AWHONN Wisconsin Postpartum Complications

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Disclosure: Suzanne McMurtry Baird, DNP, RN

- American Heart Association Scientific Advisory Board
- I do not have any commercial support for this lecture
- I do not endorse any specific product, service or system

Postpartum….Ahhh….so relaxed

Case Scenario

- G 5 – 5 – 0 – 0 – 5
- Postpartum hemorrhage
- EBL 3200 ml
- 72/38, 144, 28
- Agitated, disoriented
- Intake – 4500 ml crystalloid
- Urine output – 22 ml in 2 hours
- Difficult to palpate pulses

Case Scenario

- Postpartum/Post-op day #3
- Orders for discharge home
- Temp. 102.7, HR 124, RR 24, BP 92/56
- Patient c/o pain 8/10 (not relieved by pain medications)
  - Abdominal exam tender to touch; guarding
- Labs drawn
  - WBC 22,000, 6% bands, Hgb 8 mg/dL, Hct 31 (increased from PP day 1)

What is our REALITY ?

https://www.nytimes.com/2020/04/12/nyregion/coronavirus-births-mothers.html

Severe Maternal Morbidity

Continuum of Morbidity and Mortality

Pregnancy complication or pre-existing medical condition

Potentially life-threatening condition with predisposition to end-organ injury

Survival despite experiencing an unanticipated event likely to result in death

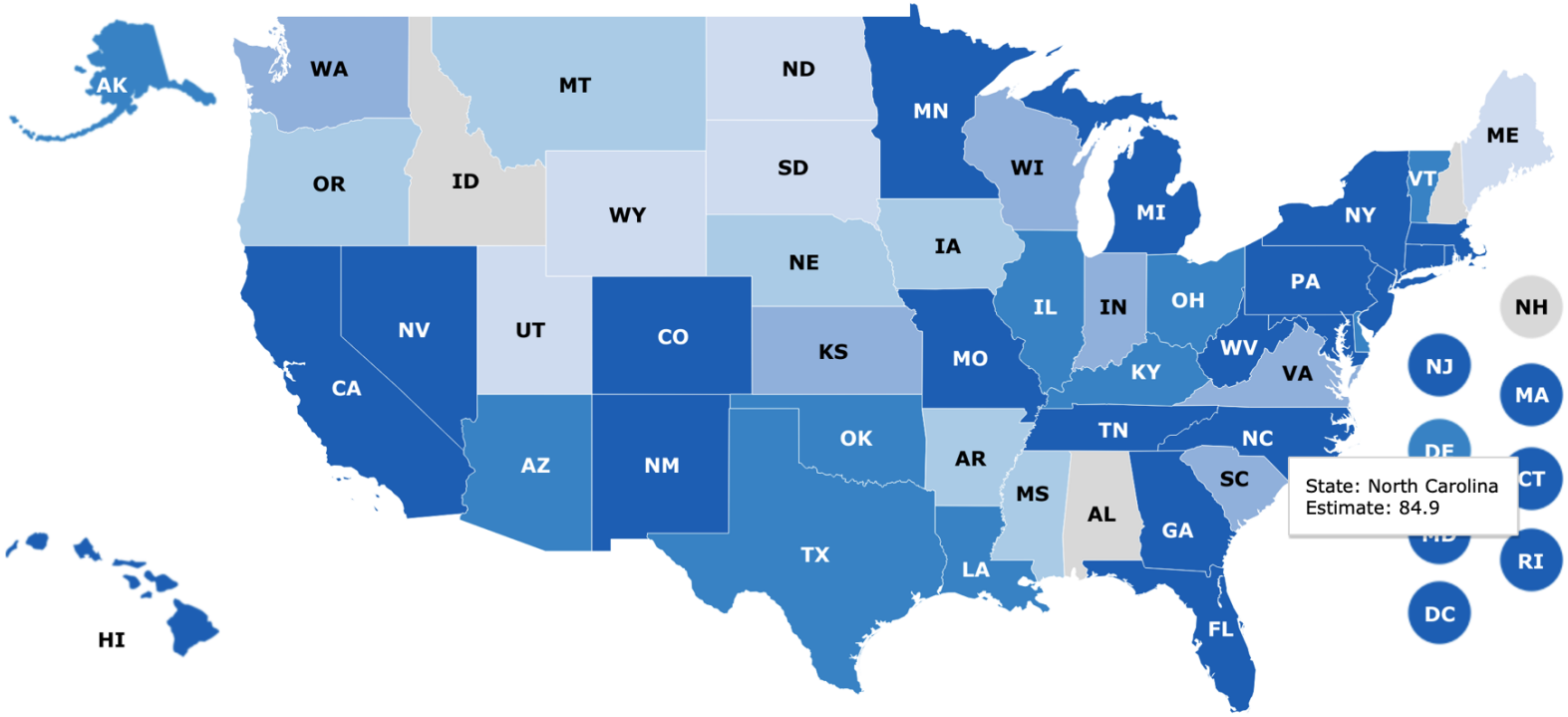
Adapted from: Witcher PM, Lindsay MK. Maternal morbidity and mortality. In: Troiano NH, Witcher PM, Baird SM (eds). High Risk and Critical Care Obstetrics, 2019; Wolters Kluwer: Philadelphia.

AHRQ Data 2022: SMM rates /10,000 hospital births

Rate per 10,000 In-Hospital Deliveries
2020 National Rate: 88.2

Click the map to select one of the identified States, or select from the list and click Select: North Carolina Select

Note: Some states selected from the map do not contain data for this tool. In this case, make a selection from the states included in the dropdown.



No Data	< 63.1	63.1 - 69.6	69.7 - 77.6	77.7 - 84.3	> 84.3

States are classified into five categories which were defined based on an equal grouping of States in 2018.
Note: Blood transfusions are not included as an SMM indicator

https://datatools.ahrq.gov/hcup-fast-stats/?type=subtab&tab=hcupfsse&count=3

	Rate per 10,000 deliveries		
Indicator	2006	2015	Cumulative Percent Increase
Acute kidney injury	2.8	6.5	134
Shock	1.9	4.3	133
Ventilation	0.6	1.2	105
Sepsis	2.6	5.2	104
ARDS	4.2	5.9	42
DIC	7.9	11.0	39
Hysterectomy	8.3	11.0	32
Cardiac arrest	0.6	0.7	26

https://datatools.ahrq.gov/hcup-fast-stats/?tab=special-emphasis&dash=92

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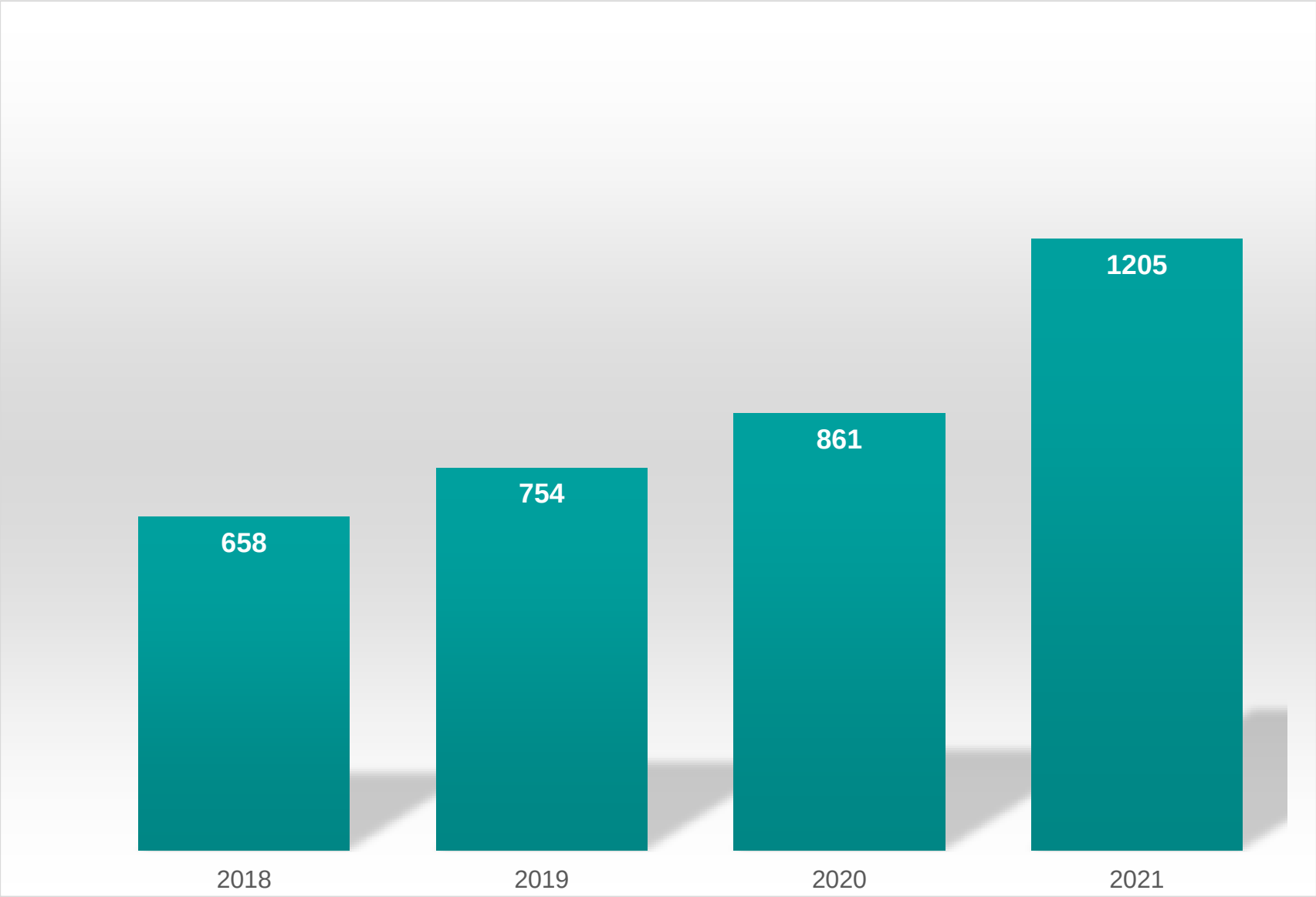
Original Investigation | Obstetrics and Gynecology

Trends in Severe Maternal Morbidity in the US Across the Transition to *ICD-10-CM/PCS* From 2012-2019

Ashley H. Hirai, PhD; Pamela L. Owens, PhD; Lawrence D. Reid, PhD, MPH; Catherine J. Vladutiu, PhD, MPH; Elliott K. Main, MD

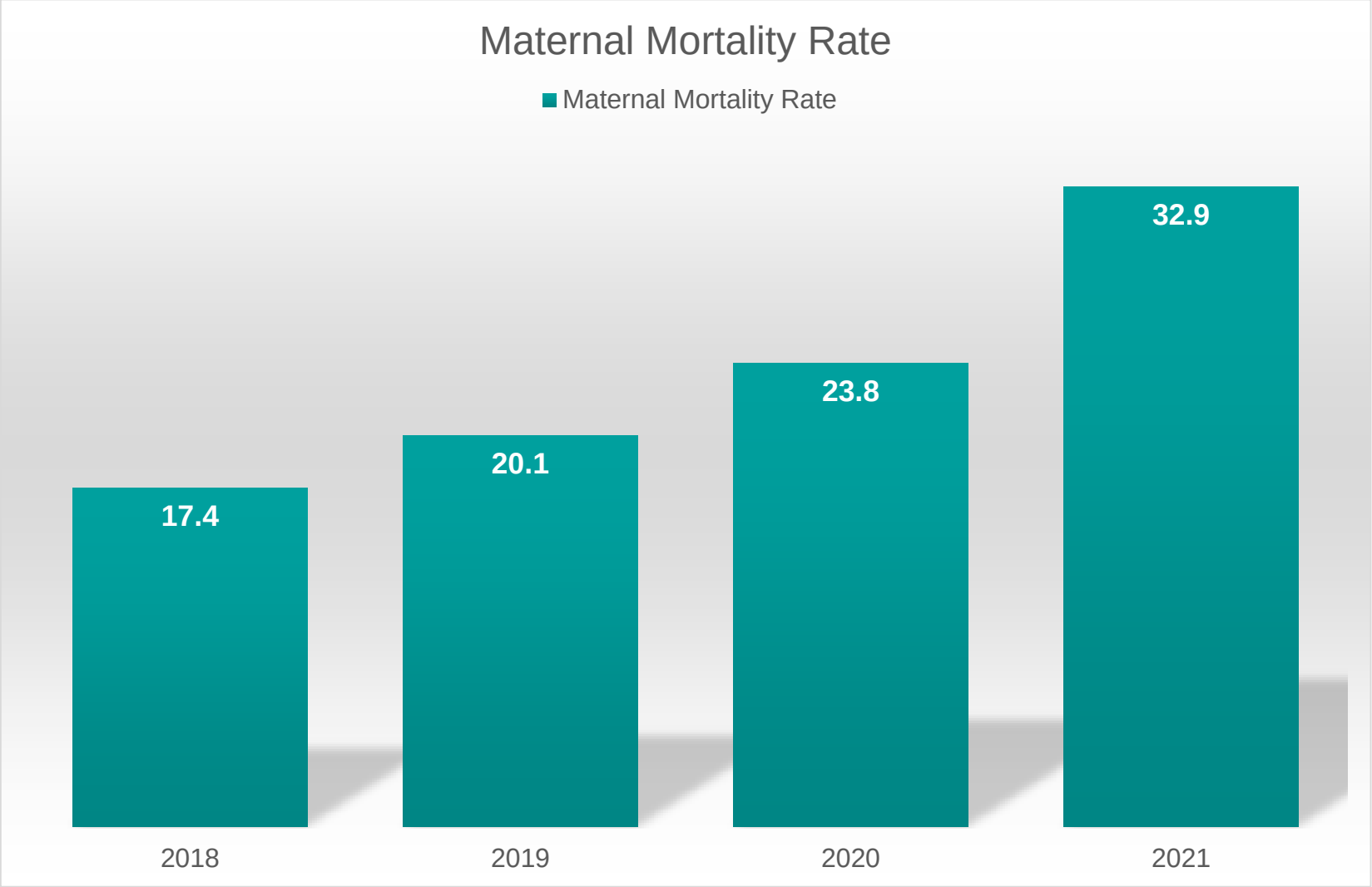
29.8 million hospital births
SMM increased from 69.5/10,000 in 2012 to 79.7/10,000 in 2019

Maternal Deaths in the US 2018-2021



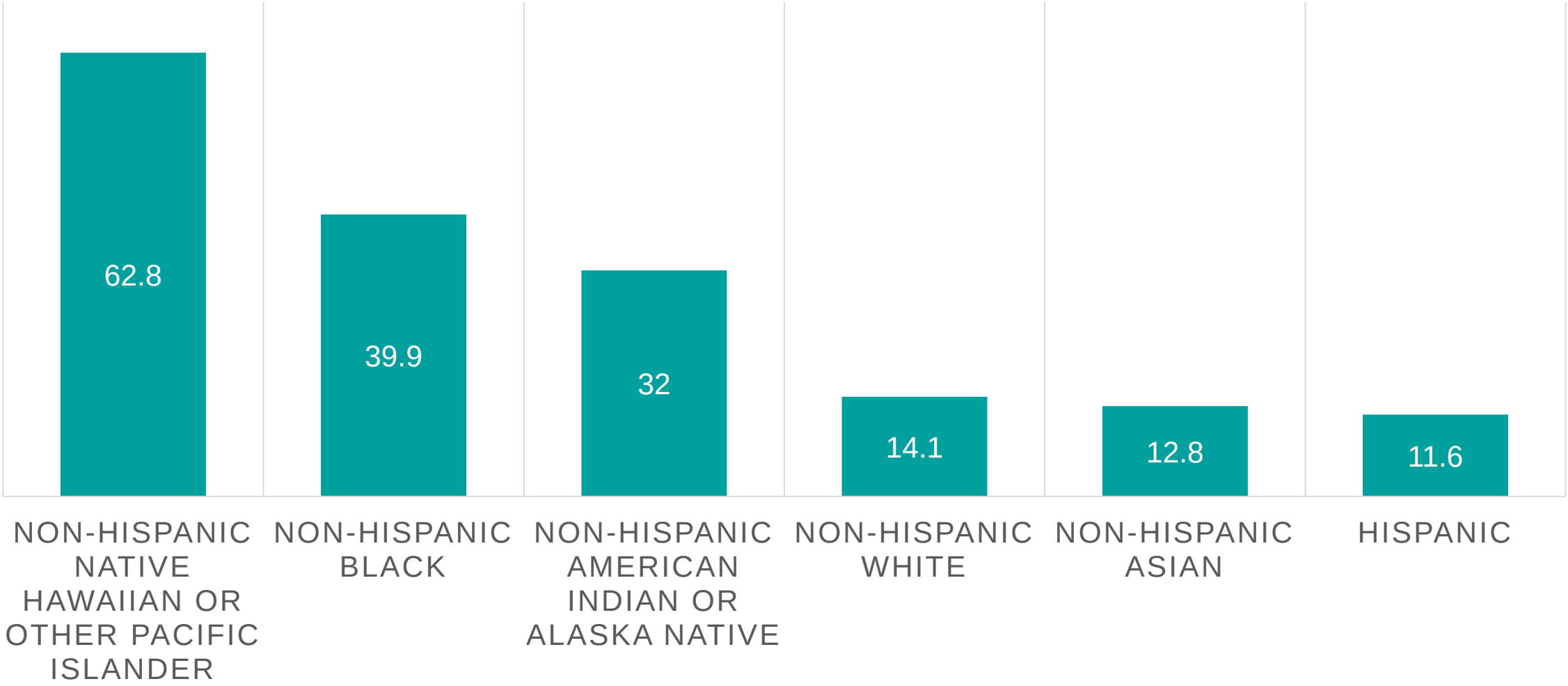
CDC, 2023

Maternal Mortality Rate in the US 2018-2021



CDC, 2023

PREGNANCY-RELATED MORTALITY RATIO BY RACE/ETHNICITY: 2017-2019



CDC, 2023

Pregnancy-Related Mortality

Cause of Pregnancy Related Death US 2017-2019	Percentage
Other Cardiovascular Conditions	14.5%
Infection/Sepsis	14.3%
Cardiomyopathy	12.1%
Hemorrhage	12.1%
Other non-cardiovascular medical conditions	11.1%
Thrombotic pulmonary or other embolism	10.5%
Hypertensive Disorders of pregnancy	6.3%
Amniotic Fluid Embolism	6.1%
Cerebrovascular accidents	5.8%
Anesthesia complications	0.2%

https://www.cdc.gov/reproductivehealth/maternal-mortality/pregnancy-mortality-surveillance-system.htm#faqs

Pregnancy-Related Deaths: Data from Maternal Mortality Review Committees in 36 US States, 2017–2019

Susanna Trost, MPH; Jennifer Beauregard, MPH, PhD; Gyan Chandra, MS, MBA; Fanny Njie, MPH; Jasmine Berry, MPH; Alyssa Harvey, BS; David A. Goodman, MS, PhD

Key Findings

- Pregnancy-related deaths occurred during pregnancy, delivery, and up to a year postpartum

Data on 1,018 pregnancy-related deaths among residents of 36 states from 2017–2019 were shared with CDC through the Maternal Mortality Review Information Application (MMRIA).

