - Up to 60% of patients with sepsis have an ejection fraction below 54%.



Most Common Infectious Etiologies of Sepsis in Pregnancy [3]

Pregnancy related etiologies:
- Septic abortion
- Chorioamnionitis
- Endometritis
- Wound infection

Non-pregnancy etiologies:
- Urinary tract
- Pneumonia
- Gastrointestinal, including appendicitis

No source is identifiable in 30% of peri-partum septic women

Actions

Healthcare providers play a key role in preventing infections and illnesses that may lead to sepsis:

- Educate patients and their family about the early signs and symptoms of severe infection and sepsis, and when to seek care for an infection. Especially those at higher risk.
- Remind patients to take care of chronic illnesses and how to help prevent infections.
- Encourage infection prevention measures such as hand hygiene and vaccination against infections.

"Pregnancies complicated by severe sepsis and septic shock are associated with increased rates of preterm labor, fetal infection, and preterm delivery. Sepsis onset in pregnancy can be insidious and patients may appear deceptively well before rapidly deteriorating with the development of severe shock, multiple organ dysfunction syndrome, or death. The outcome and survivability in severe sepsis and septic shock in pregnancy are improved with early detection, prompt recognition of the source of infection and targeted therapy"[9]

Recognition and Treatment of Sepsis

- Think sepsis. Know the signs and symptoms of sepsis to identify and treat patients early.
- Act fast when sepsis is suspected.
- Reassess the management and antibiotic therapy.

Click the picture for a larger view

Prevent sepsis and improve early recognition.

Improve health conditions.

George is a 72-year-old man with diabetes. During his check-up, George's healthcare provider takes the opportunity to strengthen his chronic disease care (glucose control and skin care), provide recommended vaccines, and share information about symptoms that indicate an infection is worsening or sepsis is developing.

Educate patients and their families.

One month later, George has a cut on his foot that might be infected. He calls his healthcare provider, who tells him how to take care of the cut and signs of infection. Two days later, his foot is worse and he becomes short of breath, has clammy skin, and is more tired than usual. He recognizes symptoms are worsening and it could be sepsis. He seeks medical attention immediately.

Think sepsis. Act fast.

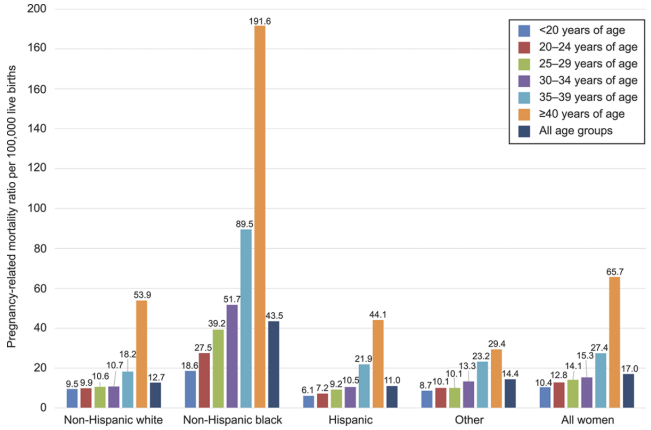
At the hospital, a healthcare provider recognizes the signs and symptoms of sepsis. She immediately orders tests to determine the source of infection and starts appropriate treatment, including antibiotics. She documents the dose, duration, and purpose of antibiotics.

Reassess patient management.

Healthcare providers closely monitor George's progress and adjust therapy as needed. When George improves, his providers transfer him to a rehabilitation facility to continue his recovery. The hospital care team discusses his treatment plan with the team at the new facility.

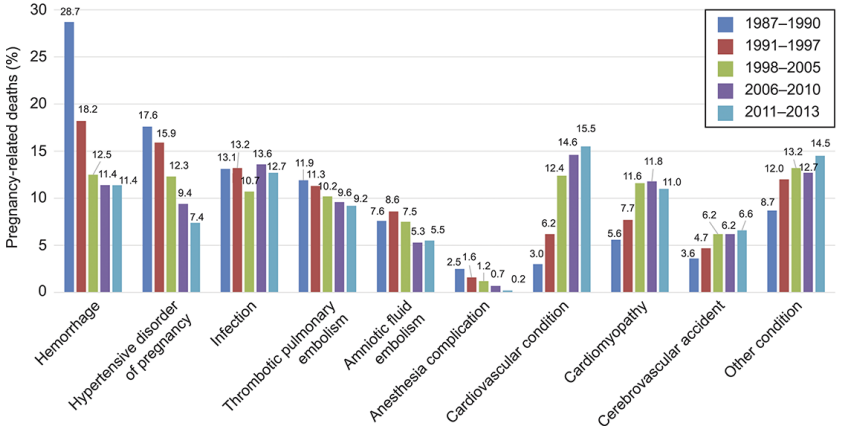
SOURCE: CDC Vital Signs, August 2016.

