



Code Sepsis: Let'  
Intervene Before It Hits!

Lori Olvera DNP,  
RNC-OB, EFM-C

# 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..



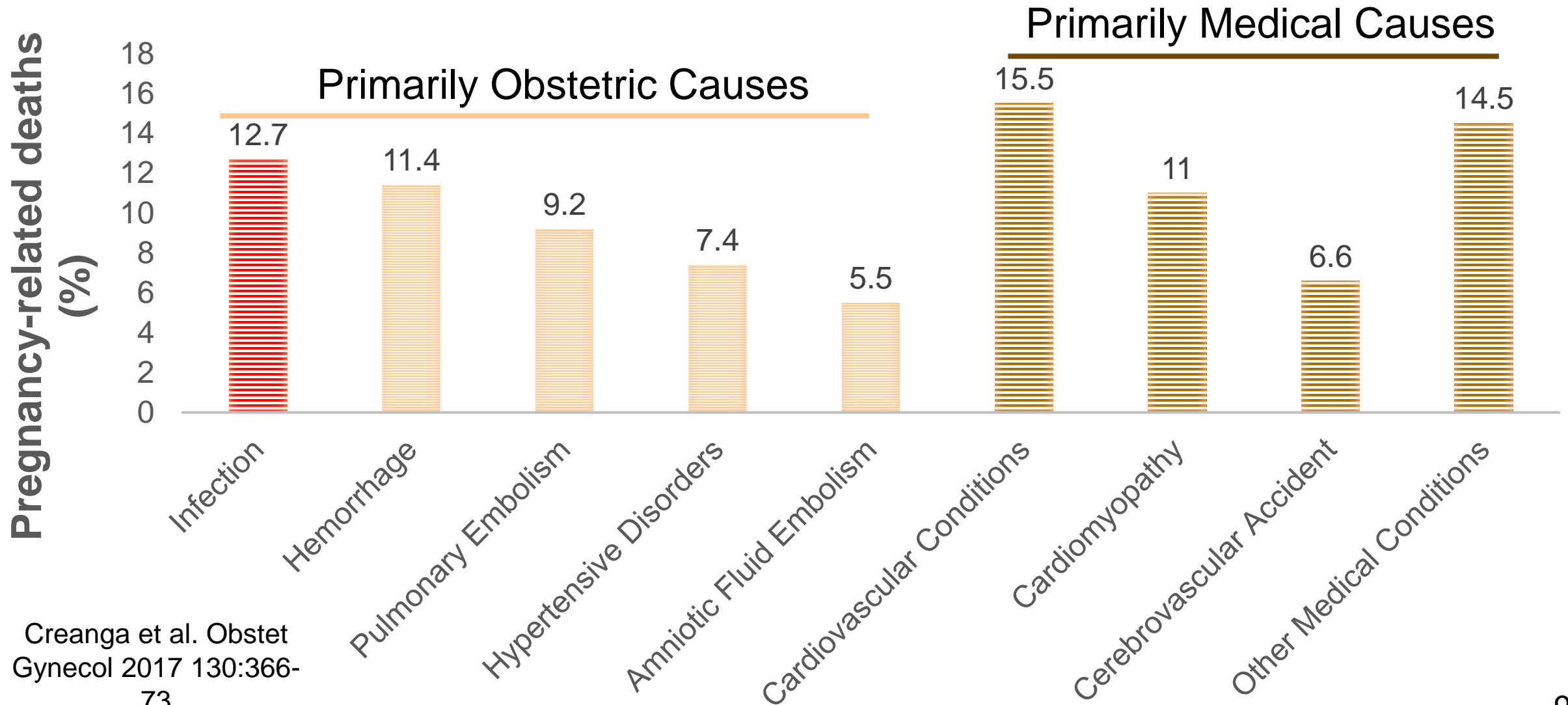
LeeAnna  
Septic Shock  
Survivor.....

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."





# Cause-Specific Pregnancy-Related Mortality, US: 2011-2013



Creanga et al. Obstet  
Gynecol 2017 130:366-

# 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**

# Definition: 2016 Surviving Sepsis Guidelines

---

## **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

**Rhodes, et al (2017). SSC: International Guidelines for Management of Sepsis & Septic Shock: 2016**

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



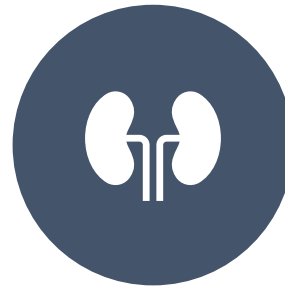
Physiological changes of pregnancy mask the signs of sepsis.



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

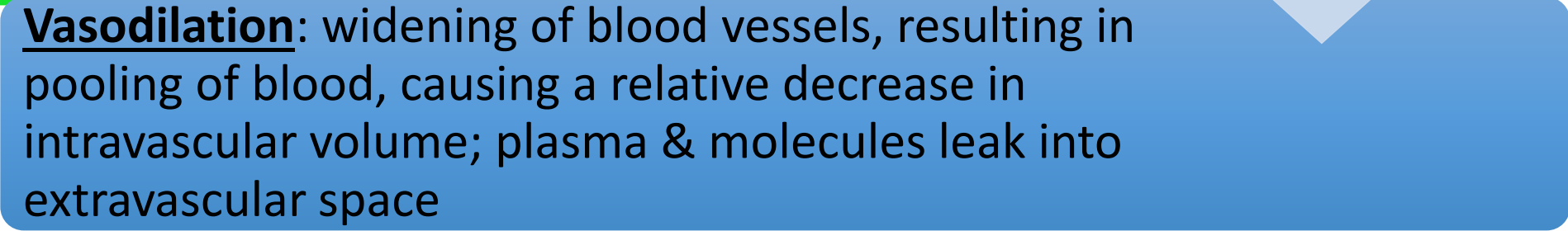
**Inflammatory mediators** (histamines, serotonin, cytokines) cause increase vascular permeability and vasodilation