Table 1. Characteristics of pregnancy-related deaths, data from Maternal Mortality Review Committees in 36 US States, 2017–2019 (N=1,018)*

	N	%

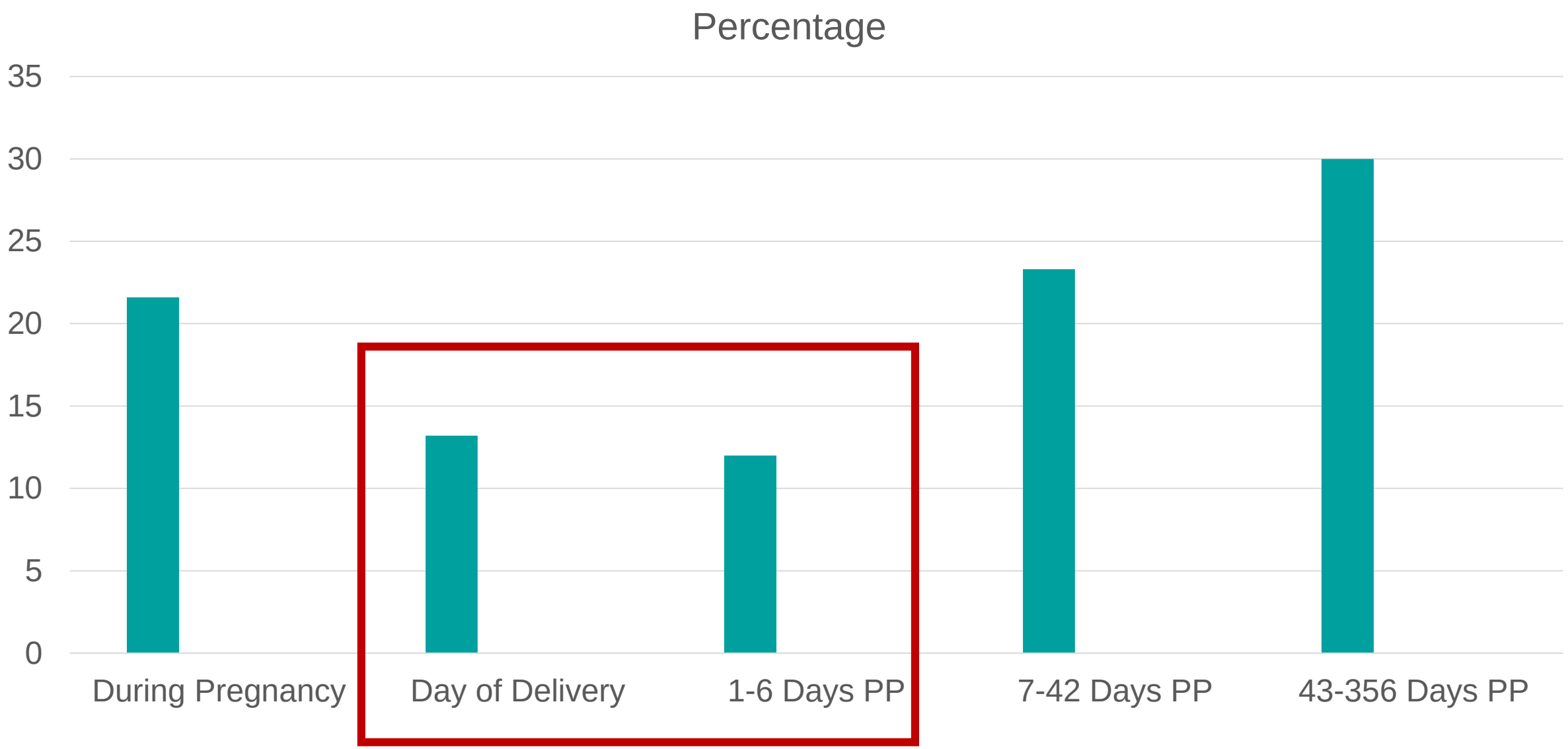
MMR Data: Underlying Causes of Pregnancy Related Death

1. Mental health conditions
2. Hemorrhage
3. Cardiac and coronary conditions
4. Infection
5. Embolism- thrombotic
6. Cardiomyopathy
7. Hypertensive disorders of pregnancy
8. AFE
9. Injury
10. Cerebrovascular accident

- 82% lived in urban counties
- 53% occurred 7-365 days postpartum

Triost, Beauregards, Nije, et al, 2022

Distribution of Pregnancy-Related Deaths by Timing



POSTPARTUM READMISSION

Scenario

- Vital Signs
- Readmission

Postpartum Readmission

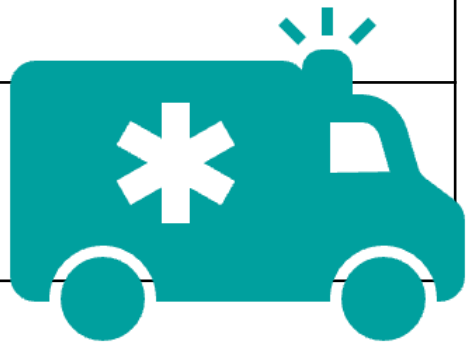
- N = 1,880,264
- Readmission for sepsis = 0.03%; 61% after 6 weeks
- Risk factors
  - Preterm birth
  - Hemorrhage
  - Obesity
  - Government provided insurance
  - Primary c-section
- Most Common diagnosis = gram negative UTI/pyelonephritis

Foeller, ME, Sie, L, Foeller, TM, et al (2020) Risk factors for maternal readmission with sepsis. American Journal of Perinatology, 37(5), 453-460.

Postpartum Readmission

Conditions Prior to Birth Associated with PP Readmission

	0-6 Days Post-Discharge	7-29 Days Post-Discharge
Preeclampsia	15.9	7.4
Preexisting diabetes	2.8	2.6
Bleeding disorder	2.2	1.7
Major mental health condition	6.8	5.3
Thyroid disorder	5.5	4.0

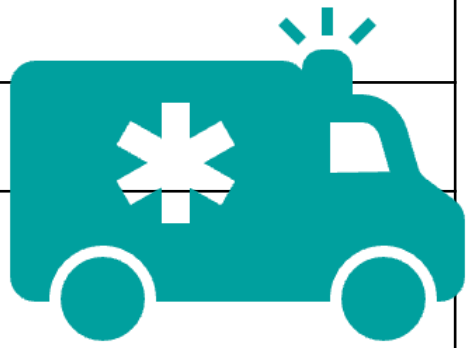


Girsen, AI, Leonard, SA, Buwick, AJ, Joudi, N, Camichael, SL, Gibbs, RS (2022) AJOG

Postpartum Readmission

Conditions at Birth Hospitalization Associated with PP Readmission

	0-6 Days Post-Discharge	7-29 Days Post-Discharge
Severe Maternal Morbidity	6.8	5.2
PP hemorrhage	6.7	5.9
Sepsis	0.6	0.5
Perineal trauma	4.1	4.0
Cesarean birth	52.5	44.6
≥ 37 weeks	82.8	86.4



Girsen, AI, Leonard, SA, Buwick, AJ, Joudi, N, Camichael, SL, Gibbs, RS (2022) AJOG

Postpartum Physiology and Assessment

Core Knowledge

Physiologic Changes of Pregnancy: Impact on Postpartum

System	Summary	
Cardiovascular	High Flow Low Resistance	Cardiac disease
Respiratory	Compensated Respiratory Alkalosis	Oxygen management
Hematologic	Hypercoagulable	Pulmonary embolus

Cardiovascular Changes

- Cardiac output increases 30-50%
- Heart appears enlarged on CXR
- Heart displaced up and leftward, apex shifts
- May see left axis deviation on EKG

Cardiovascular: High Flow

Blood Volume ↑

- ↑ 1600 cc singleton gestation
- ↑ 2000 cc multiple gestation
- Deceased Colloid Oncotic Pressure

Stroke Volume ↑

- Amount of blood ejected from the left ventricle with each myocardial contraction
- 30% increase
  Normal 73.3 ± 9

- Blood volume increase beginning at 6 weeks, peaking 28-34 weeks, returns to pre-pregnancy values 6-8 weeks postpartum

- Maintain BP
- Accommodate blood loss at birth
- 500 mL returned blood volume immediately postpartum

- Hormone stimulation of plasma renin activity and aldosterone levels; stimulates renal tubular reabsorption of Na and water (6-8 L in total body water)

Cardiovascular: Postpartum

- Autotransfusion: return of blood to maternal venous circulation that was formerly supplying the uteroplacental unit
- Cardiac output ↑60-70% (w/in 10 minutes)
- Cardiac output ↑50-70% at 1 hour

Colloid Oncotic Pressure Values in Pregnancy

	Colloid Oncotic Pressure
Non-Pregnant	25.4 ± 2.3
★ Antepartum	22.4 ± 0.54
Postpartum	15.4 ± 2.1
★ Antepartum with Preeclampsia	17.9 ± 0.68
Postpartum with Preeclampsia	13.7 ± 0.46

KEY POINT: Decline in COP = ↑ risk of pulmonary edema

Hematologic Alterations: Hypercoagulable

Clotting Factors	Non-Pregnant	Change	Pregnant
Activated PTT (sec)	31.6 +/- 4.9	Increased	31.9 +/- 2.9
Thrombin time (sec)	18.9 +/- 2.0	Increased	22.4 +/- 4.1
Factor VII (%)	99.3 +/- 19.4	Increased	181.4 +/- 48
Factor X (%)	97.7 +/- 15.4	Increased	144.5 +/- 20.1
Plasminogen (%)	105.5 +/- 14.1	Increased	136.2 +/- 19.5
Fibrinogen (mg/dL)	256 +/- 58	Increased	473 +/- 72
Antithrombin III (%)	98.9 +/- 13.2	Decreased	97.5 +/- 33.3
Protein C (%)	77.2 +/- 12.0	Decreased	62.9 +/- 20.5
Total Protein S (%)	75.6 +/- 14.0	Decreased	49.9 +/- 10.2

Hematologic Alterations

- Erythropoietin increases
- Human placental lactogen may stimulate hematopoiesis
- WBC count increases
  - Increase in polymorphonuclear leucocytes
  - Neutrophil number increases with estrogen
    - Increase in labor and with c-section
- Suppression of T and B lymphocytes
- Return to baseline 6-12 weeks postpartum

Postpartum Assessment

Postpartum Assessment: What is the frequency of nursing assessment?

Immediate Postpartum	Cesarean Section or High Risk	Low Risk Vaginal Delivery
• Every 15 minutes x 2 hours	• Every 4 hours x 24 hours, then every 8 hours until discharged.	• Every 4 hours x 24 hours; then if stable, every 12 hours until discharged.

BUBBLE HEET

B	Breasts
U	Uterus
B	Bowel
B	Bladder
L	Lochia
E	Episiotomy & Extremities
H	Hemorrhoids
E	Edema
E	Emotional
T	Thrombophlebitis

Postpartum Shivering

- Observed in 25-50% of deliveries
- Starts within 30 minutes post-delivery and lasts up to 60 minutes
- Cause unknown: etiology theories
  - Fetal-maternal hemorrhage, micro-amniotic emboli, bacteremia, maternal thermogenic reaction to sudden thermal imbalance due to placental separation, drop in body temperature following labor, use of misoprostol
- No treatment necessary other than supportive care
  - Warm blanket/air
  - Demerol 12.5 mg IVP

Perineal Trauma: Assessment

- REEDA
  - Redness
  - Ecchymosis
  - Edema
  - Discharge
  - Approximation of skin edges
- Monitor s/s infection
- Watch for urinary retention

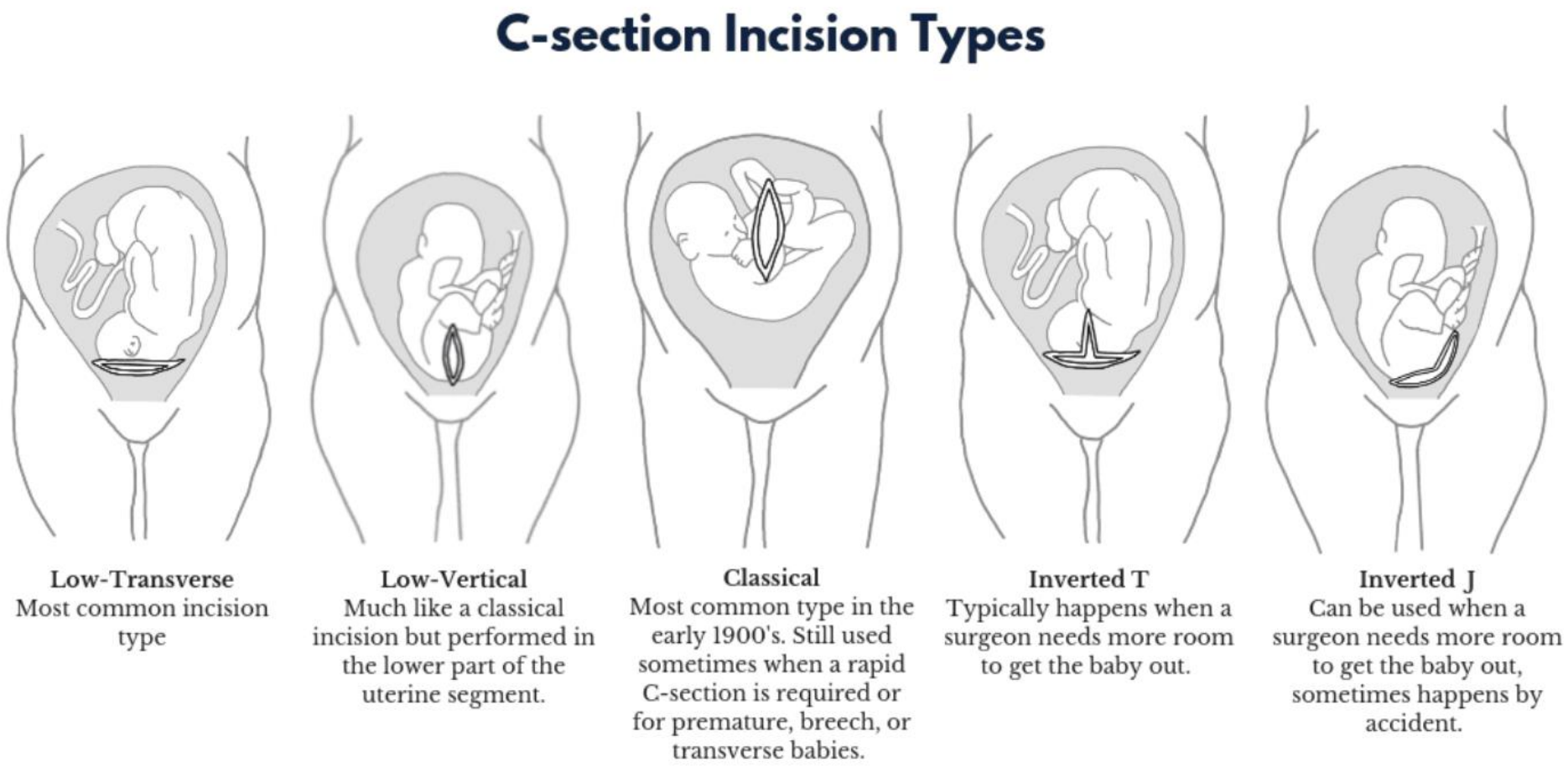
Perineal Trauma: Complications

- Infection, abscess
- Hematoma
- Cellulitis
- Incontinence
  - Urinary, fecal, flatus
- Rectovaginal fistula
- Necrotizing fasciitis
- Dehiscence

Perineal Trauma: Management

- Ice packs 24-48 hours, 10-20 minutes
  - Decrease edema
- Sitz baths after 24 hours
- Administer analgesics/anesthetics prn
  - Oral
  - Topical
- Perineal care
- Low residue diet
- Stool softeners

Cesarean Birth: Uterine Incision Type



Cesarean Birth: Complications

Endometritis	Maternal Death	Ileus or Bowel Obstruction
Wound complications infection, hematoma, seroma, dehiscence	Septic Pelvic Thrombophlebitis	Hemorrhage
Surgical Injury: broad ligament hematoma, cystotomy, bowel injury, ureteral injury	Psychological: ↓birth experience satisfaction, delay in bonding, less likely to breastfeed; feelings of loss, failure, and anger	Long Term: abnormal placentation, uterine rupture, scar complications (numbness, pain, incisional endometriosis) adhesions
Thrombotic Events: ischemic stroke, acute myocardial infarction, VTE		

Postpartum: Bladder

- Diuresis within 12 hrs of birth
  - ↓ levels of estrogen/oxytocin
- Complications
  - Distention, incomplete emptying, retention, inability to void
  - Hemorrhage
- Assessment
  - Palpation
  - Bladder scans
- Catheterization as indicated

Postpartum: Urinary Retention

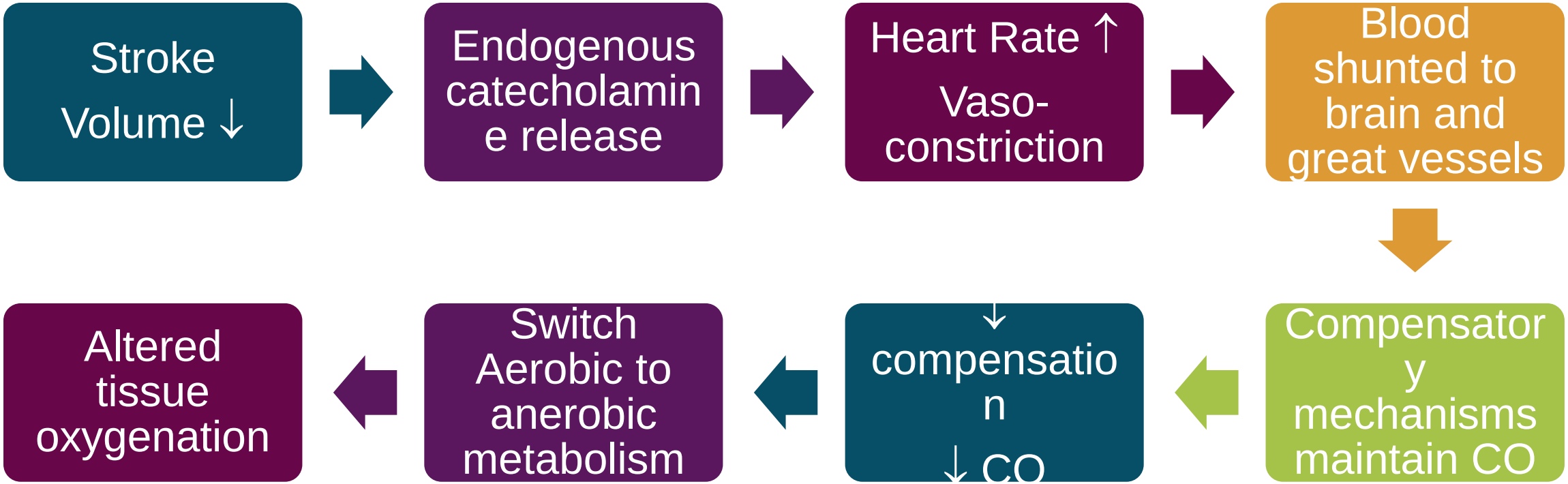
- Definition
  - No void 6 hours after delivery or post catheter removal
- Post void residual
  - >400-500mL
- Risk Factors:
  - Primiparas
  - Regional anesthesia
  - Operative delivery & episiotomy
  - Prolonged 2nd stage
  - Birth weight > 4,000 grams
  - Opioid analgesia

Non-Invasive Hemodynamic Assessment

Assessment: 2 Main Concepts

Cardiac Output	Oxygen Transport
• Preload • Afterload • Contractility • HR	• Content • Affinity • Delivery • Consumption

Clinical Condition: Hypovolemia (↓ Preload)



Clinical Condition: Hypovolemia (↓ Preload)

- Increased heart rate
- Increased respiratory rate
- BP changes
  - Initial increase
  - Hypotension (late sign)
  - Narrow pulse pressure
- Weak, thready pulses → absent
- SpO_2

- Decreased urine output
- Concentrated urine
- Cool skin temperature
- Dry mucous membranes
- LOC changes
- Decreased capillary refill
- Lactate levels increase