Sepsis and the perinatal population, a view of history 1987 - 2013

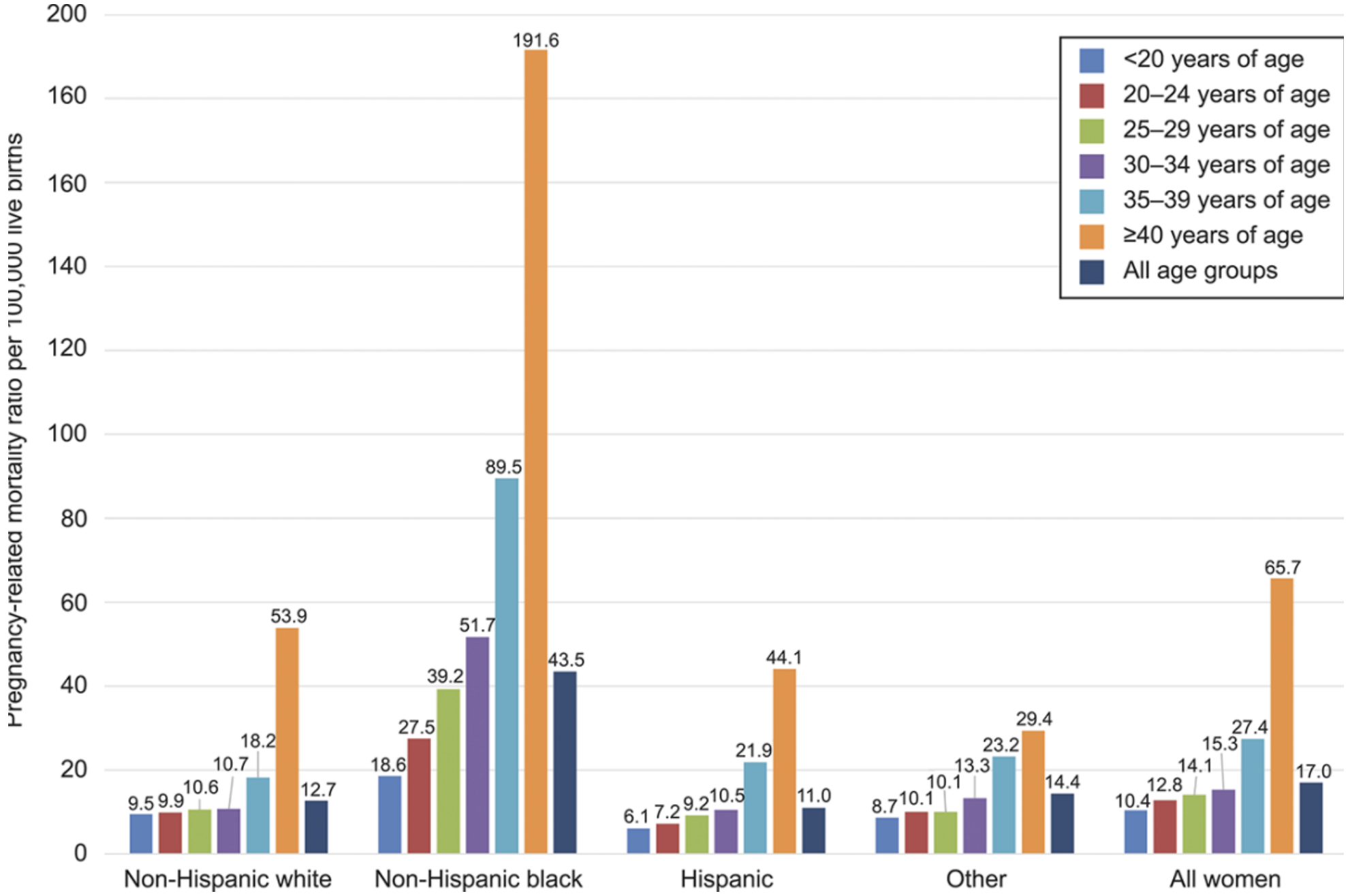


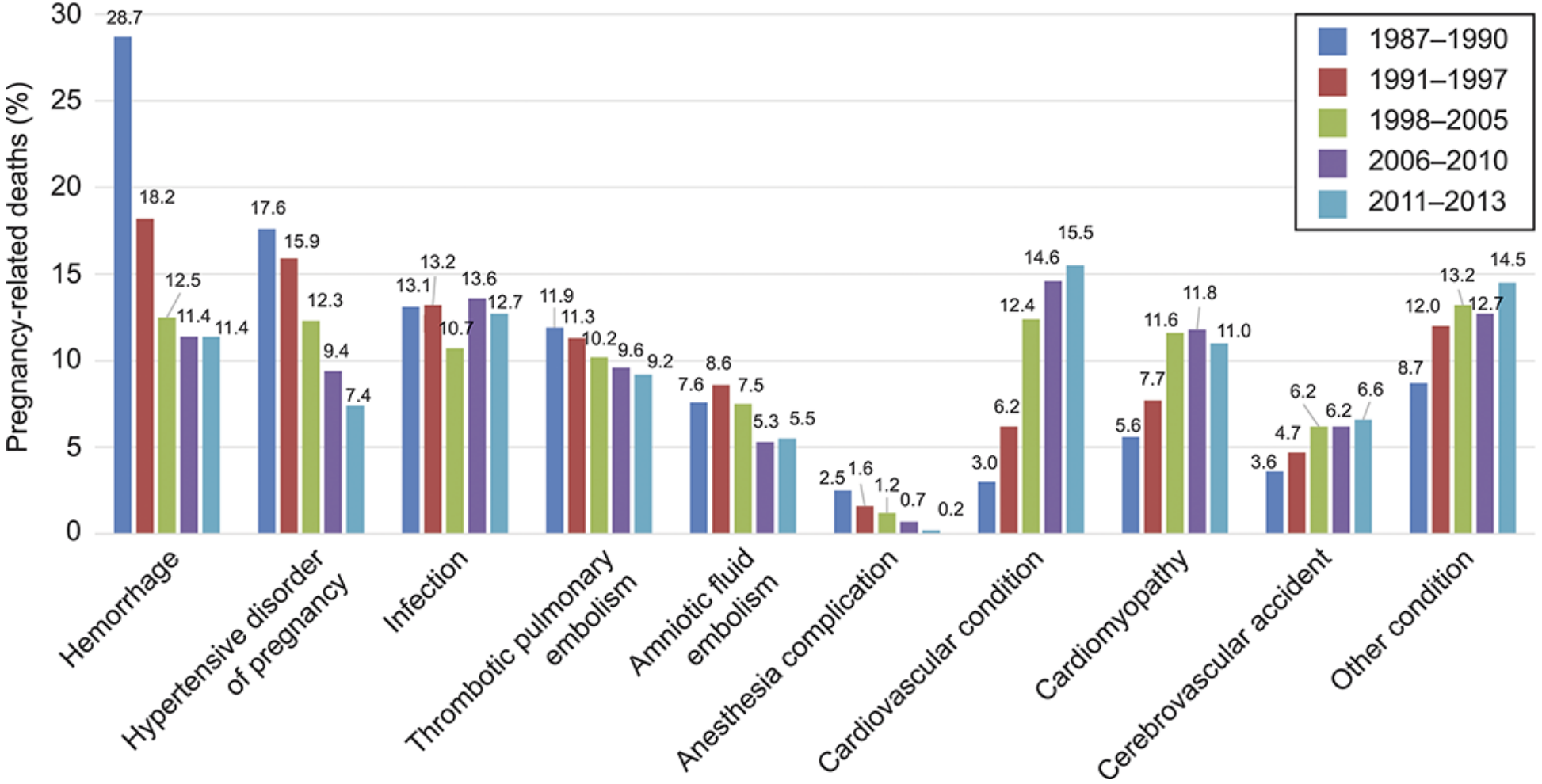
Population-level pregnancy-related mortality ratios by age, race-ethnicity, and overall for 2011-2013. Results are population-level and can be compared as absolute values.Creanga. Pregnancy-Related Mortality in the United States. Obstet Gynecol 2017. Reprinted with permission.