**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, H<sub>2</sub>O 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

```
graph TD; A[Effects of Increased Vascular Permeability of Capillaries] --> B[Reduced Circulating Volume]; B --> C[Hypotension  
Tachycardia];
```

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

<b>Antepartum</b>	<b>Intrapartum/ Immediate Postpartum</b>	<b>Post-discharge</b>
Septic abortion	Chorioamnionitis/ intraamniotic infection	Pneumonia/influenza
Chorioamnionitis/ intraamniotic infection	Endometritis	Pyelonephritis
Pneumonia/ influenza	Pneumonia/influenza	Wound Infection/ necrotizing fasciitis
Pyelonephritis	Pyelonephritis	Mastitis
Appendicitis	Wound Infection/ necrotizing fasciitis	Cholecystitis

# CMQCC Criteria for Maternal Sepsis “STEP 1”

Sepsis Screen  
Positive:

- ✓ 2 or more criteria  
with suspected  
infection

**STEP 1: All patients with suspected infection should be screened:**

- **Temp  $\geq 38$  C/100.4 F or  $< 36$  C/96.8 F**
- **HR  $> 110$  beats/min**
- **RR  $> 24$  breaths/min**
- **WBC  $> 15,000$  mm<sup>3</sup> or  $< 4,000$  mm<sup>3</sup> or  $> 10\%$  immature neutrophils (bands)**
- **Altered Mental Status**

# Step 2: Criteria for End Organ Injury

## POSITIVE IF ONE OR MORE CRITERIA ARE MET

Respiratory Function	<ul style="list-style-type: none"><li>✓ Acute Respiratory Failure AEB acute need for invasive or non-invasive mechanical ventilation OR</li><li>✓ PaO<sub>2</sub>/FIO<sub>2</sub> &lt; 300</li></ul>
Coagulation Status	<ul style="list-style-type: none"><li>✓ Platelets &lt; 100 X 10<sup>9</sup>/L OR</li><li>✓ International Normalized Ratio (INR) &gt; 1.5, OR</li><li>✓ Partial Thromboplastin Time (PTT) &gt; 60 seconds</li></ul>
Liver Function	<ul style="list-style-type: none"><li>✓ Bilirubin &gt; 2 mg/dl</li></ul>
Renal Function	<ul style="list-style-type: none"><li>✓ Creatinine &gt; 1.2 mg/dl, OR</li><li>✓ Doubling of serum creatinine, OR</li><li>✓ Urine Output less 0.5 ml/kg/hour (for 2 hours)</li></ul>
Mental Status Assessment	<ul style="list-style-type: none"><li>✓ Agitation, confusion, or unresponsiveness</li></ul>
Cardiovascular Function	<ul style="list-style-type: none"><li>✓ Persistent hypotension after fluid administration:<ul style="list-style-type: none"><li>❖ SBP &lt; 85 mm Hg, OR</li><li>❖ MAP , 65 mm Hg, OR</li><li>❖ &gt; 40 mm Hg decrease in SBP</li></ul></li></ul>
Lactic Acid	<ul style="list-style-type: none"><li>✓ &gt; 2mmol/L in absence of labor</li><li>✓ <b>Lactic Acid not used for diagnosis in labor but remains important for treatment.</b></li></ul>



# Performance of Two-Step System for Diagnosis of Maternal Sepsis

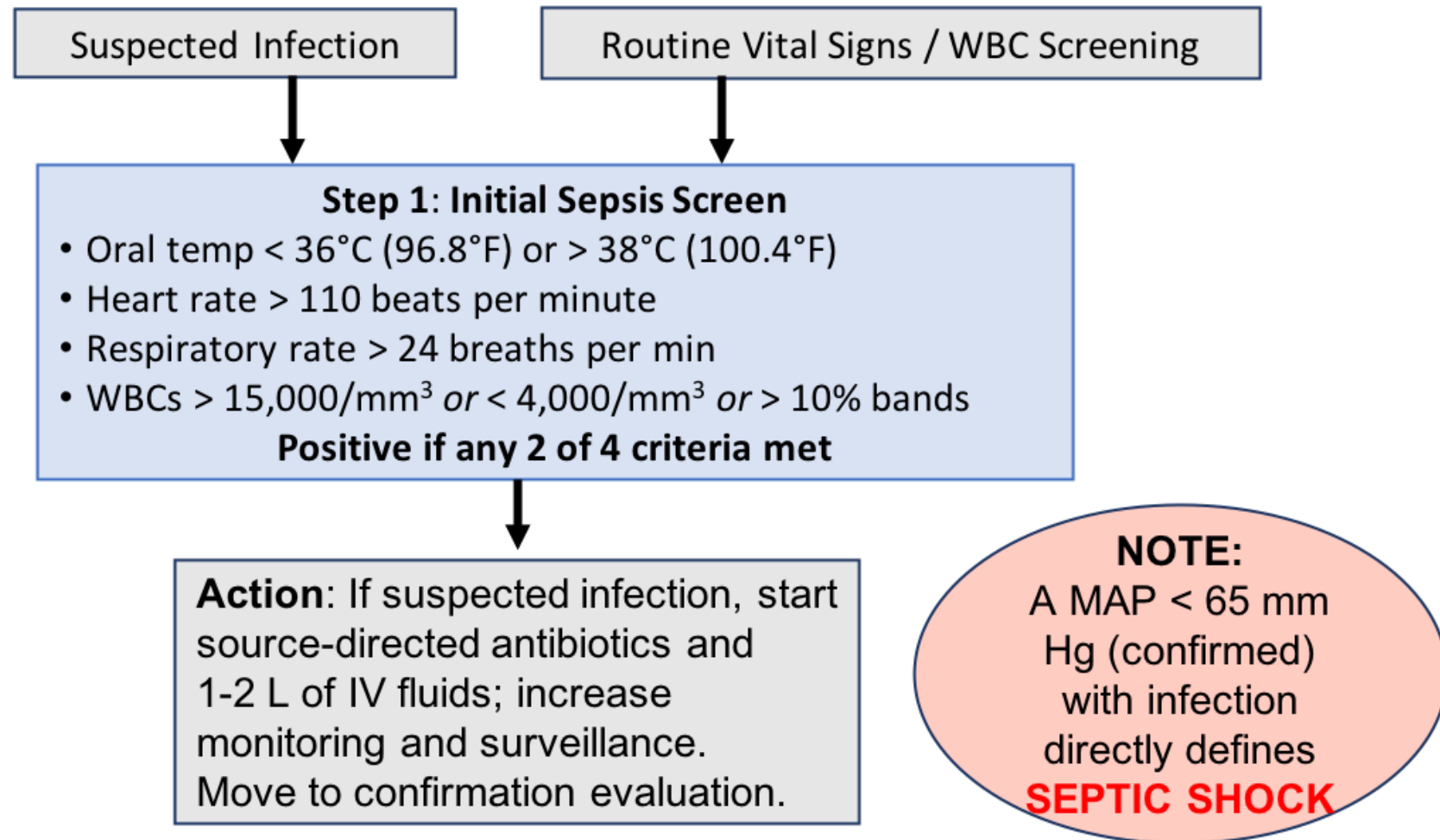
(data extracted from clinical practice data sets, not formal research studies)