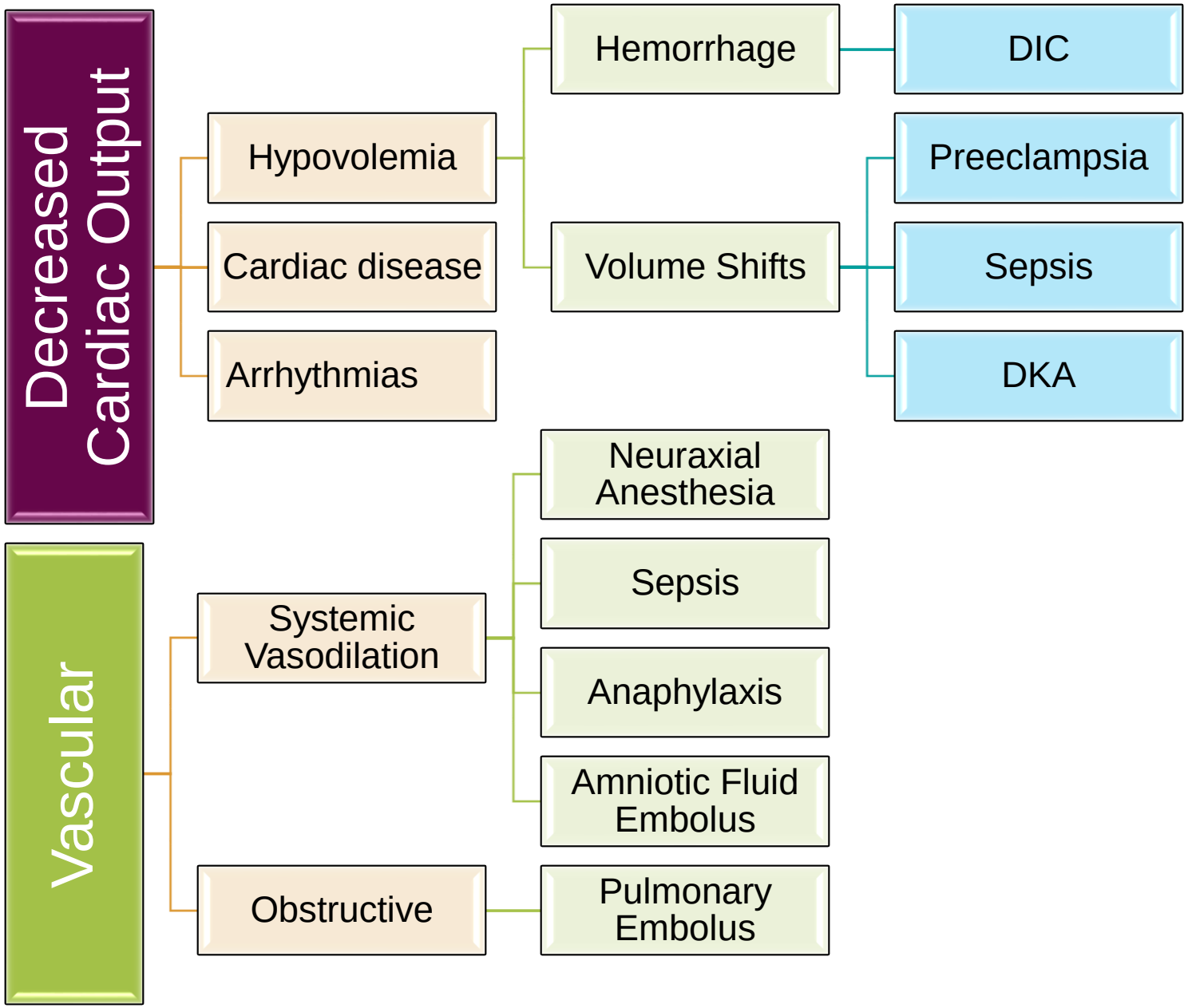
Clinical Condition: Hypervolemia (↑ Preload)

- Increased heart rate
- Increased respiratory rate
- Increased BP
- Wide pulse pressure
- Bounding, strong pulses
- SpO_2 trends

- Breath sounds
- Moise mucous membranes
- Cough
- SOB
- BNP > 100

Clinical Condition: Hypotension (↓ Afterload)

- Signs of decreased organ perfusion
  - Decrease urine output
  - Pale skin color
  - Diaphoretic
  - Weak pulses – SpO_2
- Increased HR
- Changes in LOC


Decreased Cardiac Output
Hypovolemia
Cardiac disease
Arrhythmias
Hemorrhage
Volume Shifts
DIC
Preeclampsia
Sepsis
DKA
Vascular
Systemic Vasodilation
Obstructive
Neuraxial Anesthesia
Sepsis
Anaphylaxis
Amniotic Fluid Embolus
Pulmonary Embolus

Clinical Condition: Hypertension (↑ Afterload)

- Signs of decreased organ perfusion
- Signs of pulmonary congestion
- Headache
- Visual changes

Clinical Condition: Tachycardia

- Pregnancy Changes
  - Increases 15-20 beats/min
  - Bowditch effect- changes in HR alter CO
    - **<u>Tachycardia</u>**

      ↓ filling time

      ↓ CO
    - **<u>Bradycardia</u>**

      ↓ CO

$$CO = HR \times SV$$

Knowledge Check

- Question: What are the causes of maternal tachycardia or bradycardia?

Clinical Condition: Hypoxia

Reduced oxygen at the tissue level

1

Lack of oxygen in blood (hypoxemia)

2

Lack of oxygen carrying capacity (anemia)

3

Lack of delivery of oxygen (circulatory)

4

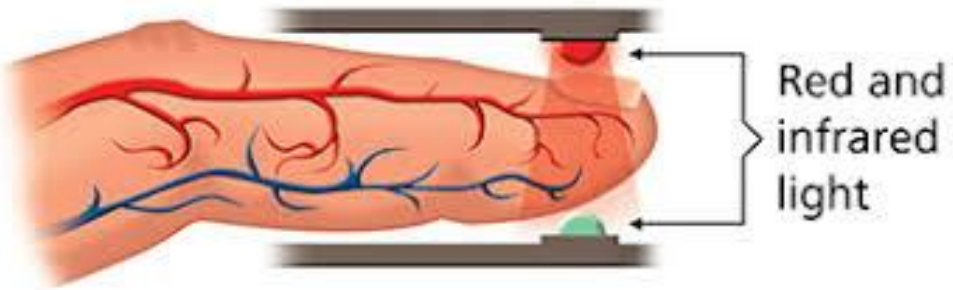
Lack of ability to extract oxygen (infection)

Clinical Condition: Hypoxia

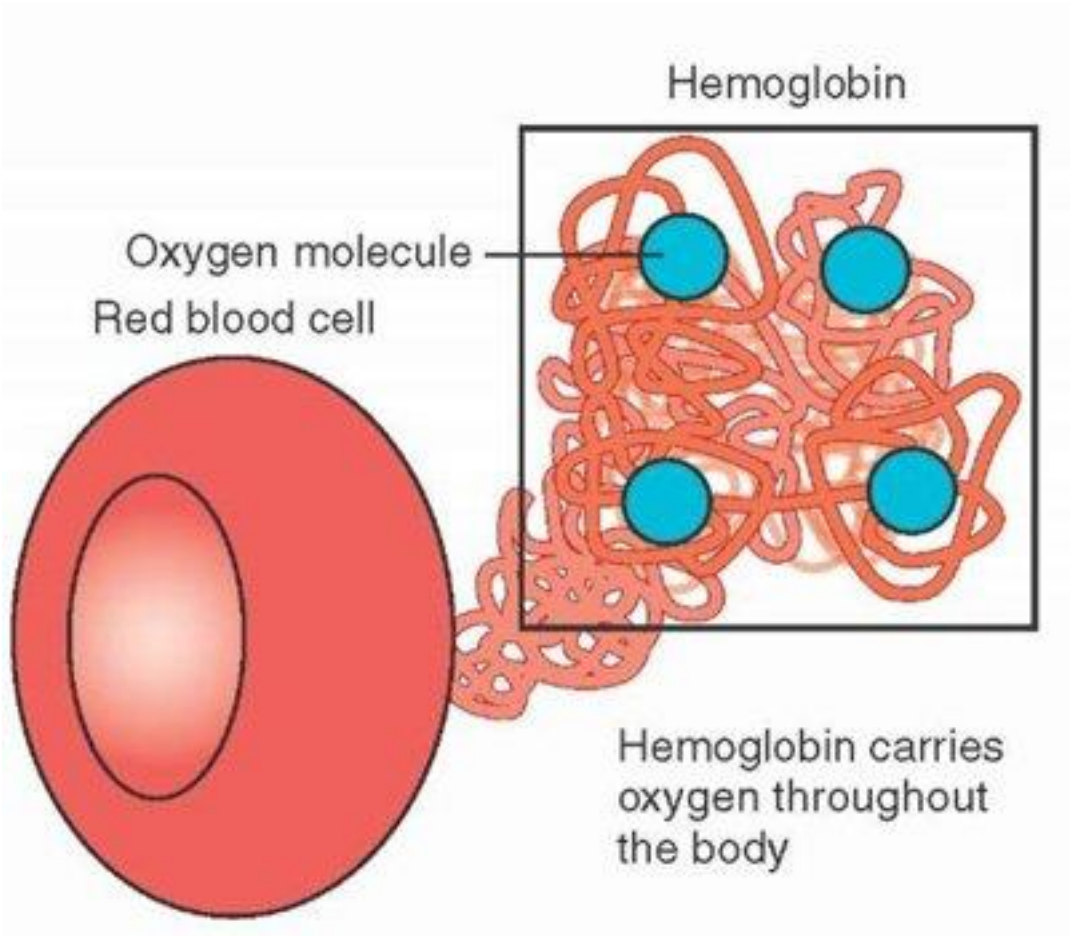
- Dyspnea
- Altered mental state
- Tachypnea or hypoventilation
- Arrhythmias
- Peripheral vasodilation
- Systemic hypotension
- Coma
- Cyanosis (unreliable)
- Nausea, vomiting
- Decreased SpO_2

Assessment

Pulse Oximetry Technology



http://www.nonin.com/What-is-Pulse-Oximetry



http://www.qsstudy.com/medical/how-oxygen-is-transported-in-blood

1. Recognition of obstetric early warning signs/symptoms
2. Communication
3. Bedside assessment by provider
4. Critical thinking as to cause
5. Documentation

Baird, S.M. & Graves, C. (2015) REACT. *JPNN*, 29(2), 138-148.

REACT Process

Patient Assessment

Cardiovascular

Pulmonary

Genitourinary

Neurologic

Lab values

Trends

REACT

MEOWS

National Partnership

MEWTS

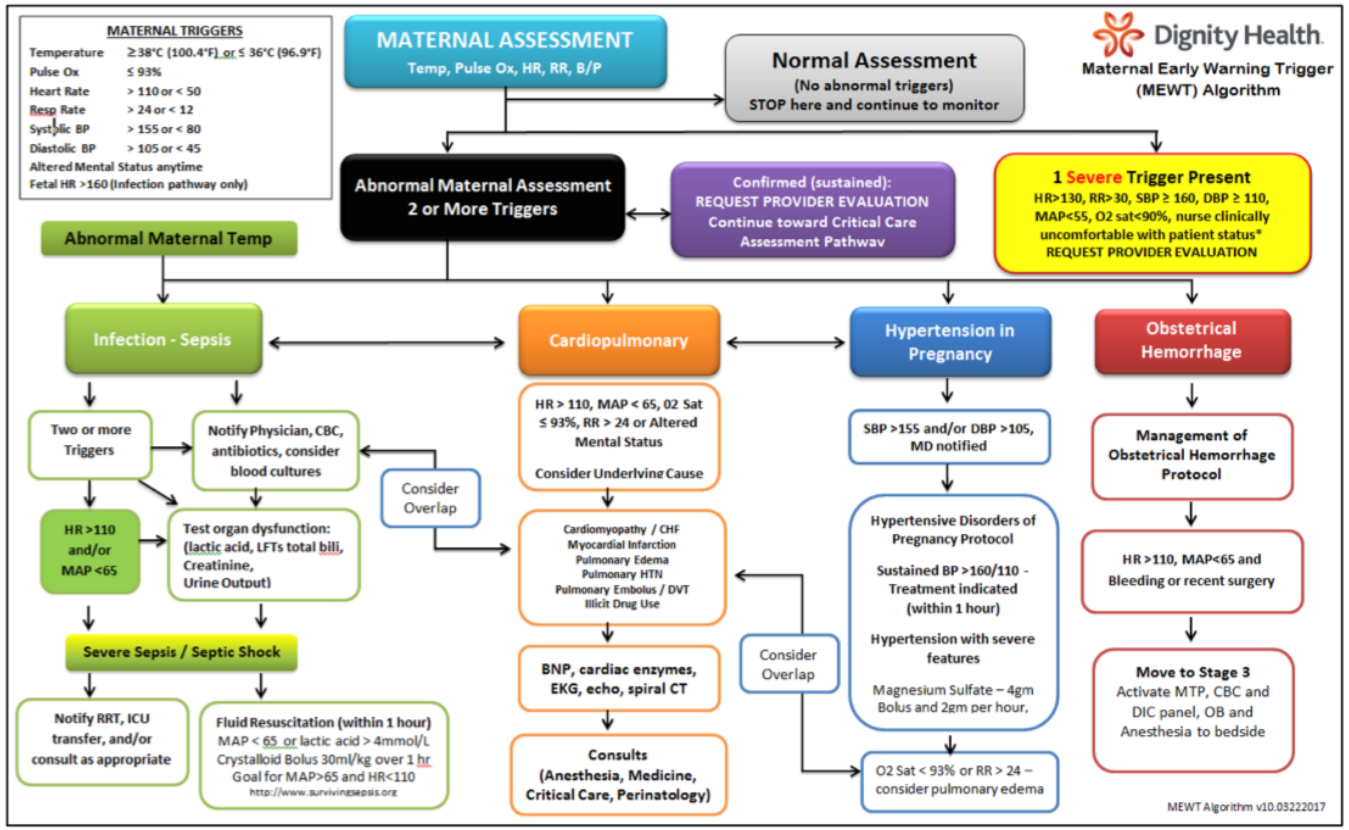
National Partnership for Maternal Safety Criteria

SBP < 90 or >160	DBP >100	HR < 50 or >120	RR < 10 or >30
SpO_2 < 95%	Oliguria mL/hr ≥ 2hrs less than 35 mL	Agitation, confusion, unresponsiveness	Preeclampsia w/ SOB, unrelenting HA

Mhyre, J.M. et al (2014). The maternal early warning criteria: a proposal from the national partnership for maternal safety. *JOGNN*, 43, 771-779.

Dignity Health

Maternal Early Warning Trigger (MEWT) Algorithm



bili, bilirubin; BNP, brain natriuretic peptide; BP, blood pressure; CBC; complete blood count; CT; computerized tomography; DBP, diastolic blood pressure; DIC, disseminated intravascular coagulation laboratory results; EKG, electrocardiogram; gm, grams; Hr, hour; HR, heart rate; ICU, intensive care unit; LFTs, liver function testing; MAP, mean arterial pressure; MTP, maternal transfusion protocol; OB, obstetrician; O2 Sat, oxygen saturation; PIH, preeclampsia laboratory assessment; Powerplan, electronic medical record preeclampsia order set; Pulse Ox, pulse oximetry; RR, respiratory rate; RRT, rapid response team; SBP, systolic blood pressure; Temp, temperature.

Bottom Line

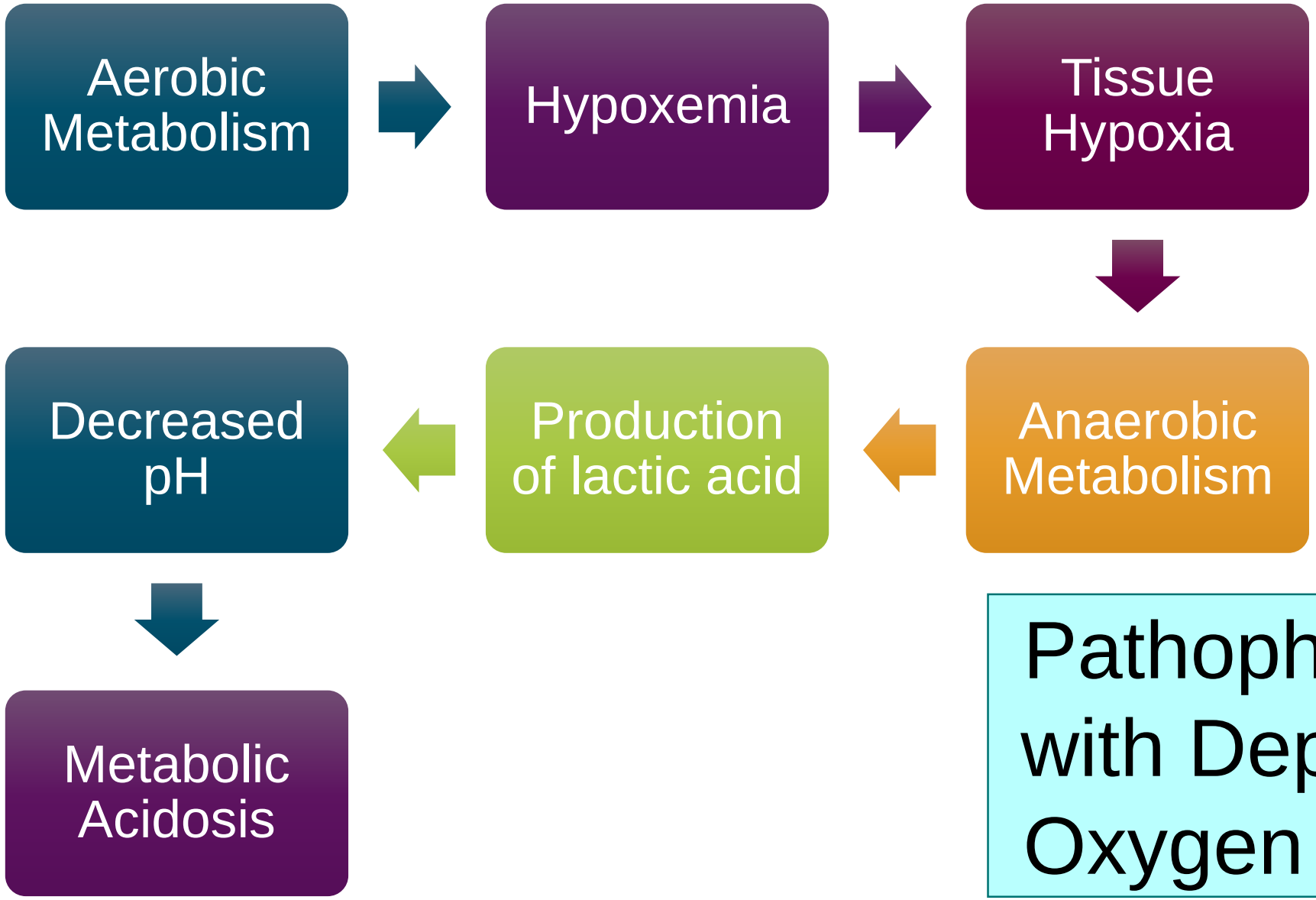
Respiratory Compromise

Respiratory Compromise: Assessment

Etiology of Respiratory Compromise in Pregnancy

- Pulmonary Edema
- Pneumonia
- Pulmonary Embolism
- Asthma Exacerbation
- Aspiration
- ARDS

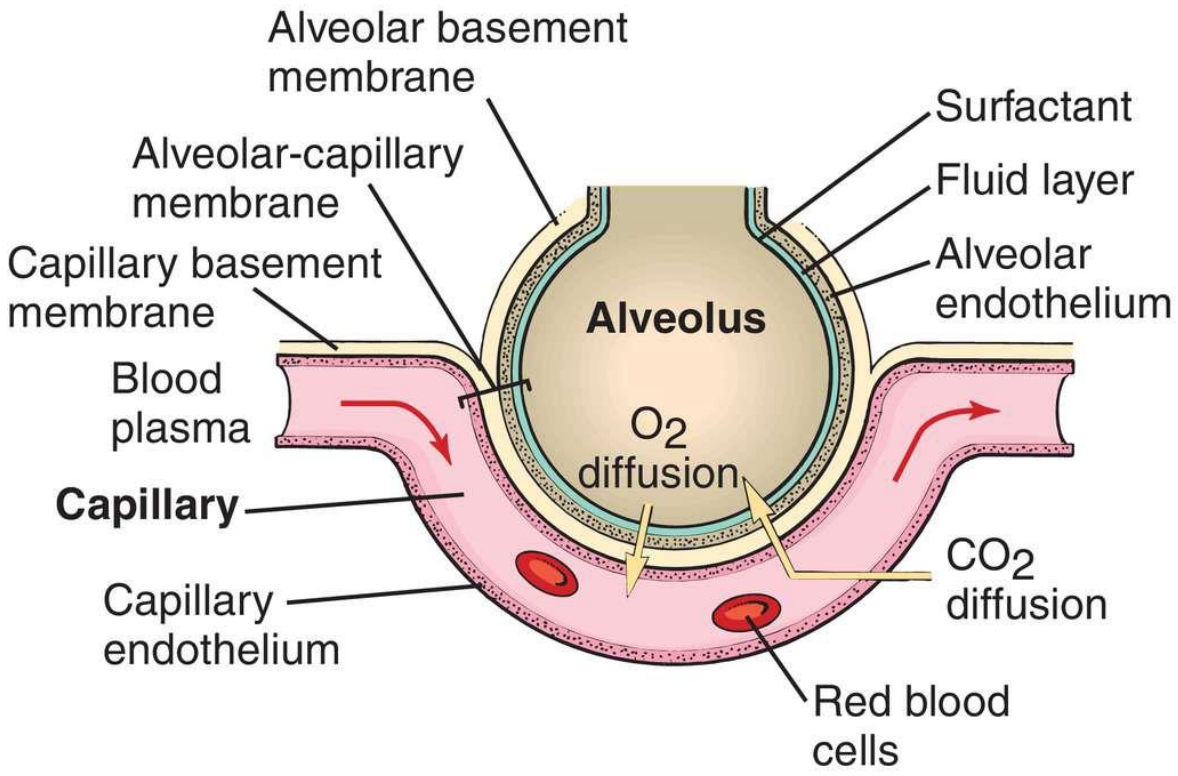
Clinical Condition: Hypoxia



Pathophysiology with Depletion of Oxygen Delivery

Diffusion Barriers

- Alveolar epithelium
- Tissue interstitium
- Capillary epithelium
- Plasma layer
- Red cell membrane
- Red cell cytoplasm
- Hb binding forces