Click on each image for a larger view



Population-level, cause-specific proportionate pregnancy-related mortality for 1987-1990, 1991-1997, 1998-2005, 2006-2010, and 2011-2013. Results are population-level and can be compared as absolute values.Creanga. Pregnancy-Related Mortality in the United States. Obstet Gynecol 2017. Reprinted with permission.


Pregnancy-related mortality ratio per 100,000 live births
200
160
160
140
120
100
80
60
40
20
0
<20 years of age
20–24 years of age
25–29 years of age
30–34 years of age
35–39 years of age
≥40 years of age
All age groups
9.5
9.9
10.6
10.7
18.2
53.9
12.7
18.6
27.5
39.2
51.7
89.5
191.6
43.5
6.1
7.2
9.2
10.5
21.9
44.1
11.0
8.7
10.1
10.1
13.3
23.2
29.4
14.4
10.4
12.8
14.1
15.3
27.4
65.7
17.0
Non-Hispanic white
Non-Hispanic black
Hispanic
Other
All women


Pregnancy-related deaths (%)
30
25
20
15
10
5
0
1987–1990
1991–1997
1998–2005
2006–2010
2011–2013
28.7
18.2
12.5
11.4
11.4
17.6
15.9
12.3
9.4
7.4
13.1
13.2
10.7
13.6
12.7
11.9
11.3
10.2
9.6
9.2
7.6
8.6
7.5
5.3
5.5
2.5
1.6
1.2
0.7
0.2
3.0
6.2
12.4
14.6
15.5
5.6
7.7
11.6
11.8
11.0
3.6
4.7
6.2
6.2
6.6
8.7
12.0
13.2
12.7
14.5
Hemorrhage
Hypertensive disorder of pregnancy
Infection
Thrombotic pulmonary embolism
Amniotic fluid embolism
Anesthesia complication
Cardiovascular condition
Cardiomyopathy
Cerebrovascular accident
Other condition

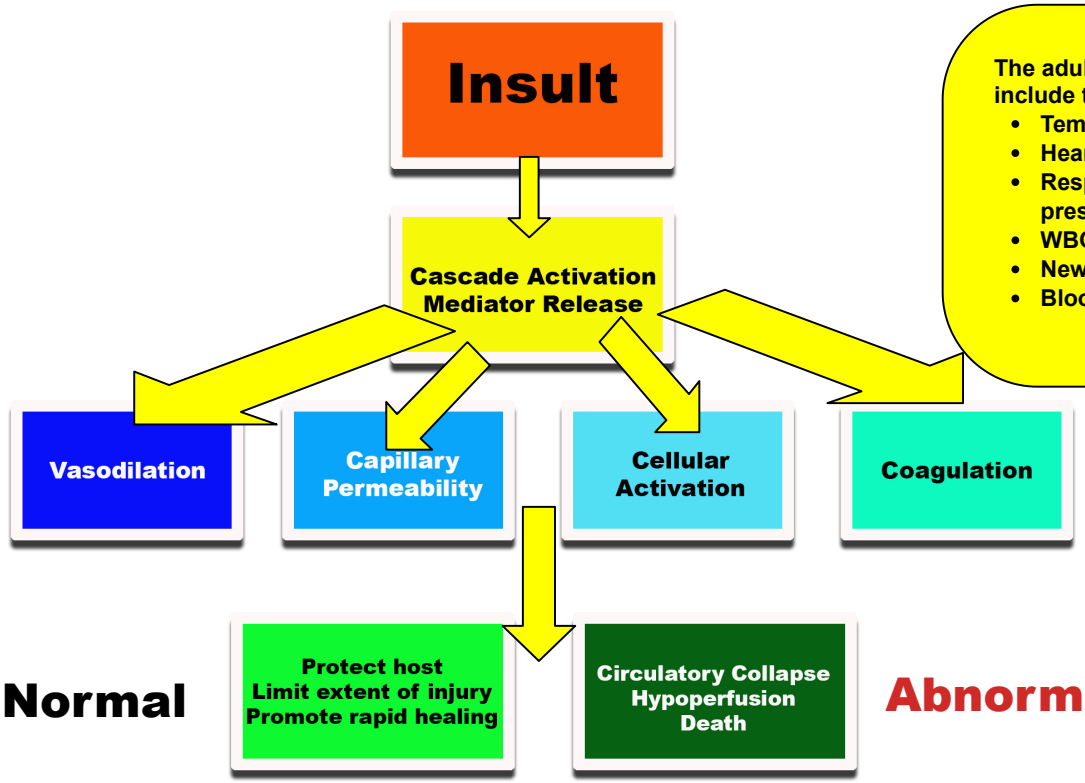
Pathophysiology of Sepsis & Definition

- A systemic inflammatory response (SIR) occurs in sepsis and is defined as a clinical manifestation resulting from an insult, infection, or trauma, that includes body-wide activation of immune inflammatory cascades.
- SIRS criteria may overlap with normal hemodynamic and other parameters during pregnancy and the peri-partum period [11].