Source	OB Vital Signs Screen		Sepsis (End Organ Injury)		
	Population Screened	Screen Positive	Total with End Organ injury	Among Screen Positive (Sens)	Not Among Screen Positive (Spec)
Combined Systems*	14,752	199 (1.3%)	33 (16.6% of screen positives) (0.22% of all screened)	32 (97%)	1 (3%)

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)



# 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

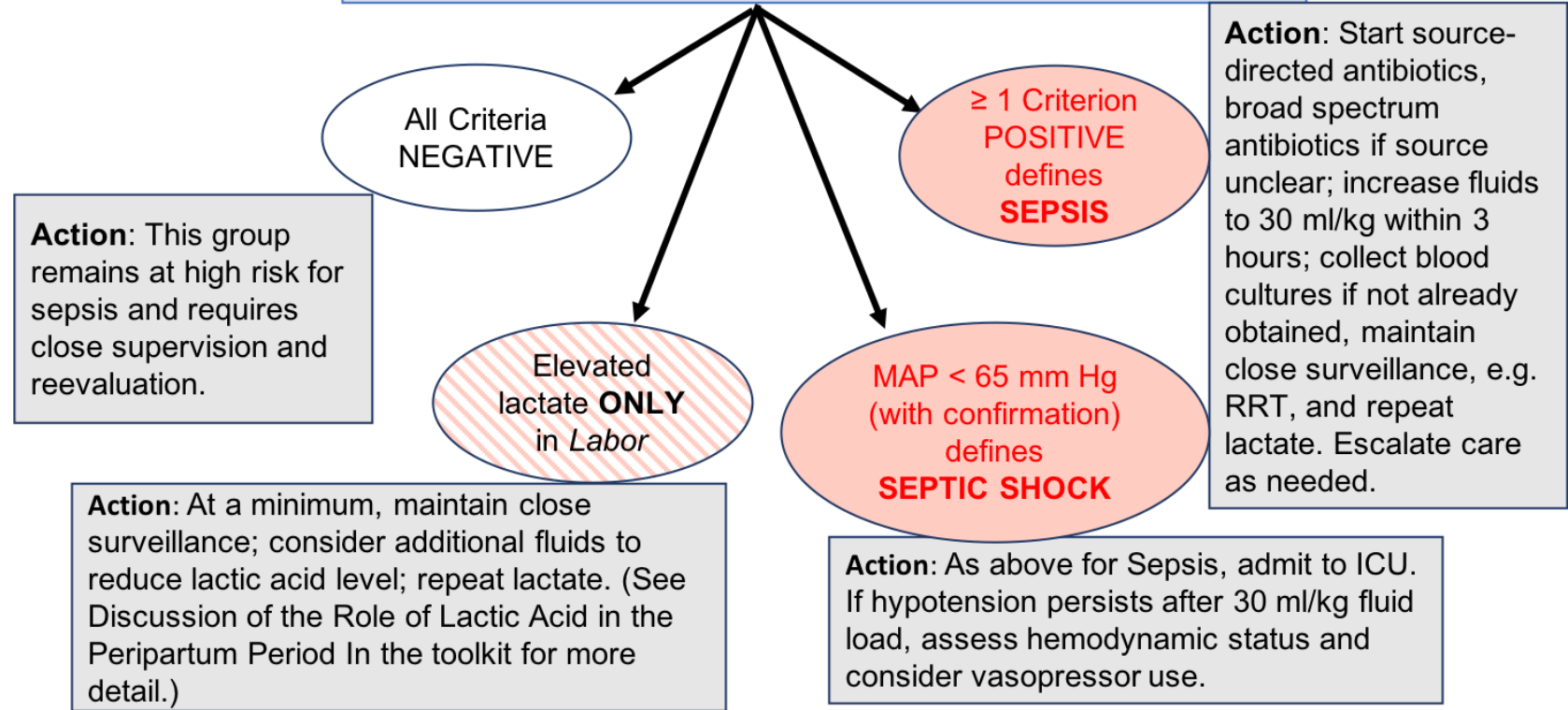
## Bedside Assessment

- Urine output
- Pulse Oximetry
- Mental Status Assessment

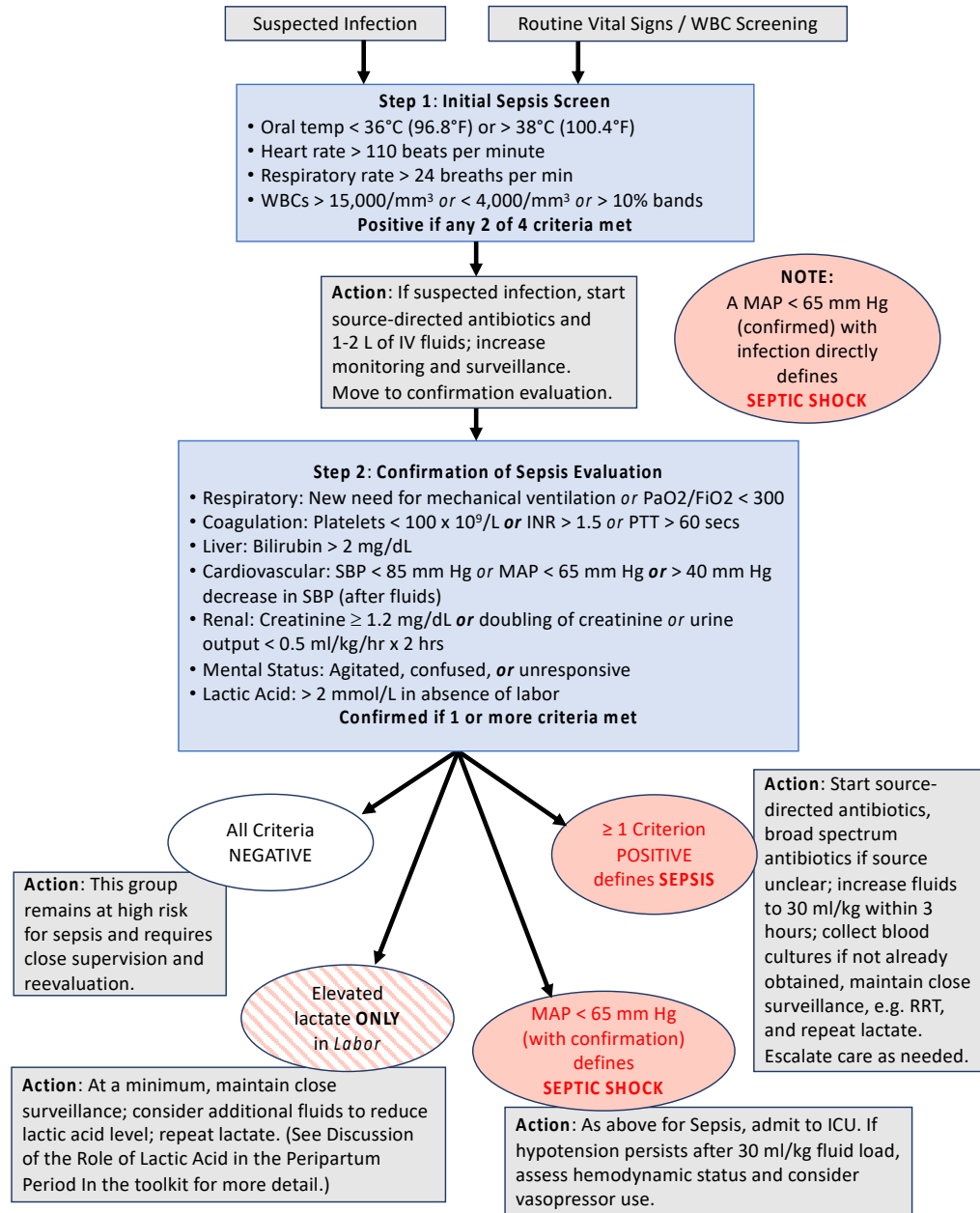
# Confirmation of Sepsis Evaluation

## (Step 2)

- Step 2: Confirmation of Sepsis Evaluation**
- Respiratory: New need for mechanical ventilation *or* PaO<sub>2</sub>/FiO<sub>2</sub> < 300
  - Coagulation: Platelets < 100 x 10<sup>9</sup>/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**



CMQCC Maternal Sepsis Evaluation Flow Chart



# Sepsis Evaluation Flow Chart

# 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  $\geq$  100.4 F
- ✓ HR  $>$  110 BPM
- ✓ RR  $>$  24
- ✓ WBC  $>$  15,000

- ✓ Organ Dysfunction Involvement
- ✓ Treatment is the same
- ✓ Monitor Closely

# Lactate in Labor

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 O<sub>2</sub> 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

# Antibiotics



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 2<sup>nd</sup> IV for infusion of ABX and IV boluses