Mosby's Medical Dictionary, 8th edition. (2009)

Pulmonary Edema: Definitic

- Abnormal accumulation of fluid outside the vascular space of the lung.
  - interstitial spaces
  - alveoli
  - cells

Incidence in Pregnancy: 2-5%
Mortality: 1-%
Postpartum: 70-80% of cases

Pulmonary Edema: Classification

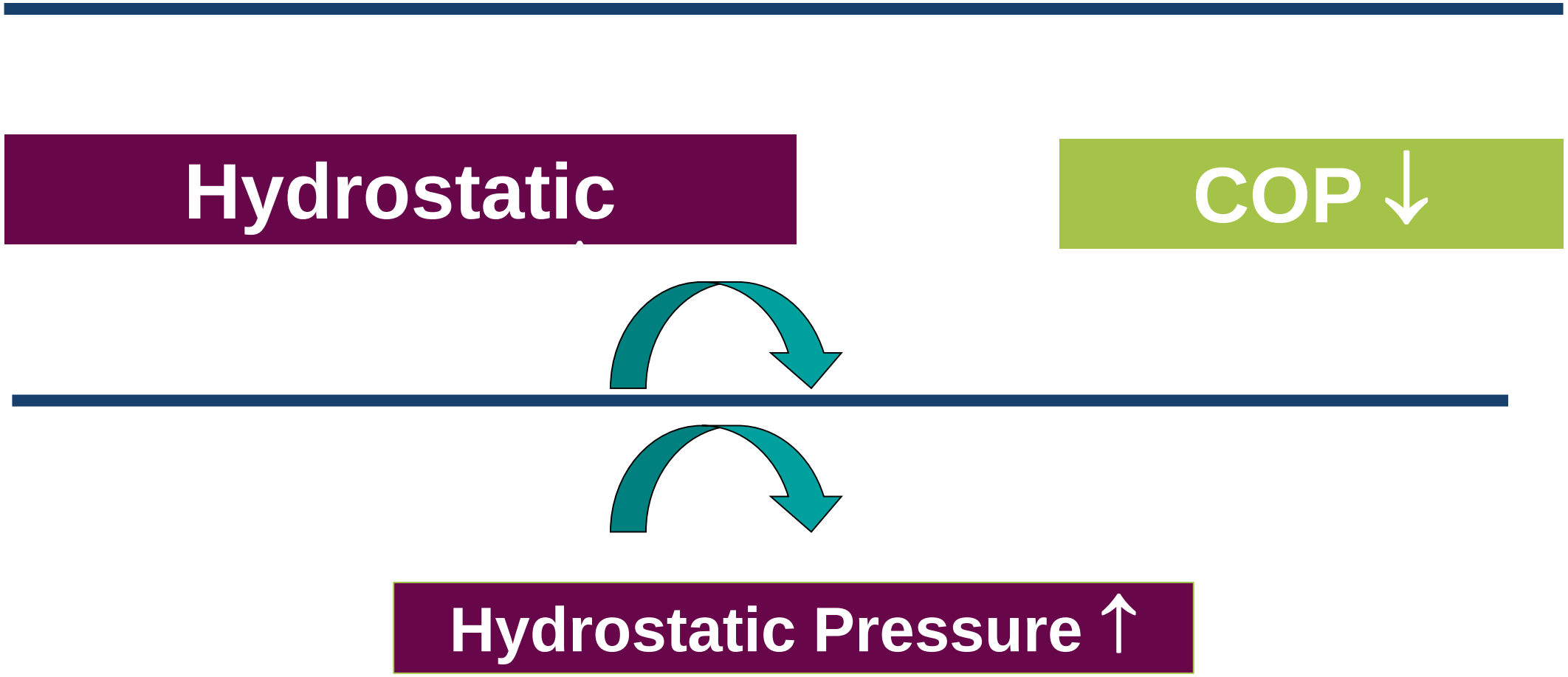
Cardiogenic

- Hydrostatic

Non-Cardiogenic

- Non-Hydrostatic
- Capillary Leak Syndrome

Pulmonary Edema: Cardiogenic



Pulmonary Edema: Cardiogenic Causes

Congenital heart disease/Acquired valvular lesions

Ischemic heart disease

Myocardial infarction

Cardiomyopathy

Dysrhythmias

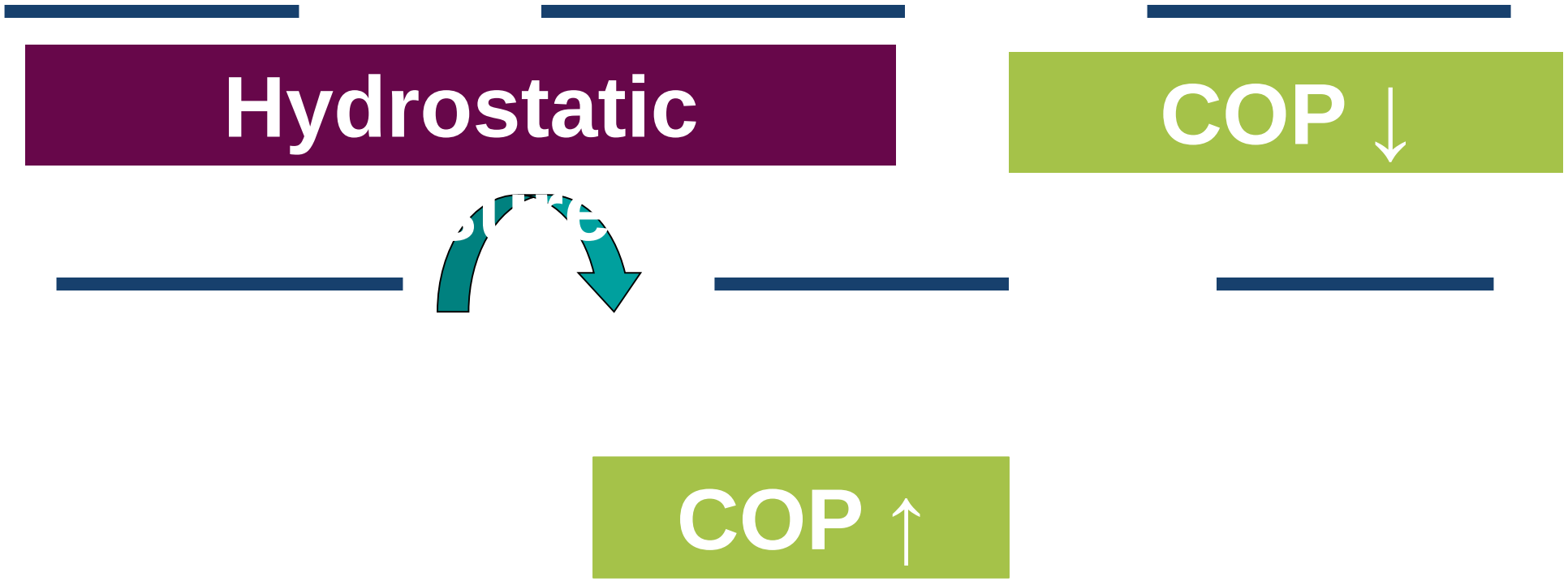
Hypertension

Intravascular volume overload

- β – mimetic therapy

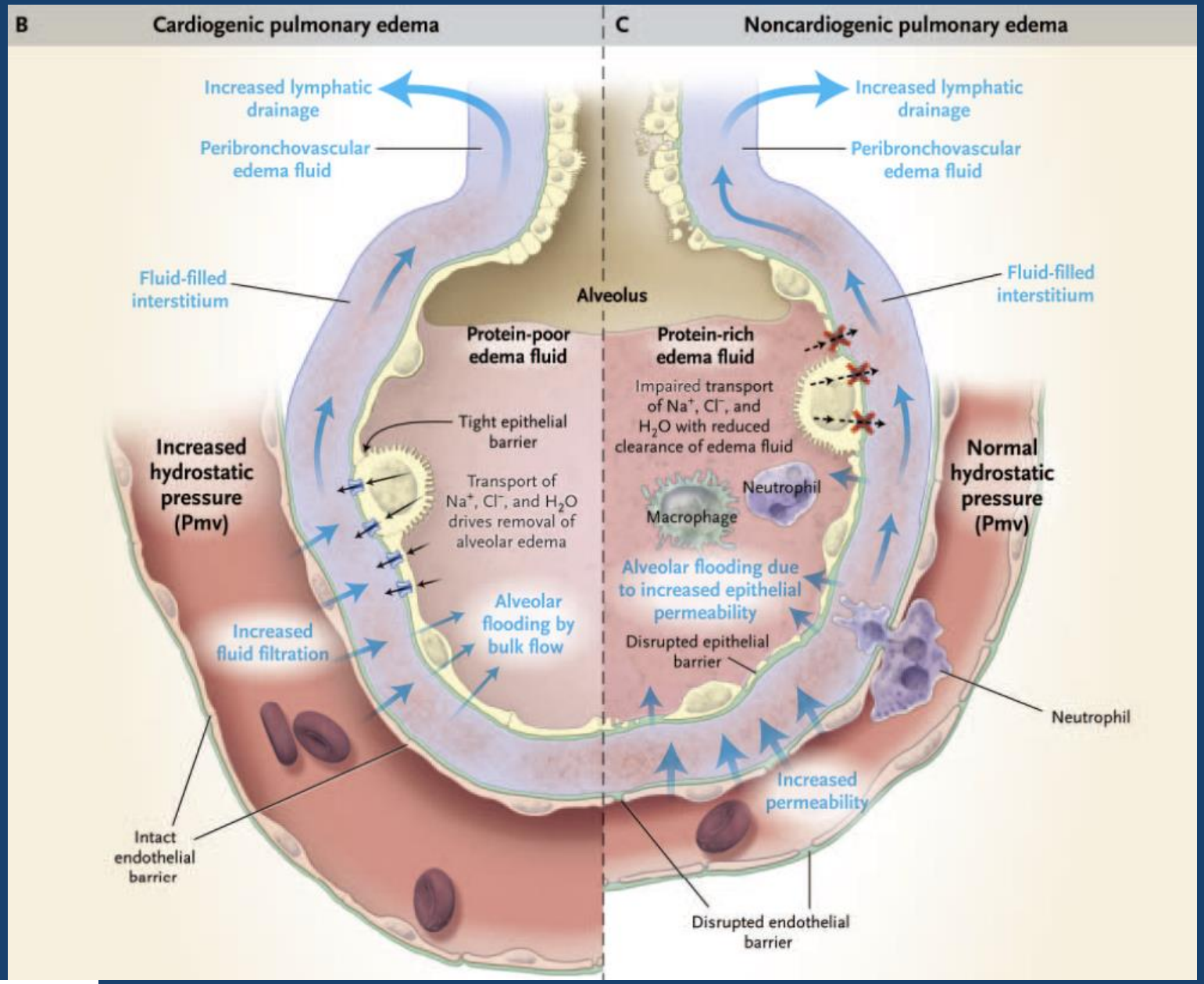
Multi-fetal pregnancy

Pulmonary Edema: Non-Cardiogenic



Pulmonary Edema: Non-Cardiogenic Causes

- Sepsis/Infection
- Blood transfusion reaction
- Amniotic fluid embolism
- Aspiration pneumonia
- Disseminated intravascular coagulation
- Inhalation injury
- Pre-eclampsia



http://crashingpatient.com

Pulmonary Edema: Clinical Presentation

- Tachycardia
- Tachypnea
- Cough
- Shortness of breath
- Chest pain
- Decrease in SaO_2
- Crackles
- Abnormal ABGs

Progressive Symptoms

B-type Natriuretic Peptide (BNP)

- Protein marker that increases with stretch on myocardium
- Correlates with LV disfunction
- Abnormal: > 100

Cardiogenic pulmonary edema: high

Non-cardiogenic pulmonary edema/ARDS: low

Cardiogenic vs. Non-Cardiogenic Pulmonary Edema Chest X-Ray

Cardiogenic	Non-Cardiogenic
• Patchy infiltrates in bases • Effusions • Kerley B lines • Cardiomegaly • Pulmonary vascular redistribution	• Homogenous fluffy shadows • No effusion • No Kerley B lines • No cardiomegaly • No pulmonary vascular redistribution

Diffuse infiltrates on Xray may not appear until up to 24 hours later in ARDS

Treatment of Pulmonary Edema

Pulmonary Edema: General Management

- Continuous SpO_2 and ECG monitoring
- Continuous fetal monitoring if viable
- Evaluate hemodynamics
- Sit patient up – recruit alveoli
- ABGs
- Diagnostic studies
  - CXR/MRI/CT/Echo
- Decrease oxygen consumption
  - Limit patient movements
  - Decrease pain
  - Evaluate SpO_2 in response to activity

GOAL

- Optimize oxygen delivery
  - Goal $SpO_2 > 95\%$
  - $PaO_2 > 70$ mmHg

Pulmonary Edema: Oxygen Therapy

- Optimize oxygen delivery
- Non-rebreather face mask
  - Prevents patient from rebreathing exhaled air
- Administer oxygen by face mask
- Monitor response
  - Continuous SpO_2
  - ABGs – consider arterial line placement

	L/Min	~ FiO_2 (%)	Comment
Nasal Cannula	1 - 6	25 - 40%	1 L ↑ FiO_2 by ~ 4 % affected by mouth breathing, RR, TV
Face Mask	6 - 10	40 - 60%	Need > 5 L affected by mask fit, RR
FM w/reservoir	6 - 10	60 - 100	1 L ↑ by approx. 10%
Venturi Mask	4-15	40-50%	Constant high flow controlled FiO_2 Room air blends with O_2 Color adapters indicate O_2 delivery
CPAP	Set	Titrate	Adds Pressure Uncomfortable

Pulmonary Edema: Management

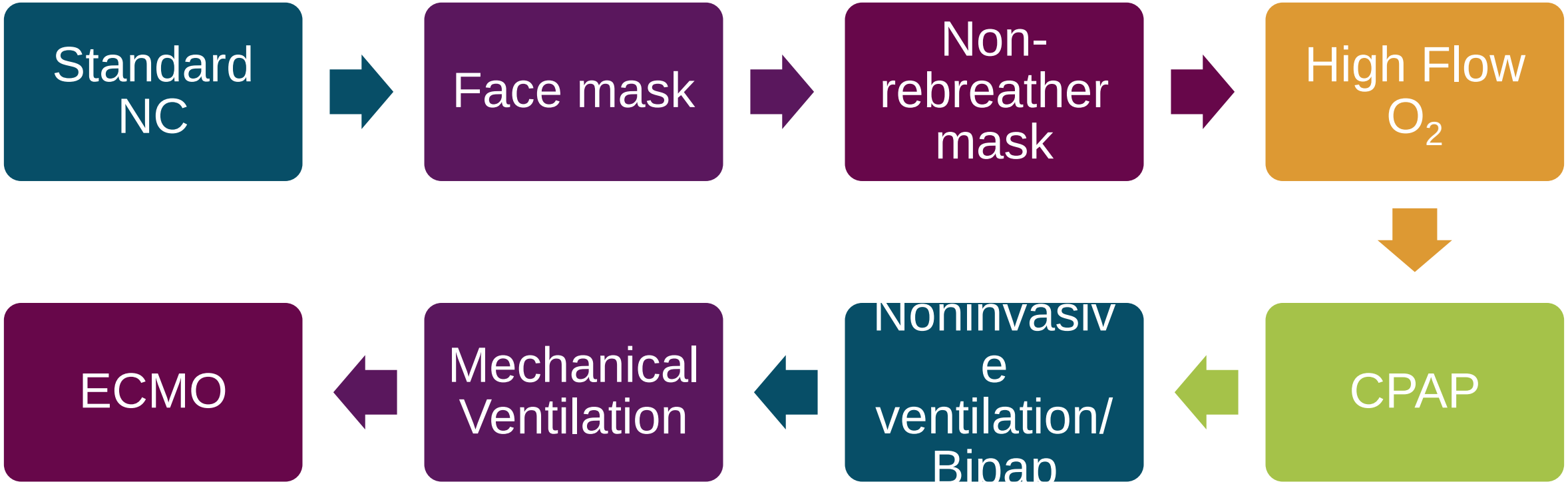
Cardiogenic

- Decrease preload
  - Diuresis
    - Lasix 10 - 20 mg IV over 1 - 2 minutes
- Decrease afterload (as indicated)

Non-Cardiogenic

- Frequent non-invasive assessments of hemodynamic function
- Anticipate
  - Invasive hemodynamic monitoring
  - Ventilator management

Respiratory Support Escalation



Indications for Intubation and Mechanical Ventilation

Failure to Oxygenate

- Cardiogenic Pulmonary edema

Failure to Ventilate

- Non-Cardiogenic Pulmonary Edema
- ARDS

Unable to Protect Airway

- Eclampsia
- Loss of consciousness

Hypertensive Disorders

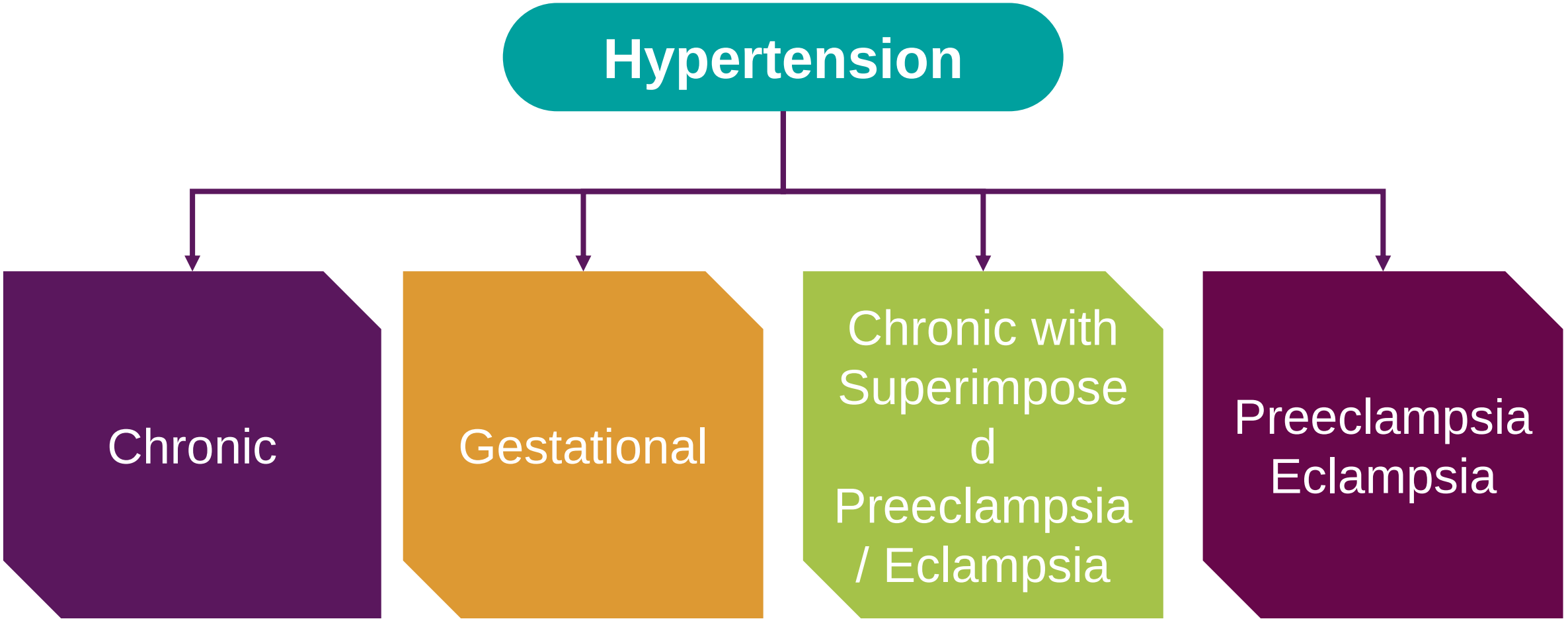
The American College of
Obstetricians and Gynecologists
WOMEN'S HEALTH CARE PHYSICIANS