Video Player

http://www.youtube.com/watch?v=o5sYBUarpmI

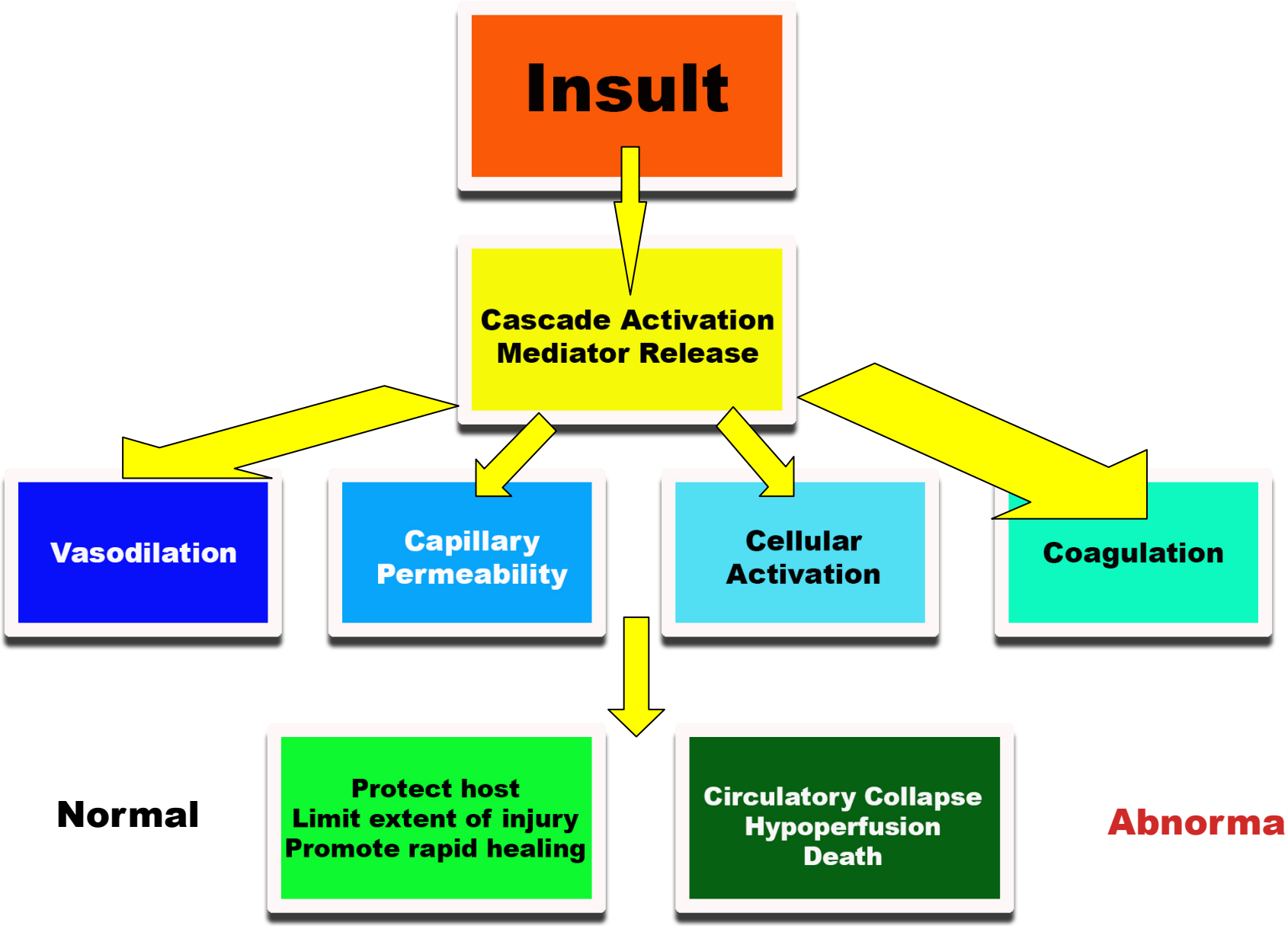
Understanding How Systemic Inflammatory Response Syndrome (SIRS) Can Kill in Sepsis



The adult screening criteria to diagnose SIRS must include two of the following:

- Temperature above 38ºC or below 36ºC
- Heart rate > 90 bpm
- Respiratory rate >20 breaths/minute or partial pressure CO2 of <32mmHg
- WBC >12,000 per ml or <4000 per ml [12]
- New mental status change
- Blood glucose 140mg/dL in the absence of diabetes

Click the picture for a larger view


Insult
Cascade Activation
Mediator Release
Vasodilation
Capillary
Permeability
Cellular
Activation
Coagulation
Normal
Protect host
Limit extent of injury
Promote rapid healing
Circulatory Collapse
Hypoperfusion
Death
Abnormal

Why is Sepsis a Topic of Concern? [9,13]

- Pregnant women are more vulnerable to infection and susceptible to serious complications
- Screening protocols are needed for early recognition and management of maternal sepsis

Why is Sepsis a Topic of Concern?[9,13]

- All perinatal staff are trained on early recognition and management of maternal sepsis
  - Recognition and treatment of maternal sepsis will improve survival, decrease length of stay and length of stay in ICU
  - A delay in diagnosing and treating sepsis is shown to increase mortality

Having trained staff who can identify maternal sepsis is important!

What are some best practices?

- Best practices are based on hospitals with the lowest sepsis mortality rate.
- Best practices are protocol driven, focusing on early recognition, and ICU level care.
- They also include communication strategies such as Code Sepsis OB. [14]

Parameters Differ in the Perinatal Period [3]

The screening criteria was adjusted for perinatal population due to the physiology of pregnancy:

- Maternal heart rate is increased by 10-20 bpm due to increased volume
- An increase in respiratory rate and tidal volume increases minute volume (Respiratory Rate x Tidal Volume) by 50%
- Decreases in lung volume and increases in the respiratory rate occur due to the position of the diaphragm
- Increase in WBC (leukocytosis) in labor and immediate postpartum
- Decrease in creatinine levels occur due to increases in perfusion to the kidneys

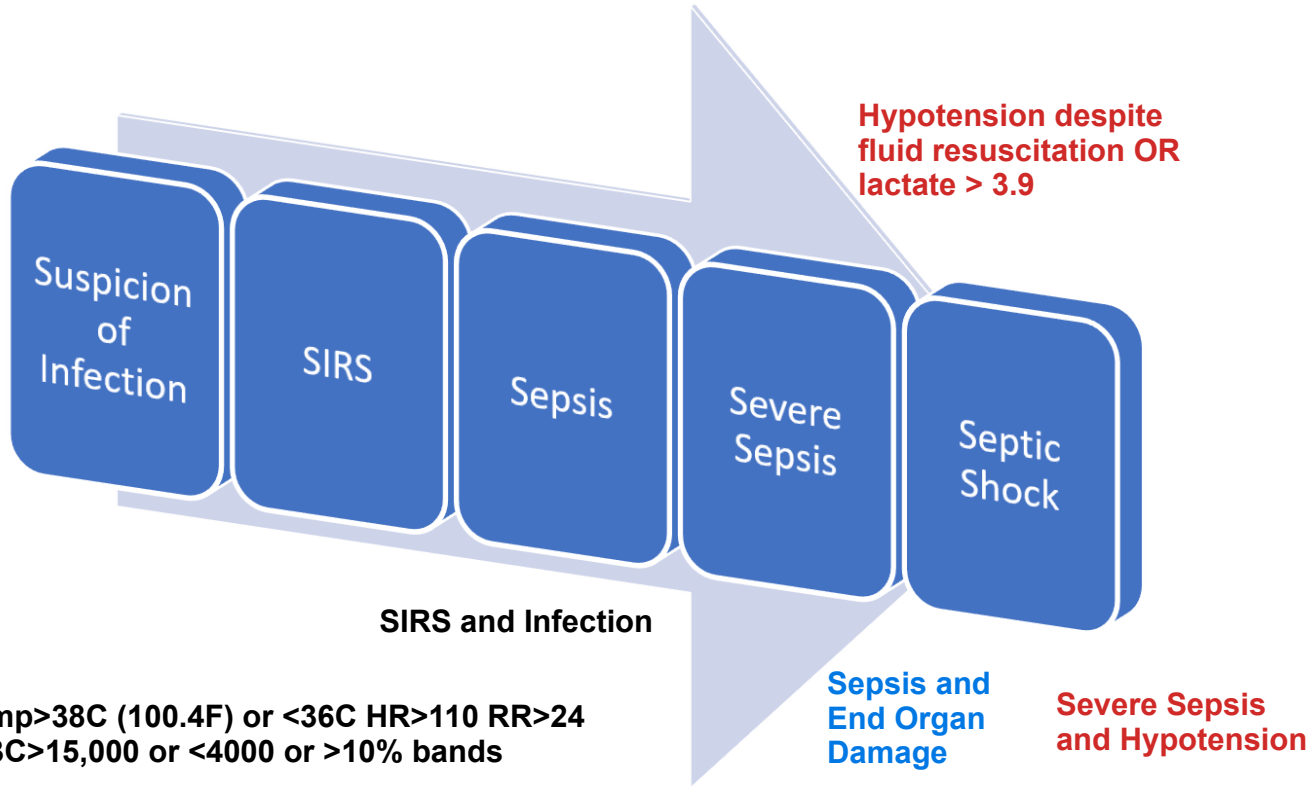
So we reviewed the parameters and differences. Now let's review the next table that compares these differences.