# Considerations for Pregnant Women with Sepsis

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

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

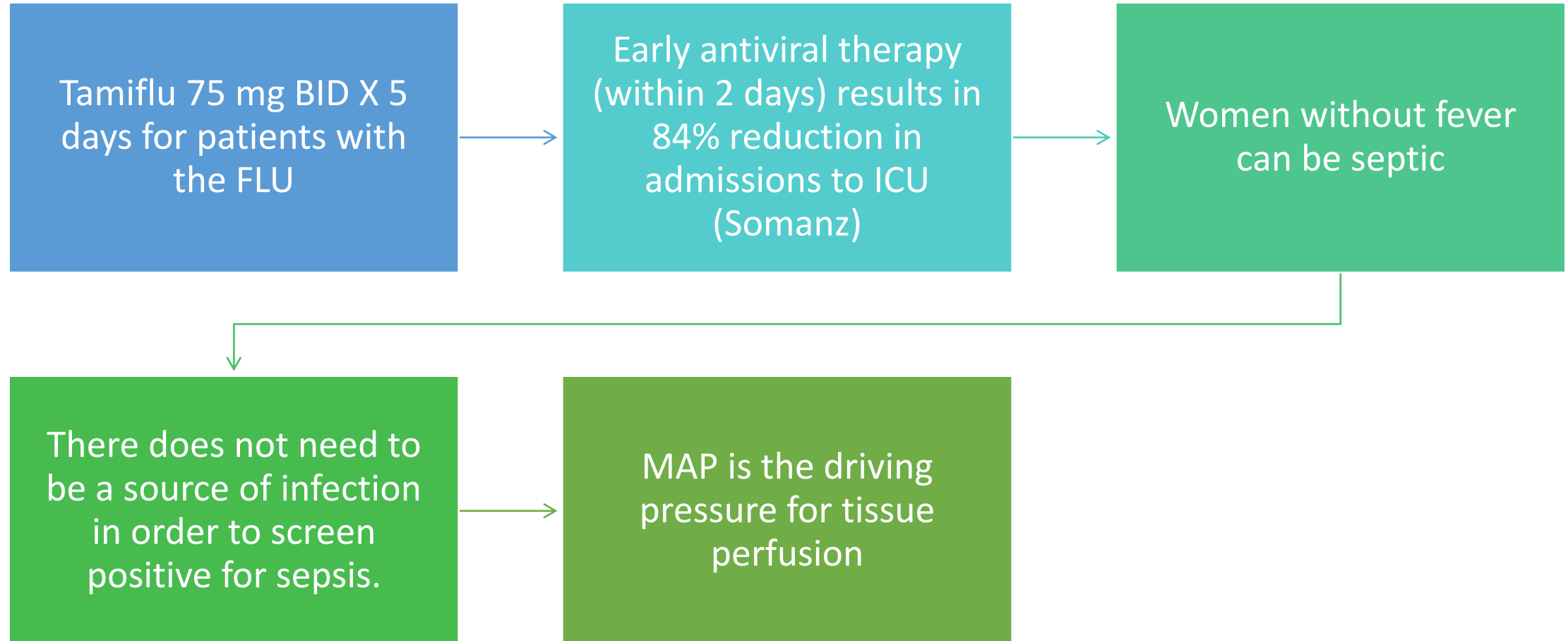
# Communication

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....