Hypertension in Pregnancy

Report of the American College of Obstetricians and Gynecologists' Task Force on Hypertension in Pregnancy

Executive Summary

Hypertensive Disease in Pregnancy: Classification



Chronic Hypertension: Epidemiology

- 0.9-1.5% of all pregnant patients

- Increased 67% between 2000 to 2009
  - 87% increase in African American patients

- 13-40% develop Superimposed Preeclampsia

Chronic Hypertension: Definition

BP > 140 mmHg systolic and/or 90 mmHg diastolic before pregnancy or prior to 20 weeks gestation

Use of antihypertensive medications prior to pregnancy

Persistence of hypertension >12 weeks after delivery

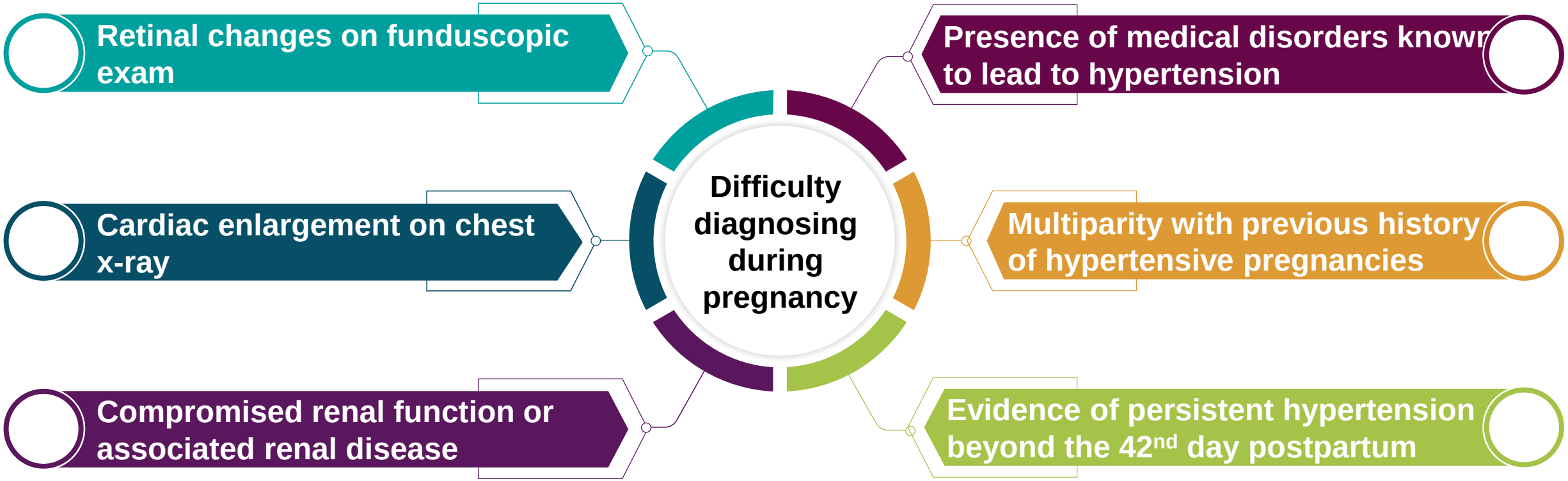
Chronic Hypertension: Definition

American College of Cardiology and American Heart Association

	Category	Parameters	
1	Normal	• SBP <120 mm Hg • DBP <80 mm Hg	
2	Elevated	• SBP 120-129 mm Hg • DBP <80 mm Hg	
3	Stage 1 Hypertension	• SBP 130-130 mm Hg • DBP 80-89 mm Hg	Recommend beginning treatment
4	Stage 2 Hypertension	• SBP ≥ 140 mm Hg • DBP ≥ 90 mm Hg	Matches ACOG BP criteria

*Criteria will double number of reproductive age females with HTN in US

Chronic Hypertension



Hypertension: Prevention of Preeclampsia

- **Aspirin**
  - Daily 81 mg aspirin decreases the risk of preeclampsia, preterm birth, and growth restriction by ~ 10-20% in patients at moderate to high risk
  - Start at 12-16 weeks and continue until delivery
- Vitamin D
  - Doses of 600-2000 IU daily may decrease preeclampsia risk
  - Most prenatal vitamins have 400-800 IU of vitamin D
- Calcium
  - Calcium supplementation 500 mg daily is recommended for patients who consume < 800 mg daily in their diet

Society for Maternal-Fetal Medicine Special Statement: Prophylactic low dose aspirin for preeclampsia prevention – quality metric and opportunities for quality improvement. (2023). www.smfm.org
Roberts JM, et al. Care plan for individuals at risk for preeclampsia: shared approach to education, strategies for prevention, surveillance, and follow-up. Am J Obstet Gynecol. 2023 Apr 27:S0002-9378(23)00260-0. doi: 10.1016/j.ajog.2023.04.023. Epub ahead of print. PMID: 37120055.

Hypertension in Pregnancy

Executive Summary: Hypertension in Pregnancy. American College of Obstetricians and Gynecologists. Obstet Gynecol 2013; 122:1122-31.

Gestational HTN

- BP elevation after 20 weeks (≥140/90 mmHg)
- No proteinuria
- No severe features

Preeclampsia (with or without severe features)

- BP elevation **AND**
- Proteinuria **OR** severe features

Gestational Hypertension

Occurs in approximately 6% of pregnancies

Severe range pressures = preeclampsia

Often resolves w/in 10-12 days postpartum period without treatment

Patients who remain hypertensive after birth may have pre-existing chronic hypertension

Preeclampsia: Pathophysiology

- Focus usually on BP
- Multisystem effects of preeclampsia

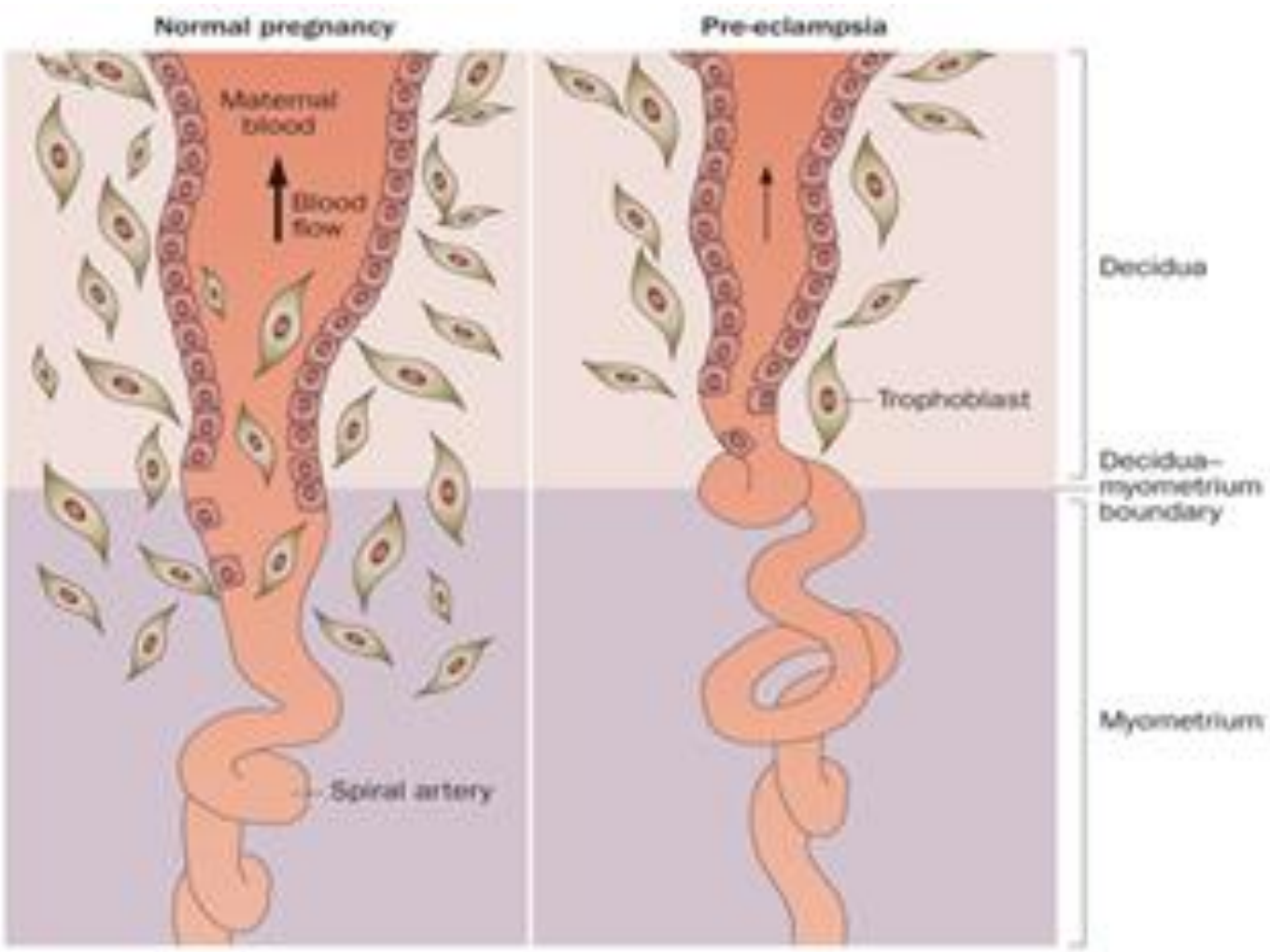
Cardiac	Neurologic	Renal
Pulmonary	Liver	Fetal

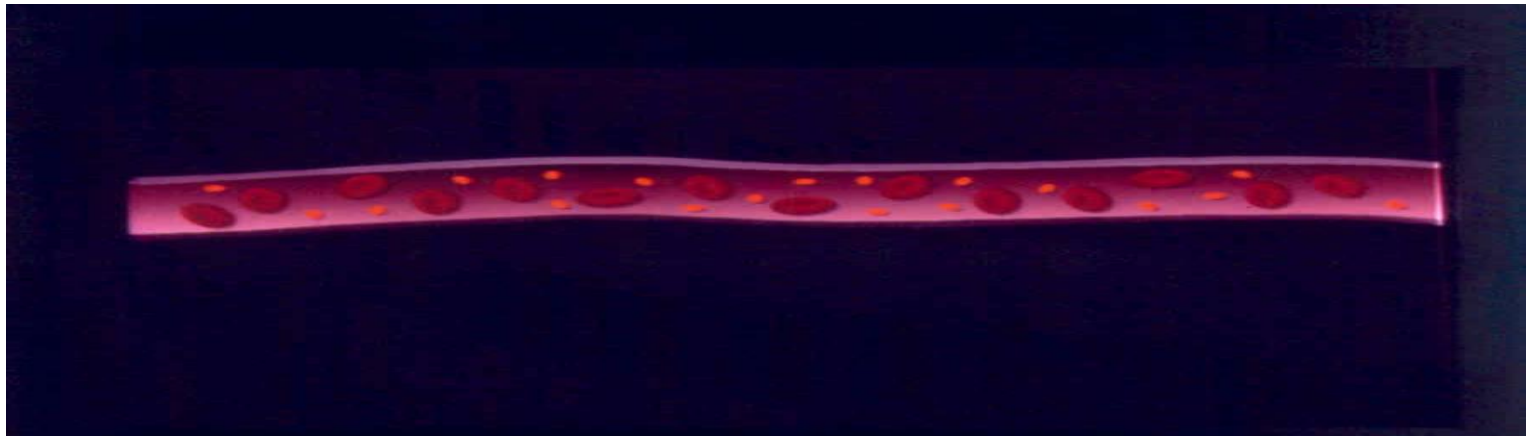
Less trophoblast invasion of uterine spiral arteries

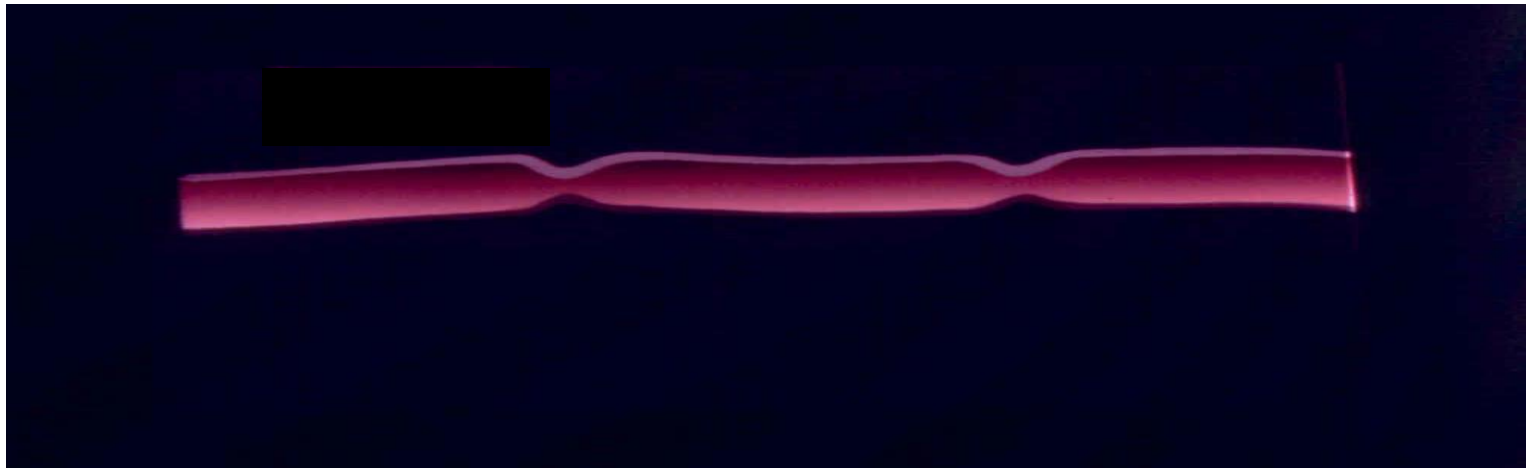
Placental hypoxia induces inflammatory events

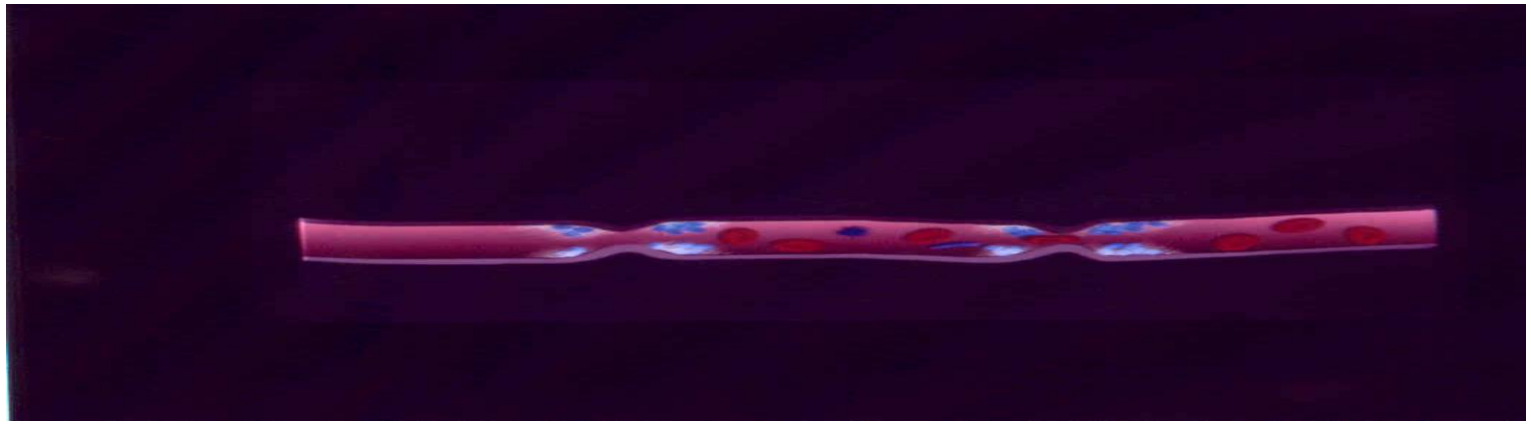
Imbalance of vascular endothelial growth factor (VEGF) and placental growth factor (PIGF)

Endothelial dysfunction and platelet aggregation









Preeclampsia: Pathophysiology

Placental release of factor(s) that alter endothelial function

Endothelial cell dysfunction

Decreased production of PG12

Reversed PG12:TXA2 ratio

Vasoconstriction Increased SVR

Hypertension

Preeclampsia: Pathophysiology

Placental release of factor(s) that alter endothelial function

Endothelial cell damage

Exposure of collagen – tissue factor

Platelet aggregation activation

Activation of clotting cascade

Thrombocytopenia, DIC

Preeclampsia: Pathophysiology

Placental release of factor(s) that alter endothelial function

Endothelial cell damage

Exposure of collagen – tissue factor

Leaky capillaries

Proteinuria; decreased COP

Edema

Preeclampsia: Severe Features

Severe pressures

- SBP ≥160, DBP ≥110

Thrombocytopenia

- Platelets < 100,000

Hepatic Symptoms

- AST & ALT twice normal, RUQ, or epigastric pain

Renal insufficiency

- Cr >1.1 or 2x baseline

Pulmonary edema

New cerebral or visual symptoms

FGR is not a severe feature. Manage as recommended regardless of hypertension or preeclampsia status.