Comparison - SIRS criteria

Adult Screening Criteria [14,15]	Perinatal Screening Criteria [14,16]
Temp > 38°C (100.4°F) or < 36°C (96.8°F)	Temp > 38°C (100.4°F) or < 36°C (96.8°F)
HR > 90 bpm	HR > 110 bpm
Resp Rate> 20 breaths/minute	Resp Rate > 24 breaths/minute
WBC >12,000, < 4,000 or >10% immature neutrophils	WBC > 15,000 or < 4,000 or > 10 % immature neutrophils
Blood glucose > 140 mg/dl in the absence of diabetes	Blood glucose > 140 mg/dl in absence of diabetes
New mental status change	Mental status change

Next, I want you to review the syndrome of sepsis, notice the progression on the next slide.

Syndrome with sepsis [14]



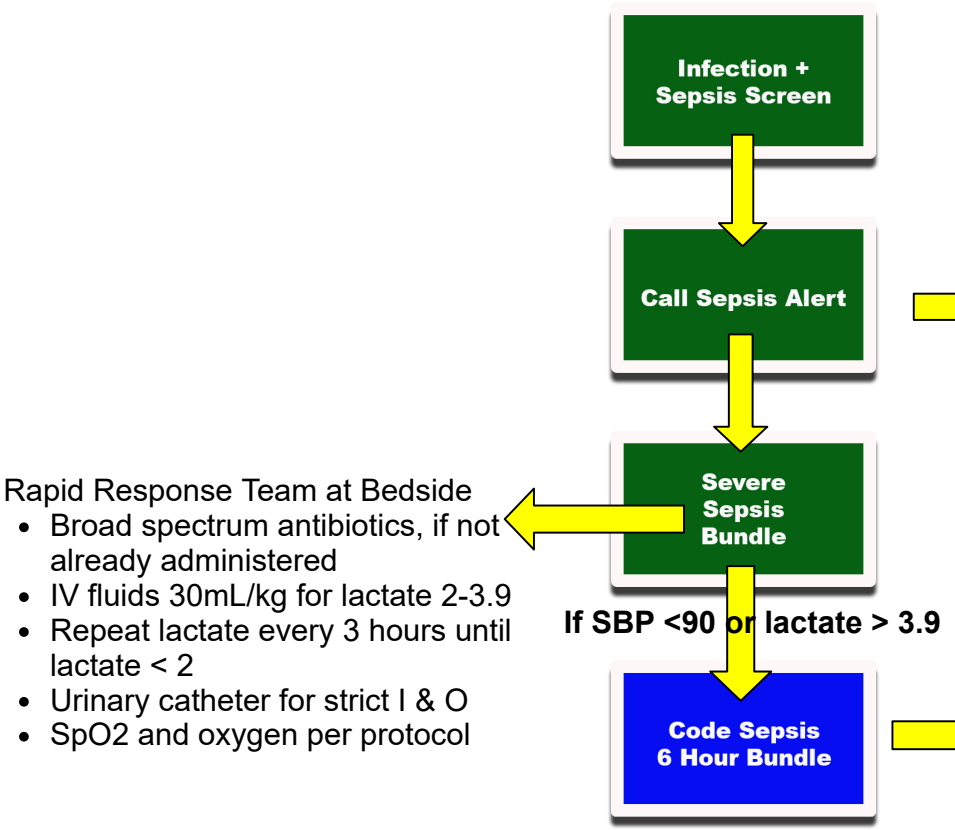
The next table I am going to show you reviews organ dysfunction. Several organs may be affected when sepsis is present.

Organ Dysfunction [16]

Respiratory: SpO2 < 92%	Platelets: >100,000
Urine Output: Less than or equal to 30ml/hour for two hours	Lactate: Lactate > 2
Creatinine > 1.5mg/dL	Bilirubin > 2mg/dL
Altered mental status	Coagulopathy: INR > 15 or PPT > 60 seconds
Blood Pressure MAP: SBP < 90mmHg or 40mmHg below the base line or MAP < 65 mmHg	

On the next slide is a table alerting you of sepsis, and when to call for a rapid response team.
Do this sooner than later!

ALERT - Sepsis [14]