# Case Scenario

- ✓ 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

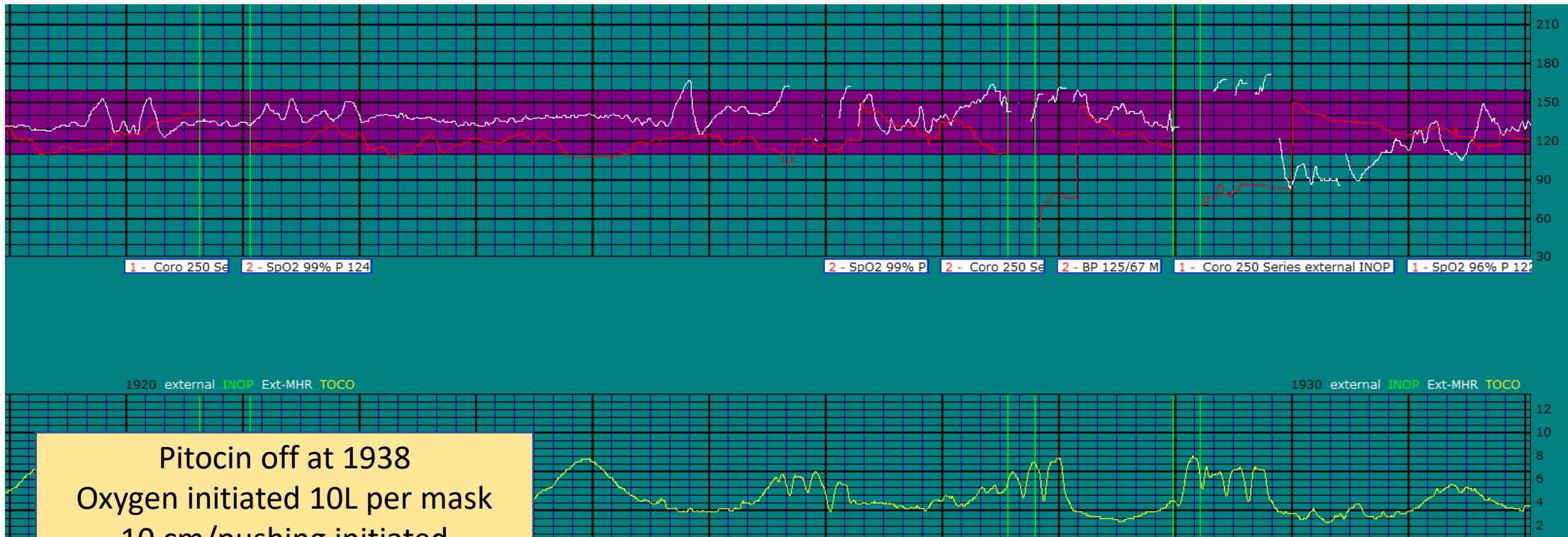
WBC 18.9

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

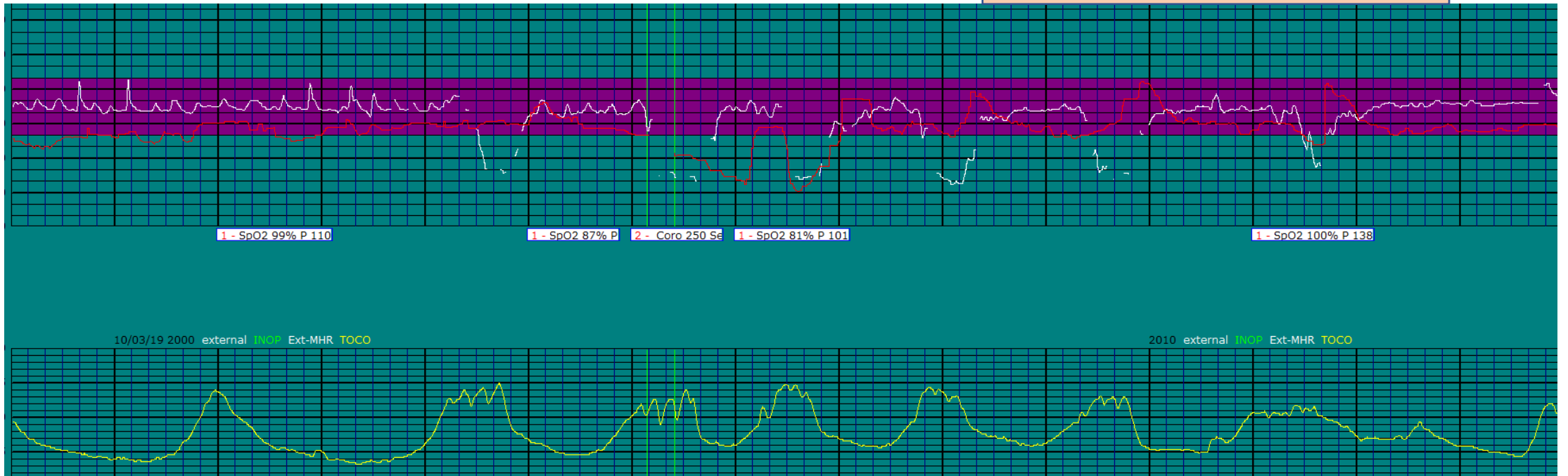
- ✓ + Sepsis Screen
- ✓ MD/RRT Aware
- ✓ No infection, ↑HR,  
↑WBC





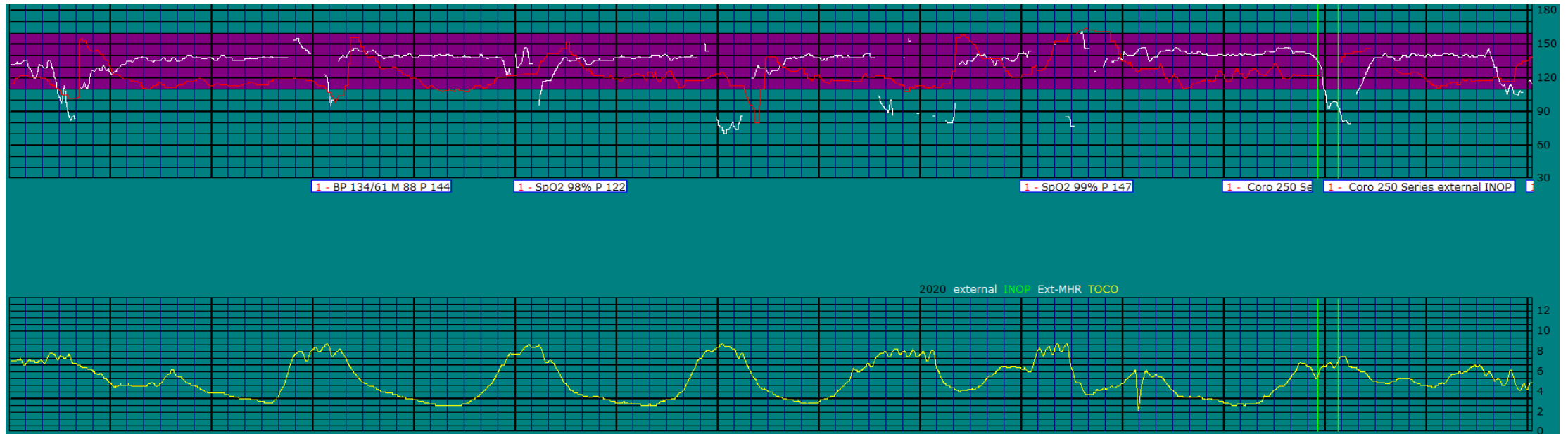
# Patient is pushing...