Preeclampsia: Pathophysiology

Phenotype	HR	SV	CO	TPR
High Output Hypertension	↑	↑	↑	↓
High Resistance Hypertension	↓	↓	↓	↑

High Cardiac Output Hypertension:

- **Late Onset Preeclampsia**
- **Normal Fetal Growth**
- **More Favorable Outcomes**

High Resistance Hypertension:

- **Early Onset Preeclampsia**
- **Fetal Growth Restriction**
- **Worse Perinatal Outcomes**

McLaughlin K, *et al.* JAHA 2022

Preeclampsia: Perinatal and Neonatal Complications

Short Term	Long Term
• Fetal growth restriction • Oligohydramnios • IUFD • Preterm birth • Low Apgar score • NICU admission	• Cerebral palsy • Low IQ • Hearing loss • Visual impairment • Insulin resistance • Diabetes mellitus • Coronary artery disease • Hypertension

Adapted from FIGO, 2019

Hypertension : Clinical Management

Hypertension

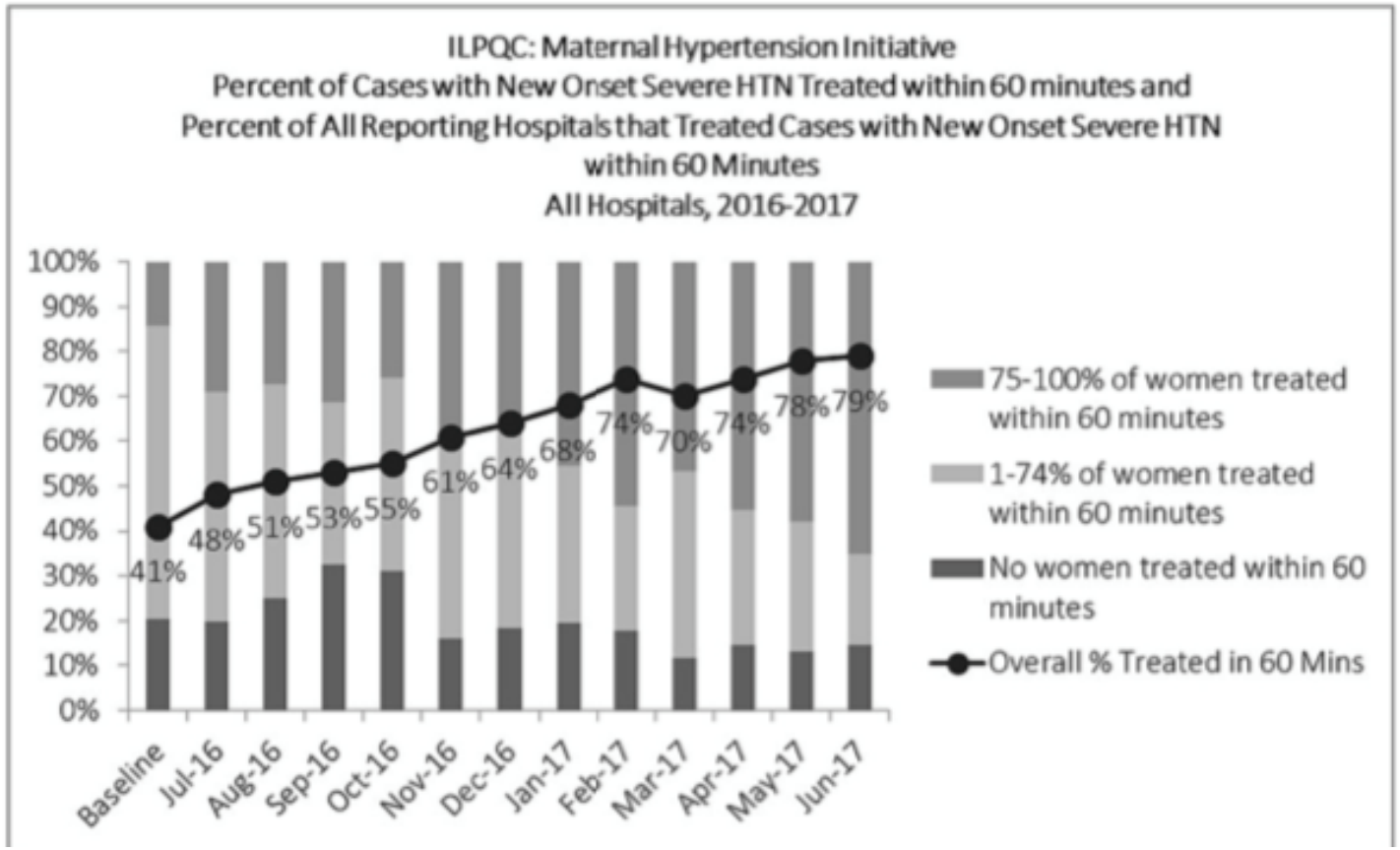
- Estimated that 60% of maternal deaths resulting from hypertension are potentially preventable
- Key errors
  - Failure to adequately control BP
  - Failure to recognize HELLP syndrome
  - Failure to diagnose and treat pulmonary edema
  - Failure to appreciate the multisystem disease nature of preeclampsia

Postpartum

- Potential Postpartum Complications
  - Readmission
  - Severe hypertension
  - Chronic hypertension
  - Heart failure (1/2 show persistent myocardial dysfunction in first months PP)
  - Stroke
  - Myocardial infarction
  - Death (majority of deaths occur PP)

ACOG, 2019; Giorgione et al, 2023

Rapid Management of Severe Range BP



King, PL, Keenan-Devlin, L, Gordon, C, Goel, S, & Borders, A (2018) Reducing time to treatment for severe maternal hypertension through statewide quality improvement. AJOG, 218(1), S4.

Treatment of Blood Pressure greater than or equal to 160/xx OR xx/110:

Position: semi-fowlers; cuff at level of heart; displace uterus

BP ≥ 160/xx or xx/110?
May recheck with manual cuff* in **10** minutes *(for verification)

Remains ≥ 160/xx or xx/110?
30-60 min timeframe begins

yes

Primary RN
Notify OB of BP
Notify Charge RN

and

- Start IV and draw Labs
- Recommend IVP med* within 30-60 min of 2nd BP
- Monitor BP q **5** min ◊
- Monitor EFM
- Admit patient

then

◊ Recommend: Continue BPs q 5 min. until BPs remain less than 160/xx or xx/110, then may repeat BP measurement
- every 10 mins for 1 hour,
- then every 15 mins for 1 hour,
- then every 30 mins for 1 hour,
- and then every hour for 4 hours.

no

Recommend: Recheck every 30 minutes.

OB Provider
- Order IV push labetalol or hydralazine *
- Admit patient

consider

- Difficult IV start, > 30-60 mins? *Give PO nifedipine 10 mg for first med dose (may repeat q 20min PRN x6).*
- Does Patient meet criteria for severe preeclampsia? *Magnesium Sulfate 4gm loading dose.*

***MED NOTES:**

Labetalol IVP: *(q 10min PRN; 300mg max dose)*
Peak response within 5 minutes
***Requires continuous pulse oximetry x 1 hr after each dose.**
On M/B unit: contact Mgr re equip/staff requirements.
Contraindicated: Bronchial Asthma or Heart Block

Hydralazine IVP: *(q 20min PRN; 25mg max dose)*
Onset: 5-15 min
Peak response: 10-80 min
Contraindicated: Mitral Valvular disease

►Be sure to CHECK ORDER for details◄

Rev 5/28/15

KAISER PERMANENTE®

Blood Pressure Measurement

Either
Systolic BP ≥ 160
OR
Diastolic BP ≥ 110

→ ***Re-take BP in 15 minutes***

Either
Systolic BP ≥ 160
OR
Diastolic BP ≥ 110

→ ***Notify Provider***

→ ***Proceed with antihypertensive***

Hydralazine Protocol

Hydralazine 5 -10 mg IVP *over 2 minutes*

*Take BP **20 minutes** after dose.* — *If BP still elevated, **proceed to next dose***

Hydralazine 10 mg IVP *over 2 minutes*

*Take BP **20 minutes** after dose.* — *If BP still elevated, **proceed to next med***

Labetalol 20 mg IVP *over 2 minutes*

*Take BP **10 minutes** after dose.* — *If BP still elevated, **proceed to next dose***

Labetalol 40 mg IVP *over 2 minutes*

*Take BP **10 minutes** after dose. If BP still elevated, **notify Provider***

Labetalol Protocol

Labetalol 20 mg IVP *over 2 minutes*

*Take BP **10 minutes** after dose.* — *If BP still elevated, **proceed to next dose***

Labetalol 40 mg IVP *over 2 minutes*

*Take BP **10 minutes** after dose.* — *If BP still elevated, **proceed to next dose***

Labetalol 80 mg IVP *over 2 minutes*

*Take BP **10 minutes** after dose.* — *If BP still elevated, **proceed to next dose***

Hydralazine 10 mg IVP *over 2 minutes*

*Take BP **20 minutes** after dose. If BP still elevated, **notify Provider***

Nifedipine Protocol

Nifedipine 10 mg orally

*Take BP **20 minutes** after dose.* — *If BP still elevated, **proceed to next dose***

Nifedipine 20 mg orally

*Take BP **20 minutes** after dose.* — *If BP still elevated, **proceed to next dose***

Nifedipine 20 mg orally

*Take BP **20 minutes** after dose.* — *If BP still elevated, **proceed to next dose***

Labetalol 40 mg IVP *over 2 minutes*

*Take BP **10 minutes** after dose. If BP still elevated, **notify Provider***

Target BP = systolic BP 140 to 159 mm Hg ***AND*** diastolic BP 90 to 100 mm Hg
*Once target BP achieved, evaluate BP e*very 10 minutes X 6, every 15 minutes X 4, every 30 minutes X 2, every hour X 4, every 4 hours thereafter

AWHONN
PROMOTING THE HEALTH OF WOMEN AND NEWBORNS

Tip

Pregnant and postpartum women receiving IV labetalol, IV hydralazine or immediate release oral nifedipine DO NOT require cardiac monitoring.

Hypertension: Radiology Testing

- Consider brain imaging studies:
  - Unremitting headache
  - Focal signs and symptoms
  - Uncontrolled HTN
  - Lethargy, confusion
  - Abnormal neurologic exam

Magnesium Sulfate

- Indication: prevent vs. control seizures
- Administration
  - 4-6 grams IV loading dose over 20-30 minutes
  - 2 grams IV/hour basal rate
  - 10 grams IM (5+5) q 4 hours
  - 24 hours postpartum

Magnesium Sulfate: Nursing Care

- Mixture: 4 or 6 grams in 100 mL (Bolus); 20 grams in 500 mL (maintenance)
  - 25 mL = 1 gram
- All IV lines on infusion pump; label lines and bags
- 2 RN check
- Staffing
  - 1:1 during 1st hour
  - Remain at bedside bolus
  - 1:1 if labor
  - 1:2 pp

TL-HA106 MAGNESIUM SULFATE

Magnesium Sulfate: Nursing Care

- Strict bed rest
- Strict I & O
  - Foley catheter
  - Assess hourly and totals
- Vital signs
  - Q 15 minutes 1st hour
  - Q 30 minutes 2nd hour
  - Q 1 hour

TL-HA106 MAGNESIUM SULFATE

Magnesium Sulfate: Nursing Care

- Other Assessments
  - Breath sounds Q 2 hours
  - $Sp0_2$ Q 1 hour
  - DTRs Q 1 hour
- Continuous EFM
- Continue in OR
- Unplug from mainline after discontinuing

TL-HA106 MAGNESIUM SULFATE

Magnesium Toxicity

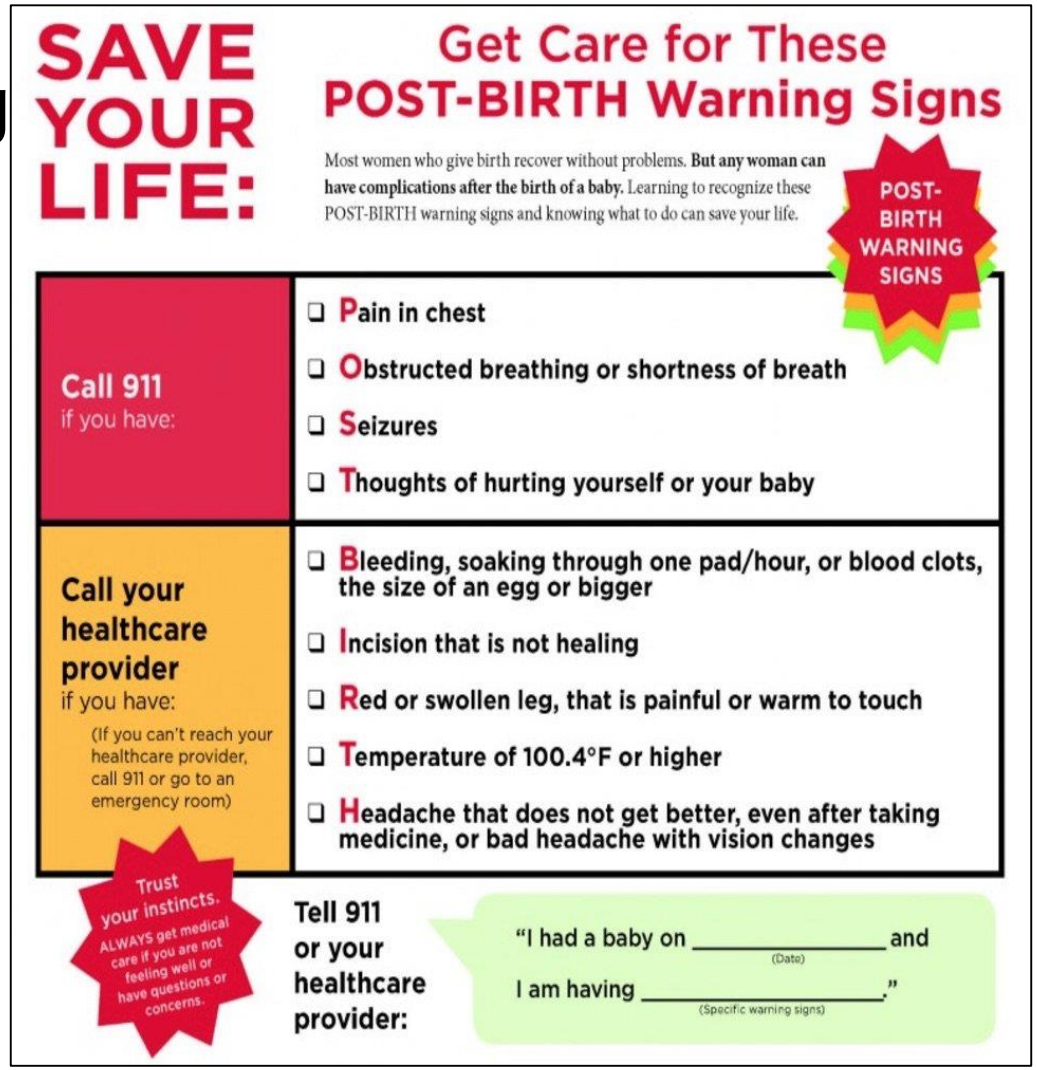
- Monitor Q 1 hour for s/s
  - Visual changes or flushing
  - Absent reflexes
  - Decreased respiratory drive
  - Somnolence
  - Paralysis

- Treatment for Toxicity
  - Administer calcium gluconate (10 mL of 10% solution) IV over 1-2 minutes

Therapeutic Range: 4-8 mEq/L

Hypertension: Postpartum Discharge

- **Example Discharge Criteria**
  - ❑ Vital signs within acceptable rang
  - ❑ Medication dosing stabilized
  - ❑ Labs within normal range
  - ❑ Post-Birth Warning Signs
  - ❑ Home BP monitoring



www.AWHONN.org

Hypertension: Postpartum Follow Up Care

- Poor compliance with postpartum follow up care (40-60%); lower rates among Black women
- Postpartum Visit
  - Within 3-7 days if DC without medication
  - < 72 hours if DC with medication
- Cardiology Consult
  - Preferable at 3 months PP
  - Comprehensive CV risk assessment
    - BP, weight, fasting glucose, HbA1C, lipids
  - Counseling re. diet, exercise, BP management
  - Yearly follow-up

Postpartum: Additional Education

- Preeclampsia can occur during 1st week PP
- BP monitoring continued for the 1st week until seen by a healthcare provider
- Report any BP $\geq$ 140/90 mmHg

Roberts et al, 2023

Hypertension: Postpartum

- 2,227,711 patients without preexisting chronic hypertension who delivered between 2008-2010

Normotensive Pregnancy	Preeclampsia	Gestational Hypertension
• 2,156,448	• 37,043 • 1st year PP = 18 x higher risk for diagnosis of CHTN • 5-10 years = 5x higher risk	• 34,220 • 1st year PP = 12 x higher risk • 5-10 years = 6x higher risk

Simon, et al (2023)

Preeclampsia: Long Term Risks

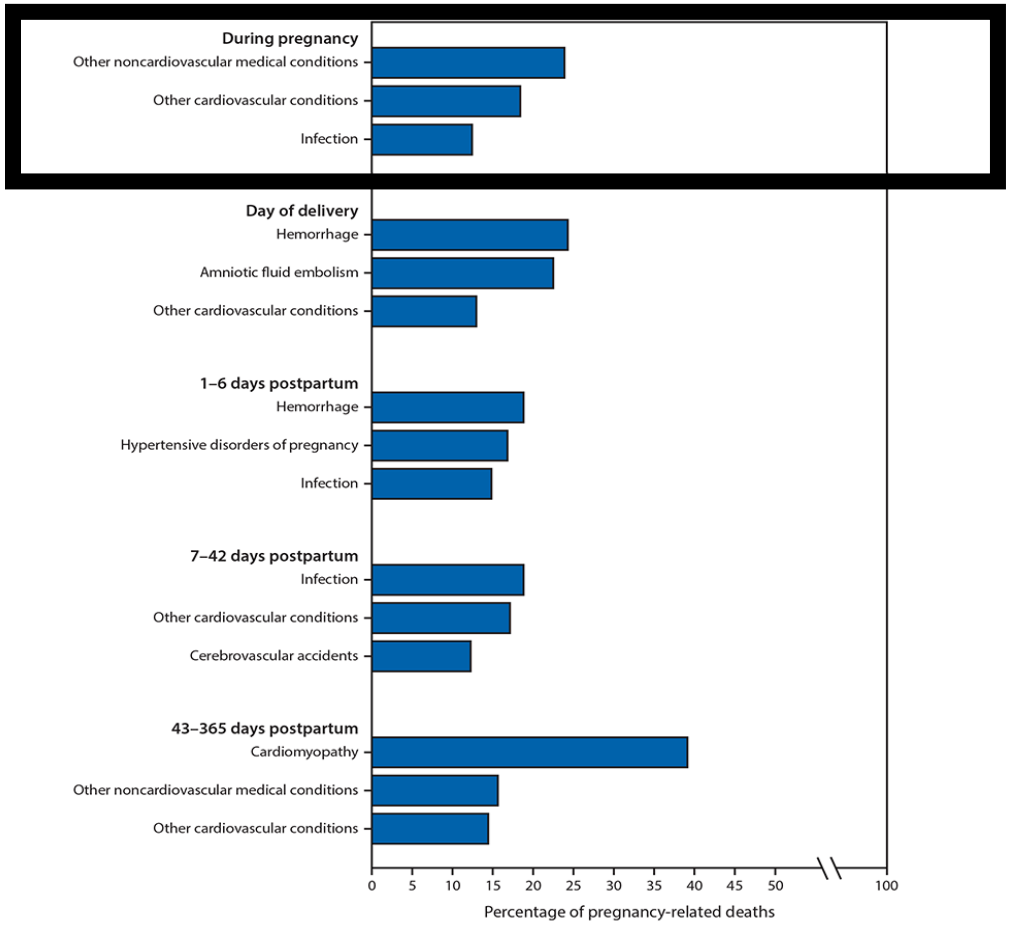
- Increased risk
  - Cardiovascular disease
  - End stage renal disease
  - Stroke
  - Dementia

Canva.com

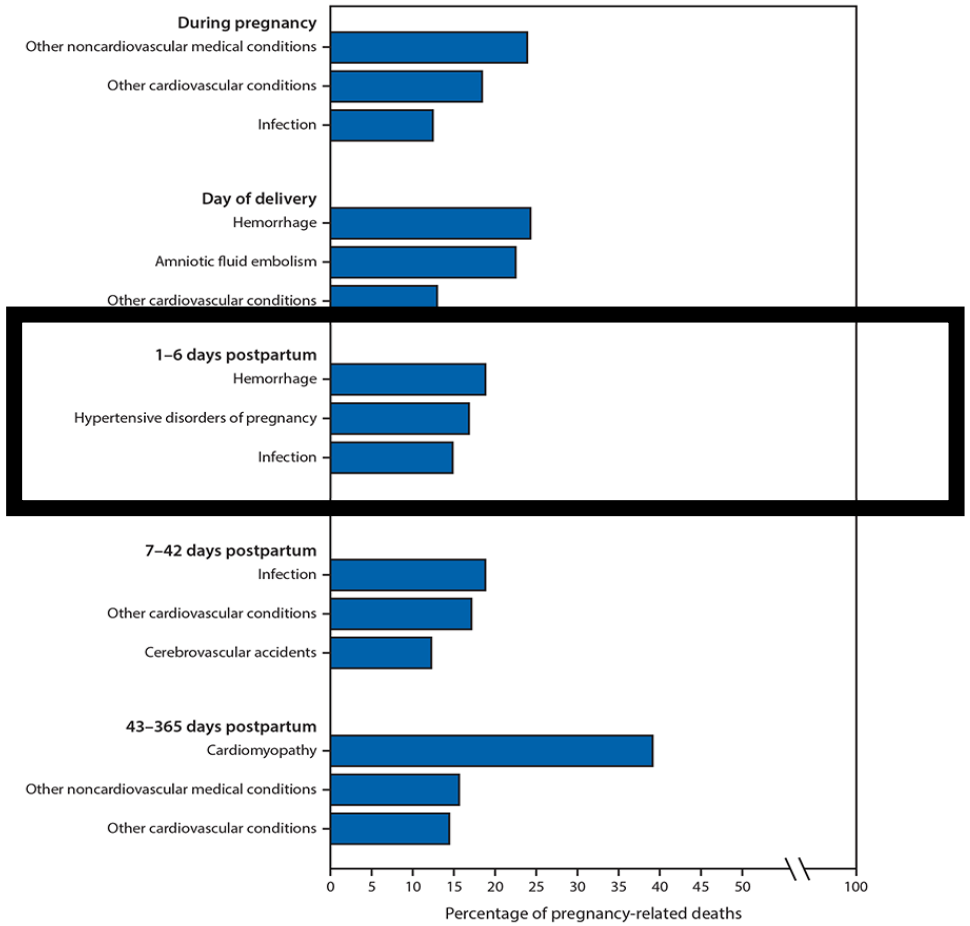
Preeclampsia Research

- Women who have had preeclampsia:
  - 3 – 4 times the risk of high blood pressure
  - Double the risk for heart disease and stroke
  - Increased risk of developing diabetes