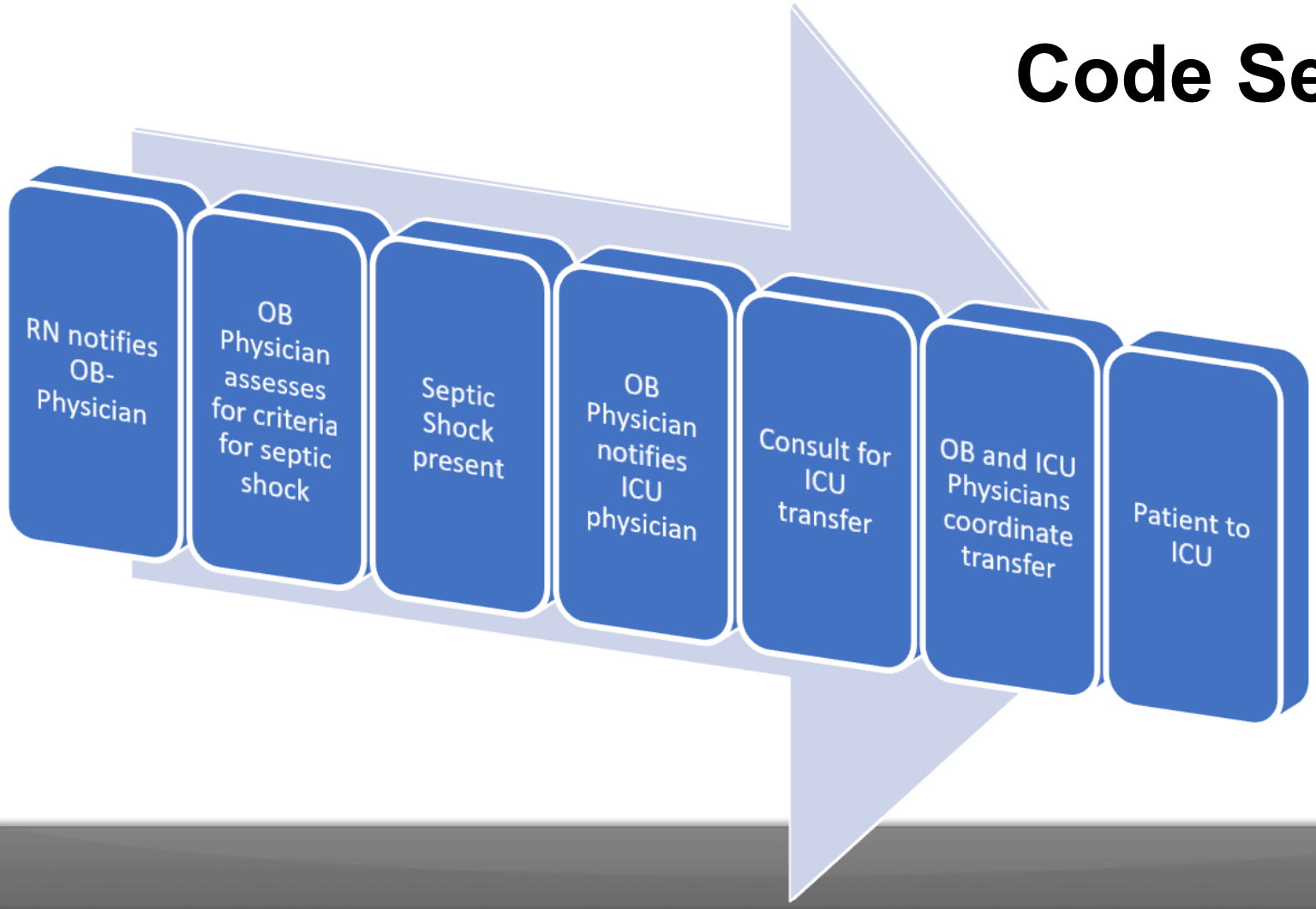
Rapid Response Team at Bedside
- Lab tests: CBC, CMP, lactate, blood culture
- Broad spectrum antibiotics
- IVF (30mL/kg), if hypotensive
- Radiology and Pharmacy on alert
- Notify OB, ICU physician

Rapid Response Team at Bedside
- Broad spectrum antibiotics, if not already administered
- IV fluids 30mL/kg for lactate 2-3.9
- Repeat lactate every 3 hours until lactate < 2
- Urinary catheter for strict I & O
- SpO2 and oxygen per protocol

ICU

The next slide will depict a code sepsis with the typical progression and providers involved; it is certainly not limited to the people stated. Ask for further help you may need!

Code Sepsis


RN notifies OB-Physician
OB Physician assesses for criteria for septic shock
Septic Shock present
OB Physician notifies ICU physician
Consult for ICU transfer
OB and ICU Physicians coordinate transfer
Patient to ICU

Decoys - Dismissing Abnormal SIRS [14]

Abnormal SIRS criteria are often seen and disregarded in postpartum states:

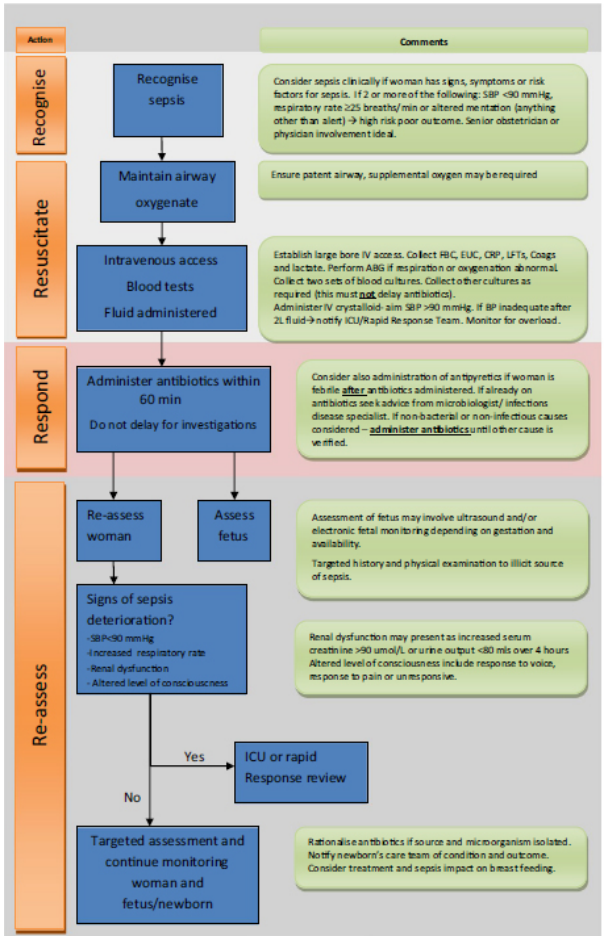
1. Fever - elevated metabolic demand
2. Tachycardia - relative hypovolemia
3. Leukocytosis - stress of delivery
4. Mild hypotension can even be dismissed especially with woman who may be hypovolemic, dismissing as a young woman with physiologically low blood pressure.

Early recognition of maternal sepsis is key! Here are some things to do [14]:

- Nursing staff should initiate sepsis screening at every shift.
- Intervene early for all patients who screen positive for maternal sepsis.
- Bring in the rapid response team and further evaluation with an intensivist as needed.
- Create protocols with SIRS criteria for maternal sepsis.
- Notify the OB Physician

Make sure to also address these barriers to help early recognition of maternal sepsis [14].