- ✓ MD at the BS
- ✓ Pushing Continues



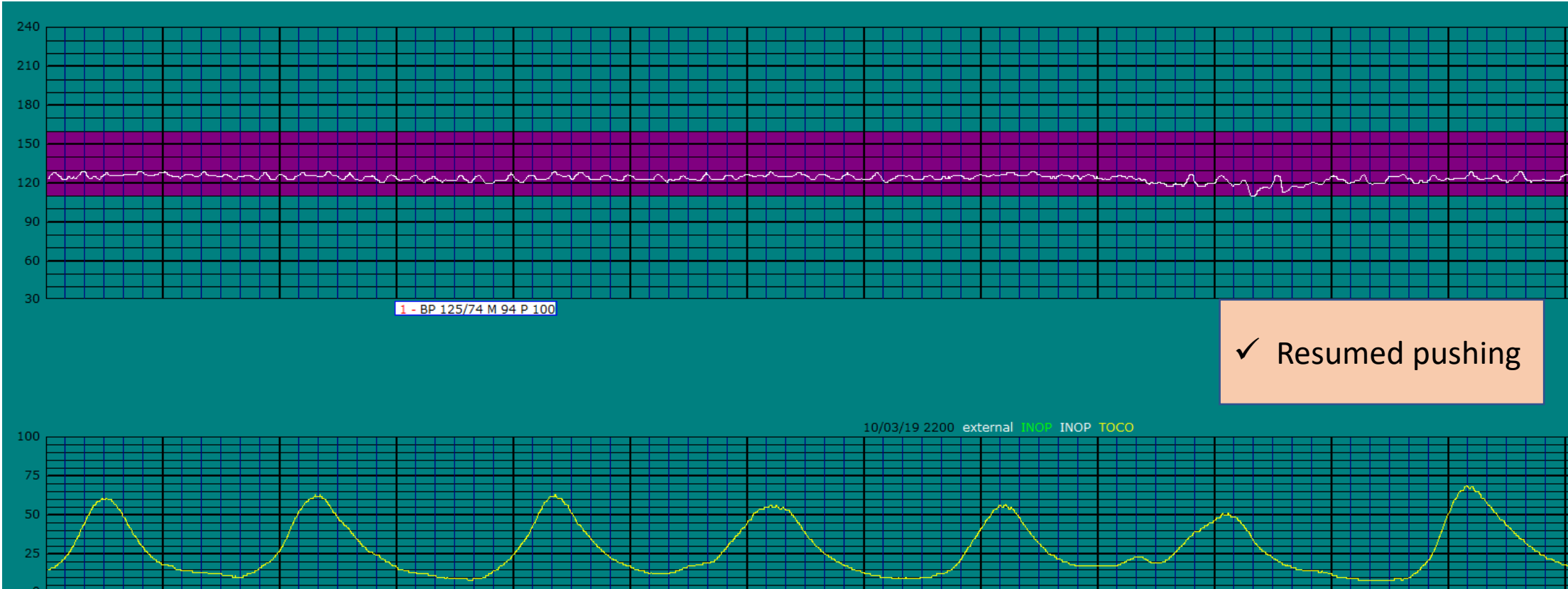
# 2<sup>nd</sup> stage of labor with Cat 2 tracing