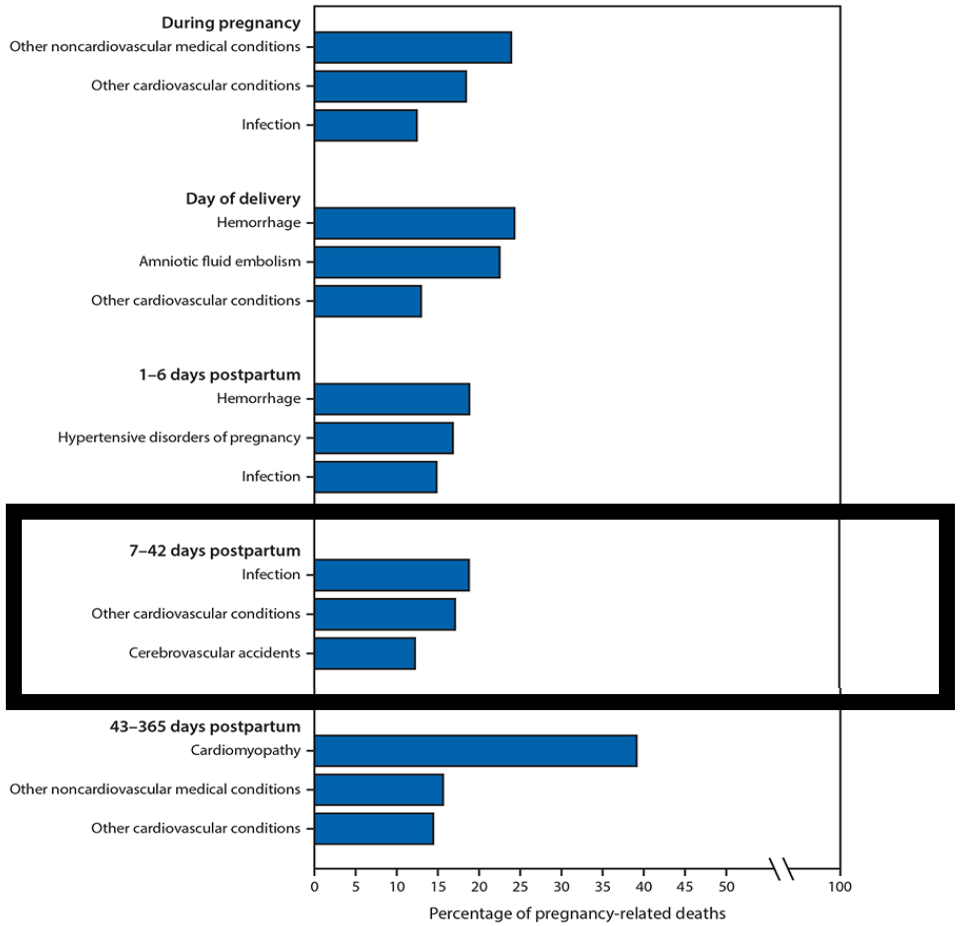
Maternal Sepsis and Septic Shock



https://www.cdc.gov/vitalsigns/maternal-deaths/index.html. May 2019

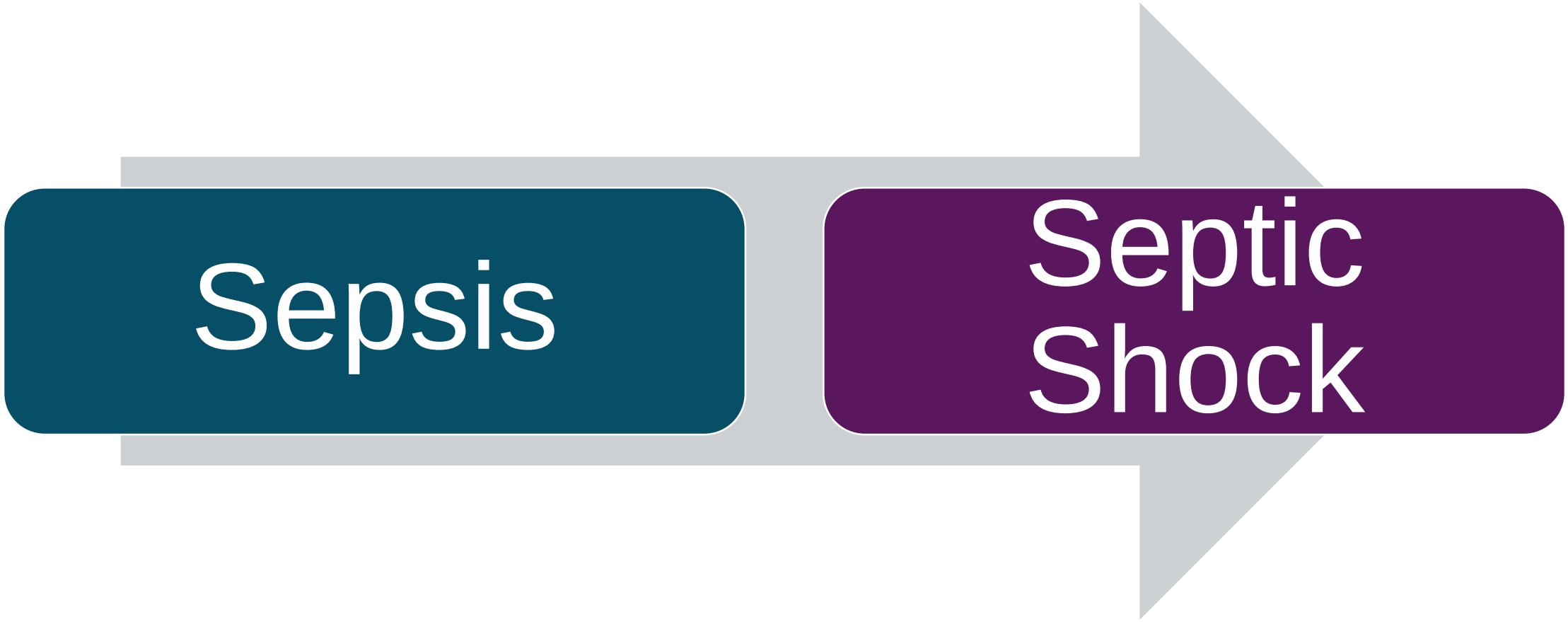


https://www.cdc.gov/vitalsigns/maternal-deaths/index.html. May 2019



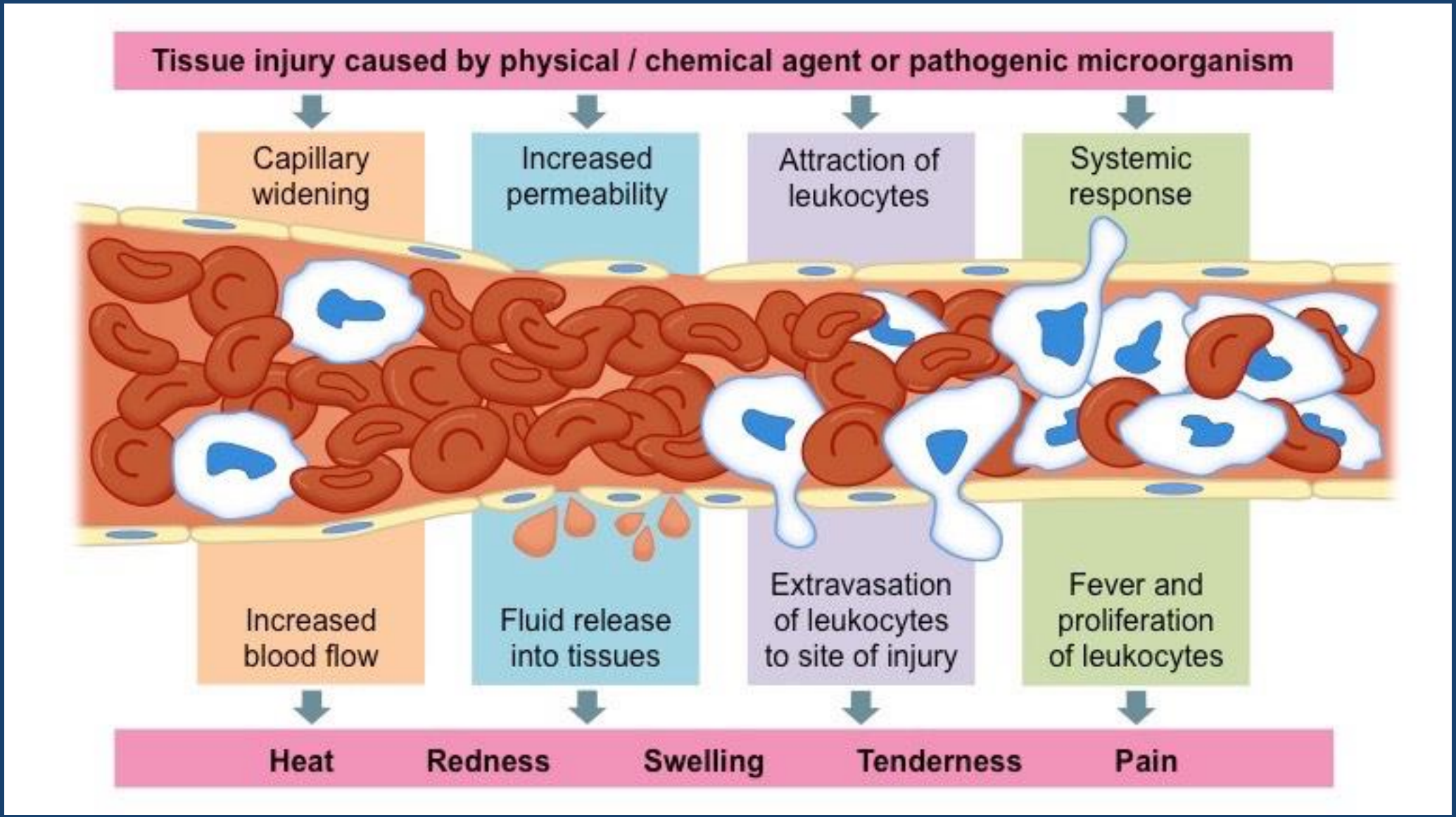
https://www.cdc.gov/vitalsigns/maternal-deaths/index.html. May 2019

Maternal Sepsis: Pathophysiology


Sepsis
Septic Shock

Sepsis: Definition

Life threatening organ dysfunction caused by a dysregulated host response to infection



http://ib.bioninja.com.au/standard-level/topic-6-human-physiology/63-defence-against-infectio/inflammation.html

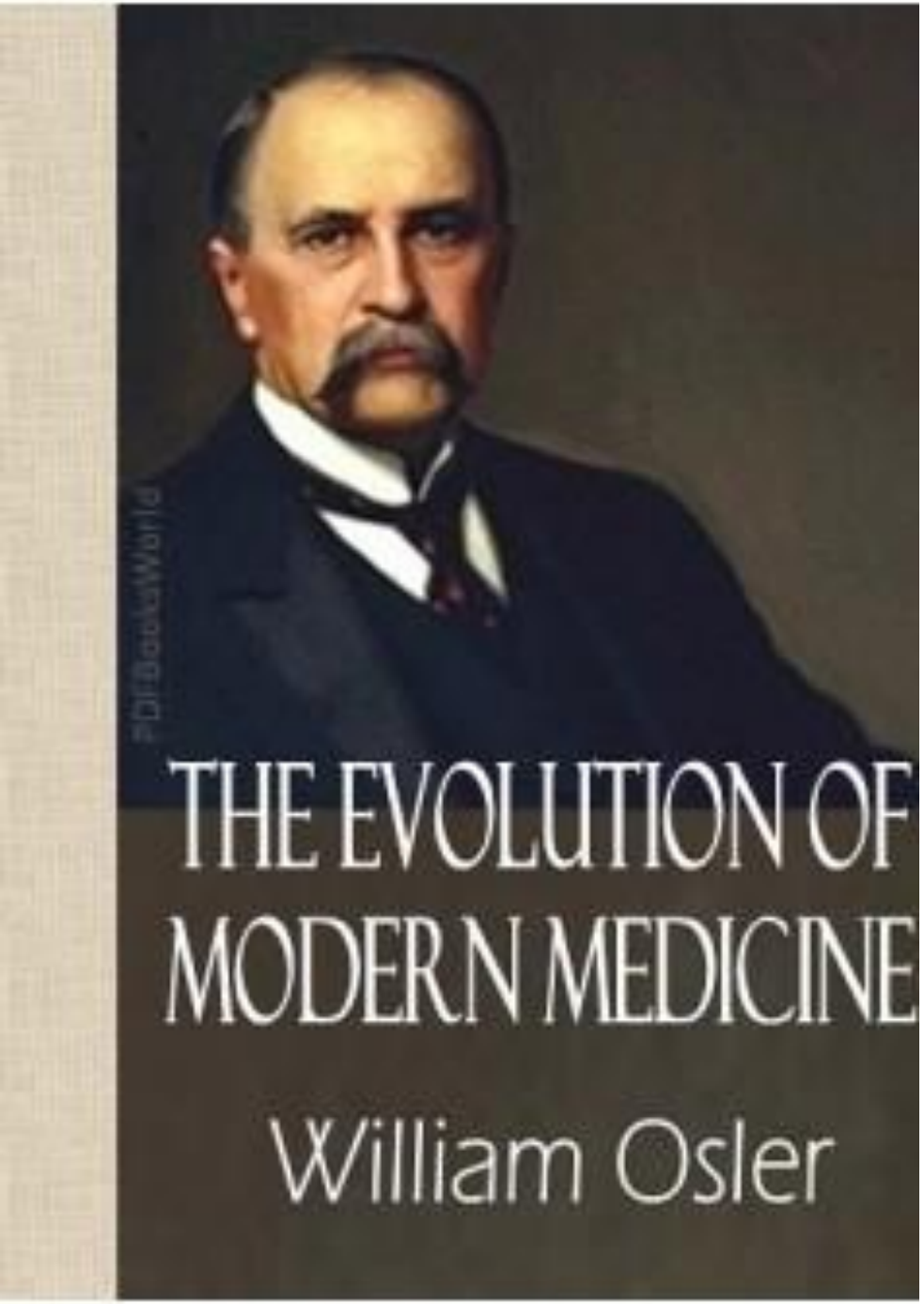
Septic Shock: Definition

Subset of sepsis patients with increased mortality (40%)

Profound underlying metabolic and circulatory derangements

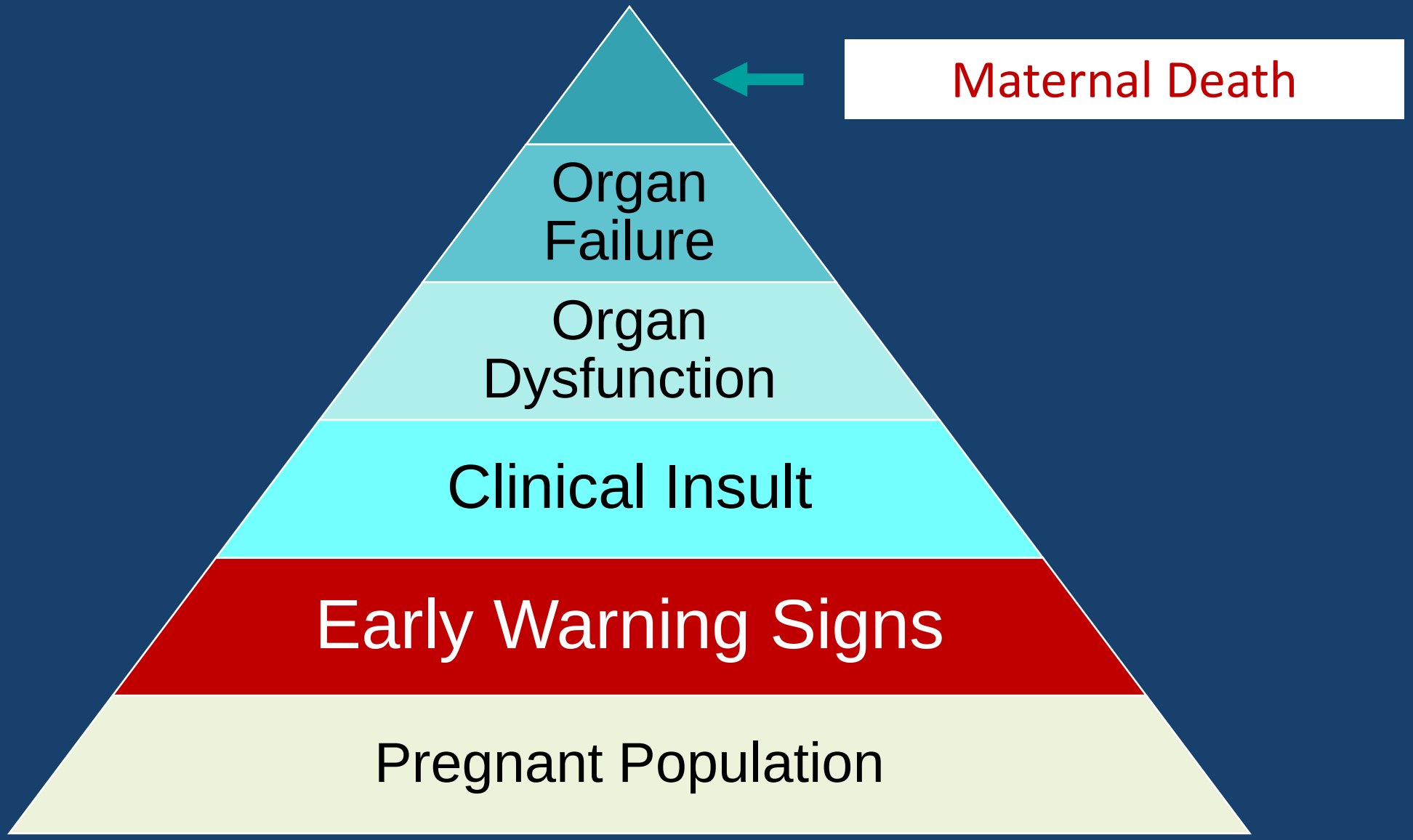
- Sepsis with persistent hypotension requiring vasopressors to maintain MAP > 65 mmHg
- Lactate level > 2 mmol/L despite adequate fluid resuscitation

Organ System	Clinical Features
Central nervous	Altered mental status
Cardiovascular	Hypotension from vasodilation and third spacing Myocardial dysfunction
Pulmonary	Noncardiogenic pulmonary edema ARDS
Gastrointestinal	Paralytic ileus
Hepatic	Elevated liver enzymes Failure
Urinary	Oliguria Acute kidney injury
Hematologic	Thrombocytopenia DIC
Endocrine	Dysfunction Increased insulin resistance



“Except on few occasions,
the patient appears to die from
the body's response to infection
rather than from it.”