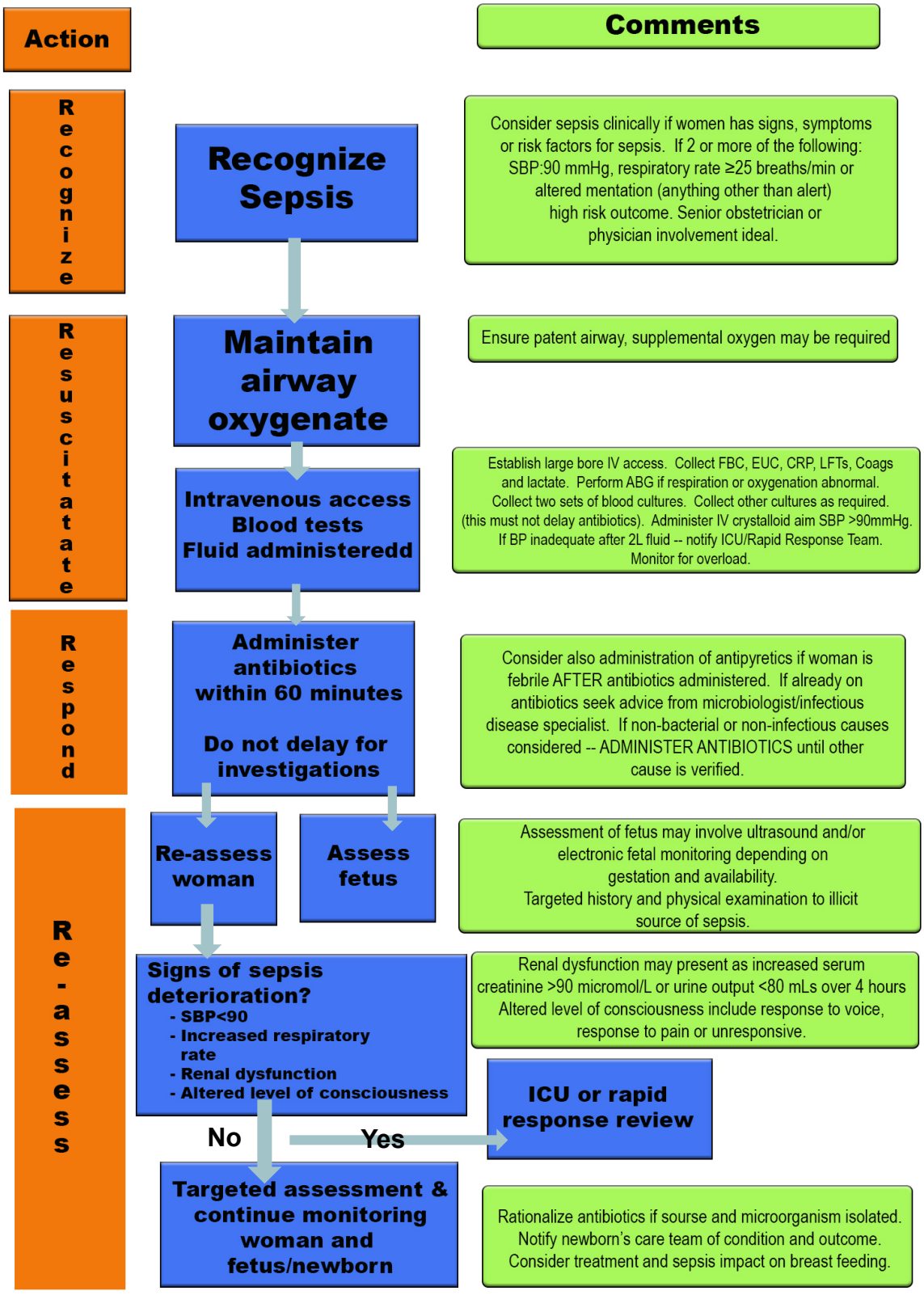
- Just because a patient is young and healthy and doesn't look septic doesn't mean she isn't. Double check!
- Utilizing bundles that may lead to over-treatment.
- When pulmonary edema is present, risk is raised.
- Fevers may occur with women who undergo epidural anesthesia.
- The laboring woman normally has an elevated lactate.
- Make sure to screen women in the second stage of labor for sepsis. It can happen here too.



Flowchart for the assessment and management of sepsis in pregnancy.

Click the image for a larger view.

The clinically important steps are noted in blue boxes and comments relating to the steps are in neighboring green boxes.


Action
Comments
Recognize
Recognize Sepsis
Consider sepsis clinically if women has signs, symptoms or risk factors for sepsis. If 2 or more of the following: SBP:90 mmHg, respiratory rate ≥25 breaths/min or altered mentation (anything other than alert) high risk outcome. Senior obstetrician or physician involvement ideal.
Resuscitatate
Maintain airway oxygenate
Ensure patent airway, supplemental oxygen may be required
Intravenous access
Blood tests
Fluid administeredd
Establish large bore IV access. Collect FBC, EUC, CRP, LFTs, Coags and lactate. Perform ABG if respiration or oxygenation abnormal. Collect two sets of blood cultures. Collect other cultures as required. (this must not delay antibiotics). Administer IV crystalloid aim SBP >90mmHg. If BP inadequate after 2L fluid -- notify ICU/Rapid Response Team. Monitor for overload.
Respond
Administer antibiotics within 60 minutes
Do not delay for investigations
Consider also administration of antipyretics if woman is febrile AFTER antibiotics administered. If already on antibiotics seek advice from microbiologist/infectious disease specialist. If non-bacterial or non-infectious causes considered -- ADMINISTER ANTIBIOTICS until other cause is verified.
Re-assess
Re-assess woman
Assess fetus
Assessment of fetus may involve ultrasound and/or electronic fetal monitoring depending on gestation and availability.
Targeted history and physical examination to illicit source of sepsis.
Signs of sepsis deterioration?
- SBP<90
- Increased respiratory rate
- Renal dysfunction
- Altered level of consciousness
Renal dysfunction may present as increased serum creatinine >90 micromol/L or urine output <80 mLs over 4 hours
Altered level of consciousness include response to voice, response to pain or unresponsive.
ICU or rapid response review
No
Yes
Targeted assessment & continue monitoring woman and fetus/newborn
Rationalize antibiotics if sourse and microorganism isolated.
Notify newborn's care team of condition and outcome.
Consider treatment and sepsis impact on breast feeding.

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1. This figure and the associated guidelines should be considered together
2. Is not meant to represent specific medical advice-appropriate advice should be sought from a medical professional in this instance .
3. They are guidelines for the management of Sepsis specific to women who are, or have recently been pregnant aimed for clinicians in Australia and NZ.
4. We accept no responsibility for the application of this guideline outside of Australia and NZ or of notifying you or your organisation of any changes to the guideline if and when they occur in the future.
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Step 1: Recognize Sepsis

Calculate omqSOFA

Is the score above 2?