- ✓ Pushing stopped at 2132
- ✓ Pain ++
- ✓ Epidural tophoff
- ✓ 500ml bolus

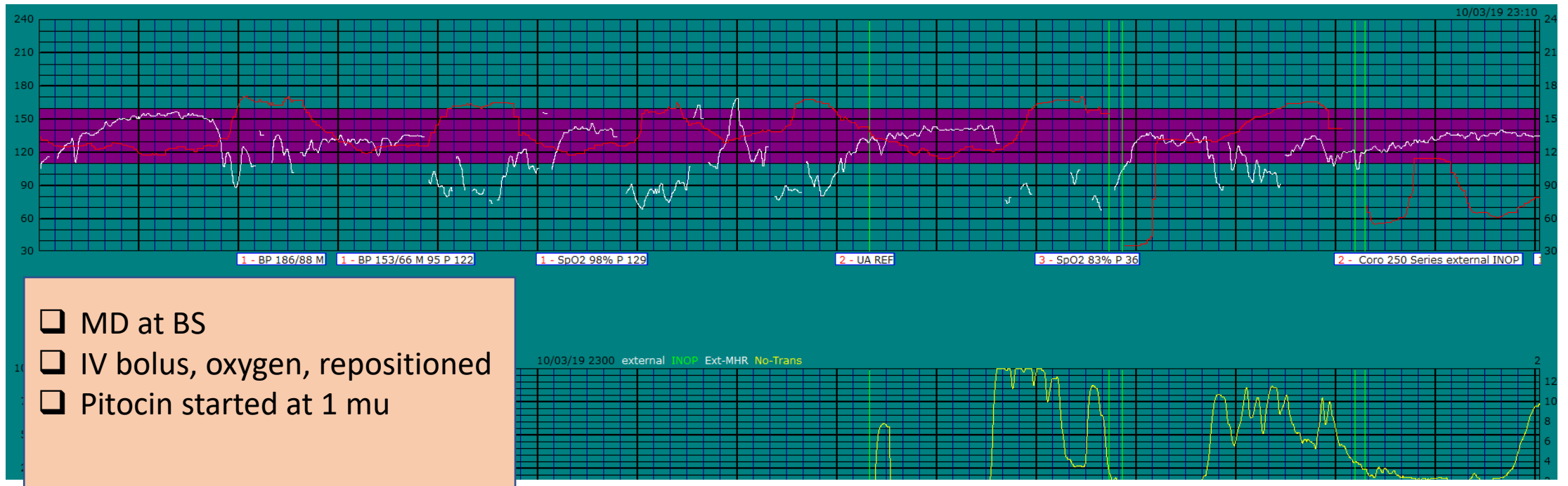


MD notified of T-100F  
Tylenol 1000mg IV

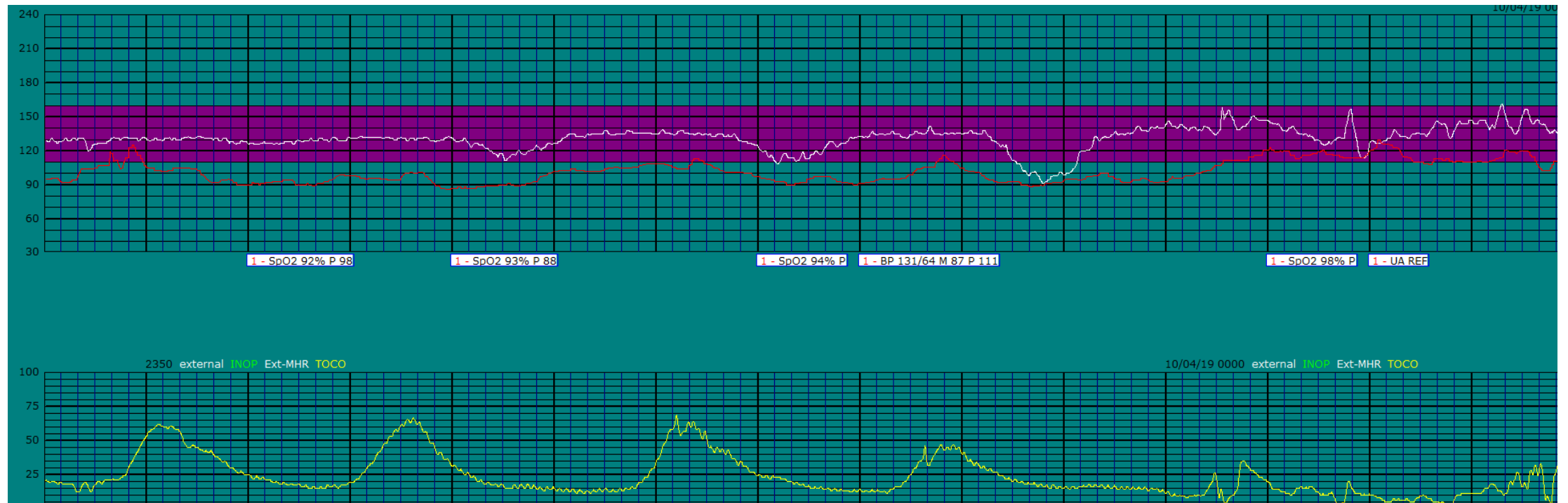
# Allowing baby to recover



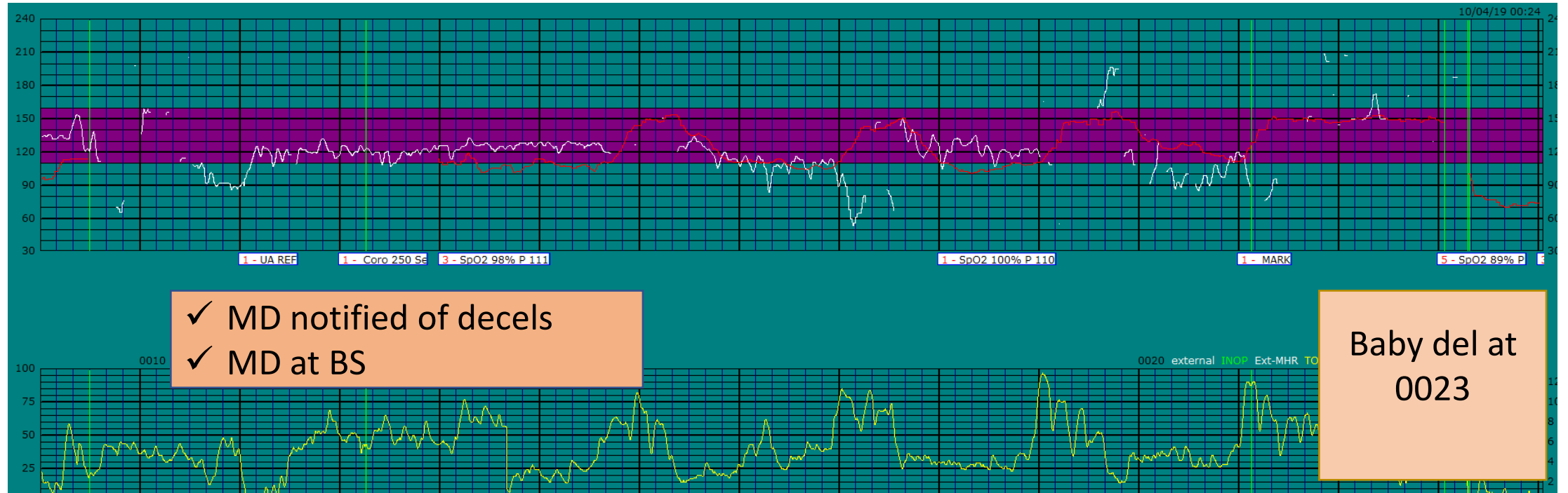
# Cat 2 tracing



- ❖ MD Notified +Sepsis screen (per Charge RN)
- ❖ Triple ABX,
- ❖ CBC, lactate, no BLD Cx
- ❖ RRT Called
- ❖ Suspect Chorioamnionitis



# Sense of urgency to deliver



# 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



# Lab Results @ 0119

Lactate 5.2

WBC 27.2

Hgb- 9.2

HCT 28.4

Fibrinogen  
332

PT. PTT,  
INR normal

# Applying the CMQCC Algorithm.....

*Let's Go Back and Apply the CMQCC Algorithm to Scenario....*

# Lessons Learned



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?

# References

- ✓ ACOG Committee on Obstetric Practice Opinion 712: Intrapartum Management of Intraamniotic Infection. *Obstet Gynecol* 2017 Aug;130(2):e95-E101.
- ✓ Bauer ME, Balistreri M, MacEachern M, et al. Normal Range for Maternal Lactic Acid during Pregnancy and Labor: A Systematic Review and Meta-Analysis of Observational Studies. *Am J Perinatol* 2019 Jul;36(9):898-906.
- ✓ Cranga AA, Syverson C, Seed K, et al. Pregnancy-Related Mortality in the United States, 2011-2013. *Obstet Gynecol* 2017 Aug; 130(2):366-373.
- ✓ Gibbs R, Bauer M, Olvera L, Sakowski C, Cape V, Main E. Improving Diagnosis and Treatment of Maternal Sepsis: A Quality Improvement Toolkit. Stanford, CA: California Maternal Quality Care Collaborative.
- ✓ Rhodes A, Evans LE, Alhazzani W et al. Surviving Sepsis Campaign: International Guidelines for Management of Sepsis and Septic Shock: 2016. *Crit Care Med* 2017 Mar;45(3):486-552.

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



Think  
**Sepsis.**  
Save a  
**Life.**