- Yes - involve senior obstetrician or physician
- No

The first step is to recognize maternal sepsis. The definition of omqSOFA is obstetric modified quick sequential.

Click on Calculate omqSOFA link to view the table to calculate the score.

System Parameter	omSOFA Score		
	0	1	2
Respiration			
PaO_2/FIO_2	≥ 400	300 to < 400	< 300
Coagulation			
Platelets, $x10^6/L$	≥ 150	100-150	<100
Liver			
Bilirubin (micromol/L)	≤ 20	20-32	>32
Cardiovascular			
Mean arterial pressure (mmHg)	MAP ≥ 70	MAP <70	Vasopressors required
Central Nervous System	Alert	Voice response	Pain response
Renal			
Creatinine (micromol/L)	(≤ 90	90-120	>120

FIO_2 fraction of inspired oxygen (expressed as a decimal); MAP, mean arterial pressure; mmHg, millimeters of mercury; PaO_2, partial pressure oxygen (in mmHg); SOFA, Sequential (sepsis-related) Organ Failure score

Step 2: Resuscitate

- Maintain airway
- Consider supplemental oxygen
- IV access - 2 large bore (≥18g) cannulas
- Send bloods (FBC, UEC, CRP, LFT, COAGS, Lactate)
- ABC if respiration or oxygenation is abnormal
- SEPTIC screen as indicated:
  - Urine MCS
  - Vaginal swabs MCS
  - Sputum MCS
  - Stool MCS

Ensure the patient airway is maintained. Supplement with oxygen when necessary. Click the links for definitions.

Step 3: Respond

- Administer IV antibiotics within 60 minutes (follow local guidance)
- Consider antipyretic if febrile AFTER antibiotics
- Administer IV crystalloid (Aim SBP >90)
- Is BP < 90 SBP after 2L IV Fluids?
  - Yes - call ICU
  - No

Respond with antibiotics. Click the links for definitions.

Step 4: Re-Assess:

- History
  - Targeted to elicit cause of sepsis
- Examination
  - Targeted to elicit cause of sepsis
- Calculate omSOFA (details on the next page)
- Are there signs of deterioration?
  - Yes? Call ICU
  - No
  - SBP >90
    - RR >25
  - Renal dysfunction (Cr >90 or urine output <80 mL/ 4 hours)
- Altered mentation
- Fetal assessment
- Ultrasound for growth and welfare
- CTG
- Notify newborn care
- Consider antibiotic use with breastfeeding

Use of the obstetrically modified quick Sequential (sepsis-related) Organ Failure Assessment score (omqSOFA) (Table 1) is recommended.
The obstetrically modified SOFA (omSOFA) score should be used for subsequent, more thorough assessment (Table 2). (Bowyer, et al, 2017)

Table 1: **Obstetrically modified qSOFA score**

Parameter	Score	
	0	1
Systolic Blood Pressure	>or= 90mmHg	<90mmHg
Respiratory Rate	Less than 25 breaths per minute	25 breath/minute or greater
Altered Mentation	Alert	Not alert

Min, minute; mmHg, millimeters of mercury; qSOFA, quick Sequential (sepsis-related) Organ Failure score

From "SOMANZ guidelines for the investigation and management sepsis in pregnancy," by L. Bowyer, et al. 2017, *Aust NZ J Obstet Gynaecol, 57,* p.542. Copyright 2017 by the Royal Australian and New Zealand College of Obstetrics and Gynaecologists. Reprinted with permission. Terms and conditions of use.

System Parameter	omSOFA Score		
	0	1	2
Respiration			
PaO_2/FIO_2	≥ 400	300 to < 400	< 300
Coagulation			
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Liver			
Bilirubin (micromol/L)	≤ 20	20-32	>32
Cardiovascular			
Mean arterial pressure (mmHg)	MAP ≥ 70	MAP <70	Vasopressors required
Central Nervous System	Alert	Voice response	Pain response
Renal			
Creatinine (micromol/L)	(≤ 90	90-120	>120

FIO_2 fraction of inspired oxygen (expressed as a decimal); MAP, mean arterial pressure; mmHg, millimeters of mercury; PaO_2, partial pressure oxygen (in mmHg); SOFA, Sequential (sepsis-related) Organ Failure score

Consider the Sepsis Six [17]

These six items are intended to be performed during the first hour after sepsis is diagnosed and consist of the following steps:

1. Administer high flow oxygen
2. Take blood cultures before antibiotics are given
3. Give broad spectrum antibiotics
4. Give intravenous fluid challenges
5. Measure serum lactate and hemoglobin
6. Accurately measure urine output

[3]

- The majority of women who died from sepsis had a delay in escalation of her care.
- Most were afebrile, possibly delaying the recognition of sepsis being present.
- Shockingly, even after diagnosis, 73% of women were started on antibiotics providing inadequate coverage.
- Involving an expert in infectious disease may help save her life.
- Implementation of protocols are critical.

[18]

- Educate her on risks of contact with young children and risk of exposure to pharyngitis
- Hand washing and perineal hygiene education should be reviewed
- Treatment of other infections promptly
- Before surgery, ensuring a shower occurs with antiseptic agent
- Within 30 days of surgery, she should avoid smoking
- Control of glucose levels
- Prophylaxis for antimicrobials
- PROM (premature rupture of membranes) should require antenatal prophylaxis for less than 37 weeks gestation
- PROM at greater than 37 weeks gestation should require antibiotics
- When she requires cesarean delivery, antibiotic prophylaxis should be given
- When she has a 3rd or 4th degree laceration, broad spectrum antibiotics should be given

In Conclusion [3]

- Sepsis and septic shock are considered medical emergencies requiring immediate treatment and resuscitation.
- Sepsis should be consider when pregnant women, with otherwise unexplained end organ damage, have an infectious process regardless of whether a fever is present or not.
- Empiric broad spectrum antibiotics need to be administered as soon as possible in any pregnant woman suspected to have sepsis, ideally within the hour of diagnosing or suspecting sepsis.
- Cultures should be obtained: Blood, urine respiratory, wound, or any other culture as indicated
- Early administration of crystalloid solutions when sepsis is complicated by hypotension or suspected organ hypo-perfusion
- Earlier than later, consider transferring the patient to ICU. Then, the providers in ICU should consider norepinephrine as first line vasopressor with peri-partum sepsis when persistent hypo-perfusion or hypotension is present.

Congratulations! You have successfully completed this module!

Click in the 'X' to take the post-test for this course. If you do not attain a passing score after two attempts at the post-test, the entire program must be repurchased.

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