Sepsis Specific Screening Tools


Maternal Death
Organ Failure
Organ Dysfunction
Clinical Insult
Early Warning Signs
Pregnant Population

Key Component: Screening for Organ Dysfunction

- Non-invasive assessment
- Screening Tools
  - Quick SOFA used outside of ICU
  - Tool for identifying patients at risk of sepsis with a higher risk of hospital death, prolonged ICU stay, or both

Should no longer be used as a single screening tool – not superior to NEWS, SIRS, MEWS criteria for sepsis screening

Sequential Organ Failure Assessment (SOFA) Score

Variable	0	1	2	3	4
paO_2/FiO_2	>400	301-400	201-300	101-200	≤100
Platelet count $10^3/\mu L$	>150	101-150	51-100	21-50	≤20
Serum bilirubin	<1.2	1.2-1.9	2-5.9	6-11.9	≥12
Hypotension	None	MAP <70mmHg	Dopamine <5μg/kg/min or dobutamine any dose	Dopamine >5μg/kg/min; epinephrine <0.1gμ/kg/min; norepinephrine ≤0.1μg/kg/min	Dopamine >15μg/kg/min; epinephrine >0.1gμ/kg/min; norepinephrine >0.1μg/kg/min
GCS	15	13-14	10-12	6-9	<6
Serum creatinine	<1.2	1.2-1.9	2-3.4	3.5-4.9	>5
Urine output	NA	NA	NA	<500 mL/24h	<200 mL/24h

JAMA. 2016;315(8):801-810. doi:10.1001/jama.2016.0287

Maternal Sepsis-Specific Tools

Roberts et al. Current Key Challenges in Managing Maternal Sepsis. *J Perinat Neonat Nurs 2021;* 35(2): 132–141

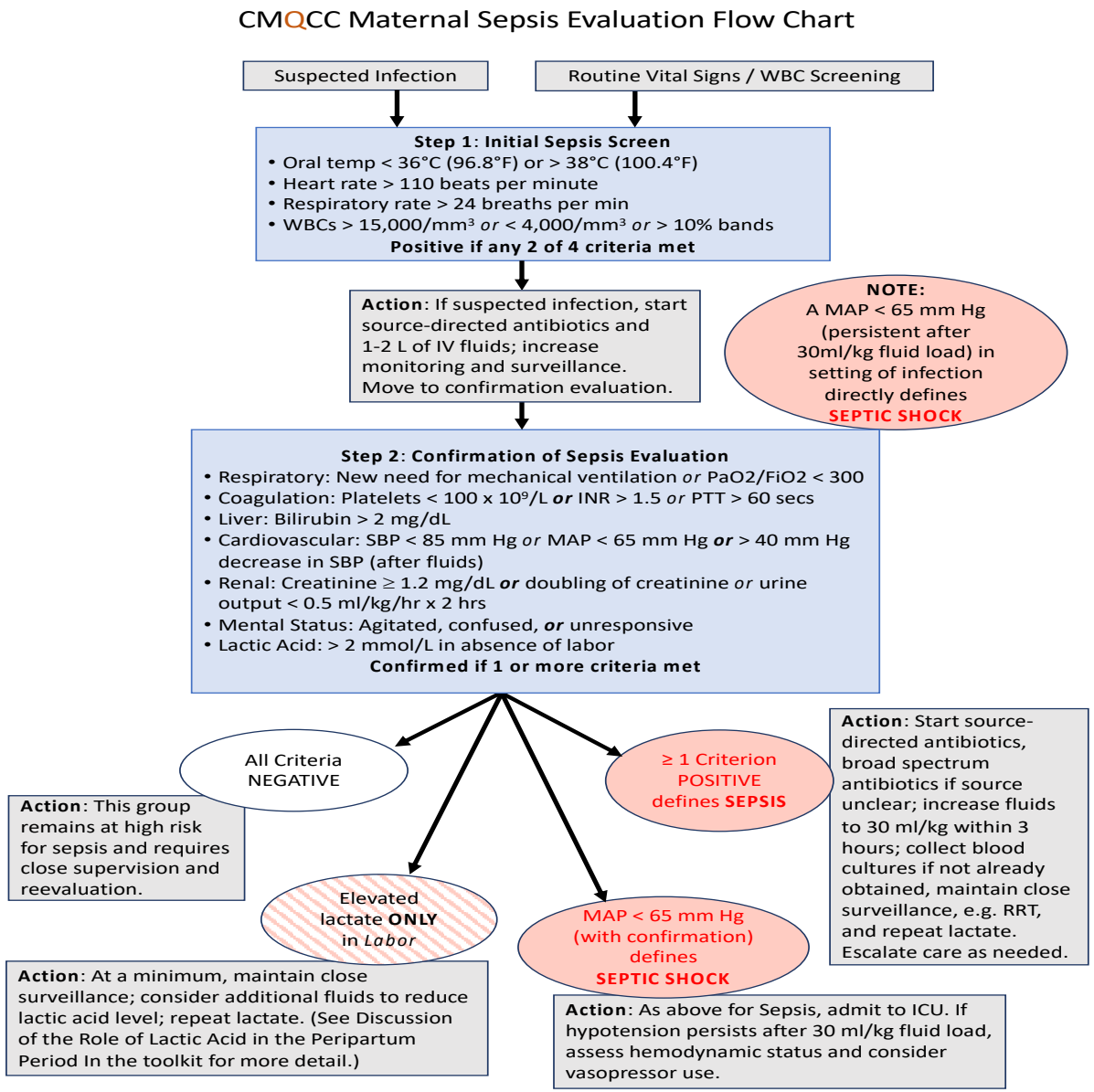
Maternal sepsis-specific tools			
Sepsis in Obstetrics Score (SOS) 2014[28]	Tool	Specific to suspected sepsis patients Includes larger variety of triggers compared with other tools Assigns score for abnormal triggers Score assigned predicts likelihood of ICU admission for sepsis	Prospectively validation of over 400 patients who screened positive Score ≥6 demonstrates increased risk for ICU admission: • AUC of 0.85 (95% CI, 0.76-0.95)[29]
CMQCC 2-Step Method for Sepsis Screening 2019[9]	Tool	Modified SIRS criteria for pregnancy using 2 SD from mean as range of normal 2-step process for sepsis screening Results of screening process suggest next actions	No peer-reviewed publications available. Only data available are extracted from clinical practice data sets, not formal research studies and published on the CMQCC Web site Data from over 14 000 patients: • 97% sensitive; 99% specific

Sepsis in Obstetric Score (SOS)

Temperature	Score	Respiratory Rate	Score	WBC	Score
< 30 C or < 86 F	4	≤ 5	4	< 1	4
30-31.9C or 86-89.4 F	3	6-9	2	1-2.9	2
32-33.9 C or 89.6-91.4 F	2	10-11	1	3-5.6	1
34-35.9 C or 93.2-96.6 F	1	12-24	0	5.7-16.9	0
36-38.4 C or 96.8-101.1F	0	25-34	1	17-24.9	1
38.5-38.9 C or 101.3-102 F	1	35-39	3	25-39.9	2
39-40.9 C or 102.2-105.6 F	3	> 49	4	> 39.9	4
> 40.9 C or > 105.6 F	4	SpO2	Score	% Immature Neutrophils	Score
Systolic BP	Score	< 85%	4		
< 70	4	85-89%	3	< 10%	0
70-90	2	90-91%	1	> 10%	2
> 90	0	≥ 92%	0	Lactic Acid	Score
Heart Rate	Score	SOS > 6 more likely to be admitted to ICU or telemetry unit, have positive blood cultures, fetal tachycarida, and longer hospital stays than those with SOS < 6		≤ 4	0
≤ 119	0			> 4	2
120-129	1			SOS combines elements of Rapid Emergency medicine Score, Acute Physiology and Chronic Health Evaluation II (APACHE II), and SIRS criteria from Surviving Sepsis Campaign	
130-149	2				
150-179	3				
> 179	4				

Source: Calculation of Sepsis Obstetrics Score - BETA TESTING. Perinatology.com and Albright CM, et al. The Sepsis in Obstetrics Score: A model to identify risk of morbidity from sepsis in pregnancy. *AJOG*, 2014; 211: 39.e1-6.

Sepsis Evaluation Flow Chart: CMQCC



Initial Sepsis Screen (Step 1)

Suspected Infection

Routine Vital Signs / WBC Screening

Step 1: Initial Sepsis Screen

- Oral temp < 36°C (96.8°F) or > 38°C (100.4°F)
- Heart rate > 110 beats per minute
- Respiratory rate > 24 breaths per min
- WBCs > 15,000/mm^3 *or* < 4,000/mm^3 *or* > 10% bands

Positive if any 2 of 4 criteria met

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

NOTE:
A MAP < 65 mm Hg (persistent after 30ml/kg fluid load) in setting of infection directly defines
SEPTIC SHOCK

Confirmation of Sepsis: Step 2

Tests to Evaluate End Organ Injury
Laboratory values
• CBC (including % immature neutrophils [bands], Platelets)
• Coagulation status (PT, INR, PTT)
• Comprehensive Metabolic Panel (specifically include bilirubin, creatinine)
• Venous Lactic Acid
Bedside assessment
• Urine output (place Foley catheter with urometer)
• Pulse oximetry
• Mental status assessment

Step 2: Criteria for End Organ Injury

Measure of End Organ Injury	Criteria Positive if one (1) or more criteria are met
Respiratory function*	• Acute respiratory failure as evidenced by acute need for invasive or non-invasive mechanical ventilation, OR • $PaO_2/FiO_2 < 300$
Coagulation status	• Platelets < 100 x 10^9/L, OR • International Normalized Ratio (INR) > 1.5, OR • Partial Thromboplastin Time (PTT) > 60 seconds
Liver function	• Bilirubin > 2 mg/dL

Cardiovascular function	• Persistent hypotension after fluid administration:
	  ○ SBP < 85 mm Hg, OR
	  ○ MAP < 65 mm Hg, OR
	  ○ > 40 mm Hg decrease in SBP

Renal function	• Creatinine > 1.2mg/dL, OR • Doubling of serum creatinine, OR • Urine output less 0.5 mL/kg/hour (for 2 hours)
Mental status assessment	• Agitation, confusion, or unresponsiveness
Lactic acid	• > 2 mmol/L in absence of labor (Lactic acid not used for diagnosis in labor, but remains important for treatment.)

Confirmation of Sepsis Evaluation Step 2

Step 2: Confirmation of Sepsis Evaluation

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

Confirmed if 1 or more criteria met

All Criteria NEGATIVE

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

Elevated lactate **ONLY** in *Labor*

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

≥ 1 Criterion POSITIVE defines **SEPSIS**

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

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

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

Sepsis Bundle

Sepsis and septic shock are medical emergencies, and we recommend that treatment and resuscitation begin immediately.

Best Practice Statement
2016 Surviving Sepsis Campaign

Critical Care Medicine

Society of Critical Care Medicine

Surviving Sepsis Campaign

International Guidelines for Management of Sepsis and Septic Shock 2021

Evans, Laura[1]; Rhodes, Andrew[2]; Alhazzani, Waleed[3]; Antonelli, Massimo[4]; Coopersmith, Craig M.[5]; French, Craig[6]; Machado, Flávia R.[7]; Mcintyre, Lauralyn[8]; Ostermann, Marlies[9]; Prescott, Hallie C.[10]; Schorr, Christa[11]; Simpson, Steven[12]; Wiersinga, W. Joost[13]; Alshamsi, Fayez[14]; Angus, Derek C.[15]; Arabi, Yaseen[16]; Azevedo, Luciano[17]; Beale, Richard[18]; Beilman, Gregory[19]; Belley-Cote, Emilie[20]; Burry, Lisa[21]; Cecconi, Maurizio[22]; Centofanti, John[23]; Coz Yataco, Angel[24]; De Waele, Jan[25]; Dellinger, R. Phillip[26]; Doi, Kent[27]; Du, Bin[28]; Estenssoro, Elisa[29]; Ferrer, Ricard[30]; Gomersall, Charles[31]; Hodgson, Carol[32]; Hylander Møller, Morten[33]; Iwashyna, Theodore[34]; Jacob, Shevin[35]; Kleinpell, Ruth[36]; Klompas, Michael[37]; Koh, Younsuck[38]; Kumar, Anand[39]; Kwizera, Arthur[40]; Lobo, Suzana[41]; Masur, Henry[42]; McGloughlin, Steven[43]; Mehta, Sangeeta[44]; Mehta, Yatin[45]; Mer, Mervyn[46]; Nunnally, Mark[47]; Oczkowski, Simon[48]; Osborn, Tiffany[49]; Papathanassoglou, Elizabeth[50]; Perner, Anders[51]; Puskarich, Michael[52]; Roberts, Jason[53]; Schweickert, William[54]; Seckel, Maureen[55]; Sevransky, Jonathan[56]; Sprung, Charles L.[57]; Welte, Tobias[58]; Zimmerman, Janice[59]; Levy, Mitchell[60]

Online only Oct 4, 2021

Sepsis: Hour-1 Bundle

1. Lactate level
2. Cultures
3. Antibiotics
4. IV Fluid
5. Vasopressors

Surviving Sepsis, 2021

Sepsis Hour-1 Bundle: Lactate

- Normal Lactate Level: 1 – 2 mmol/dL
- If Lactate 2 – 4: Diminished perfusion of oxygen to cells
- If Lactate > 4 : Lactic acidemia

Increased production combined with decreased utilization leads to lactic acidemia/acidosis

Increased production during labor

Remeasure if > 2 mmol/L

Sepsis Hour-1 Bundle: Cultures

- 2 Blood Cultures (minimum)
  - 1 percutaneous
  - 1 from each vascular access ≥ 48 hrs
  - Aerobic and Anaerobic
- Urine Culture/Urinalysis
- Sputum Culture
- Wound Cultures

Each hour delay in starting antibiotics increases mortality by 5-7%

Sepsis Hour-1 Bundle: Broad Spectrum Antibiotics

Ampicillin and Gentamycin cover ~90% of organisms that cause maternal sepsis

Bauer, ME et al. Anesthesia & Analgesia 2013;117(4):944-50

Sepsis: Sources of Infection

Variables	Antepartum	Postpartum
Obstetric	Septic abortion	Endometritis
	Chorioamnionitis	Wound infection
Non-obstetric	UTI	UTI
	Pneumonia	Pneumonia
	Appendicitis	GI

Society for Maternal-Fetal Medicine. Sepsis during pregnancy and the puerperium. Am J Obstet Gynecol 2019.

Sepsis Hour-1 Bundle: IV Fluids

- Start rapid administration of 30 mL/kg crystalloid for hypotension or if lactate ≥ 4 mmol/L

Sepsis Hour-1 Bundle: Vasopressors

- Vasopressors if patient is hypotensive during or after fluid resuscitation
  - Norepinephrine recommended
  - **Maintain MAP ≥ 65 mmHg**
  - **Admit to ICU**
  - **Central line**
  - **Arterial line**

Cardiac Disease

Cardiac Disease

Congenital

- Most common birth defect (1% of all births in US)
- Examples: VSD, ASD, tetralogy of Fallot, hypoplastic left heart syndrome

Acquired

- Examples: mitral or aortic stenosis due to rheumatic heart disease
- Cardiomyopathy
- Arrhythmias
- Myocardial infarction

Cardiac Disease: Data

How did women who died present?

Symptoms

- Shortness of breath
- Wheezing
- Palpitations
- Edema
- Chest pain
- Dizziness
- Extreme fatigue

Abnormal Exam

- BP > 140/90 (64%)
- Tachycardia > 120 bpm (59%)
- Crackles, S3 or gallop (44%)
- Hypoxemia SpO_2 < 90% (39%)

Hameed et al. AJOG 2015;213

Predicting Pregnancy Risk

New York Heart Association Classification

Grade	Symptoms
Grade I	Patients have no limitations of physical exercise, ordinary activity does not cause undue fatigue, palpitations, dyspnea or angina.
Grade II	Patients have slight limitations of physical exercise, ordinary activity results in fatigue, palpitations, dyspnea or angina.
Grade III	Patients have marked limitations of physical activity, less than ordinary activity causes symptoms
Grade IV	Patients have an inability to carry on physical activity, without symptoms

WHO Risk Class I

Pregnancy Risk by Medical Condition
No detectable increased risk of maternal mortality No/mild increase in morbidity
Management: Cardiology evaluation once or twice during pregnancy
Examples: Uncomplicated pulmonary stenosis, PDA, mitral valve prolapse Successfully repaired simple lesions (ASD, VSD, PDA) Atrial or ventricular ectopic beats

WHO Risk Class II

Pregnancy Risk by Medical Condition
Small increased risk of maternal mortality or moderate increase in morbidity
Low-moderate Risk Cardiology evaluation every trimester
Examples: Unoperated atrial or ventricular septal defect Repaired tetralogy of Fallot Most arrhythmias

WHO: Risk Class II-III

Pregnancy Risk by Medical Condition
Mild left ventricular impairment
Management: Varies by patient
Examples: Hypertrophic cardiomyopathy Native or tissue valvular heart disease not considered WHO I or IV Marfan syndrome without aortic dilatation Aorta <45 mm in aortic disease associated with bicuspid aortic valve Repaired coarctation

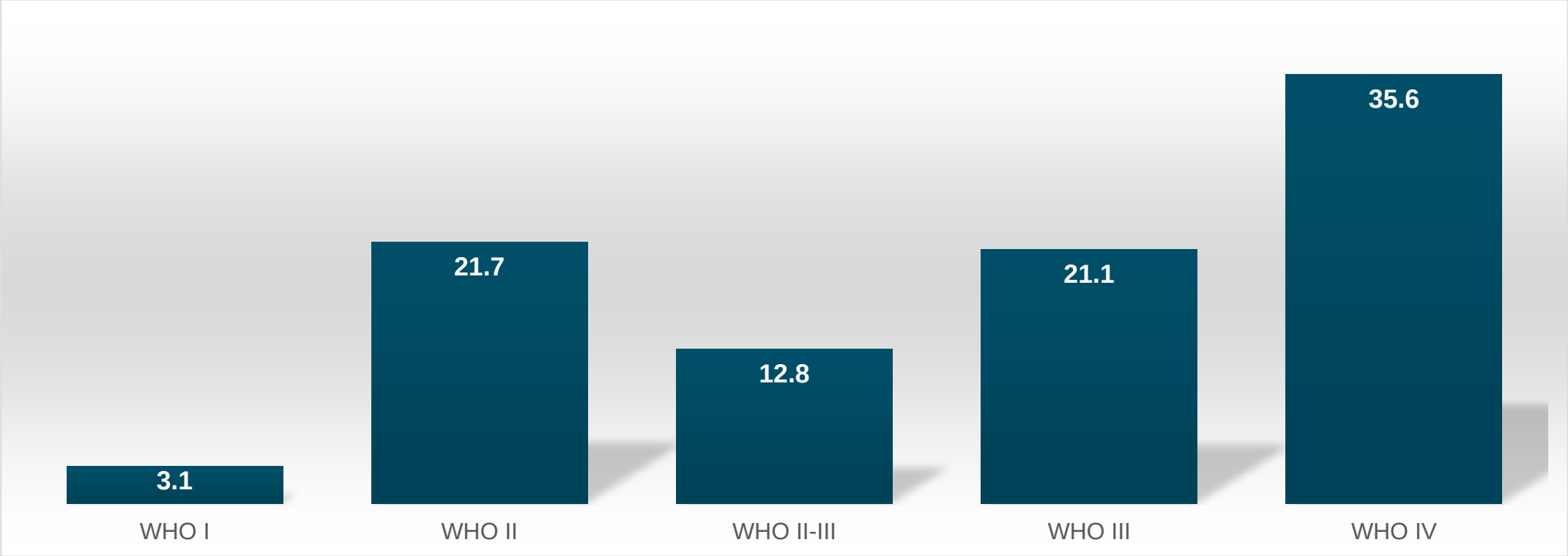
WHO Risk Class III

Pregnancy Risk by Medical Condition
Significantly increased risk of maternal mortality or severe morbidity. Expert counselling required. If pregnancy is decided upon, intensive specialist cardiac and obstetric monitoring needed throughout pregnancy, childbirth and the puerperium.
High Risk: Cardiology evaluation q 2-4 weeks
Mechanical valve, Systemic right ventricle, Fontan circulation, Cyanotic heart disease (unrepaired) Other complex congenital heart disease: Aortic dilatation 40-45 mm in Marfan syndrome. Aortic dilatation 45-50 mm in aortic disease associated with bicuspid aortic valve

WHO Risk Class IV

Pregnancy Risk by Medical Condition
Extremely high risk of maternal mortality or severe morbidity; pregnancy contraindicated. If pregnancy occurs termination should be discussed. If pregnancy continues, care as for class III.
ADVISED AGAINST PREGNANCY Discuss Pregnancy termination
Pulmonary arterial hypertension – any cause, Severe systemic ventricular dysfunction (LVEF <30%, NYHA III-IV), History of PPCM with any residual LV dysfunction, Severe mitral stenosis, severe symptomatic aortic stenosis, Aortic dilatation >45 mm in Marfan syndrome, Aortic dilatation >50 mm in aortic disease associated with bicuspid aortic valve, Native severe coarctation, Vascular Ehlers Danlos

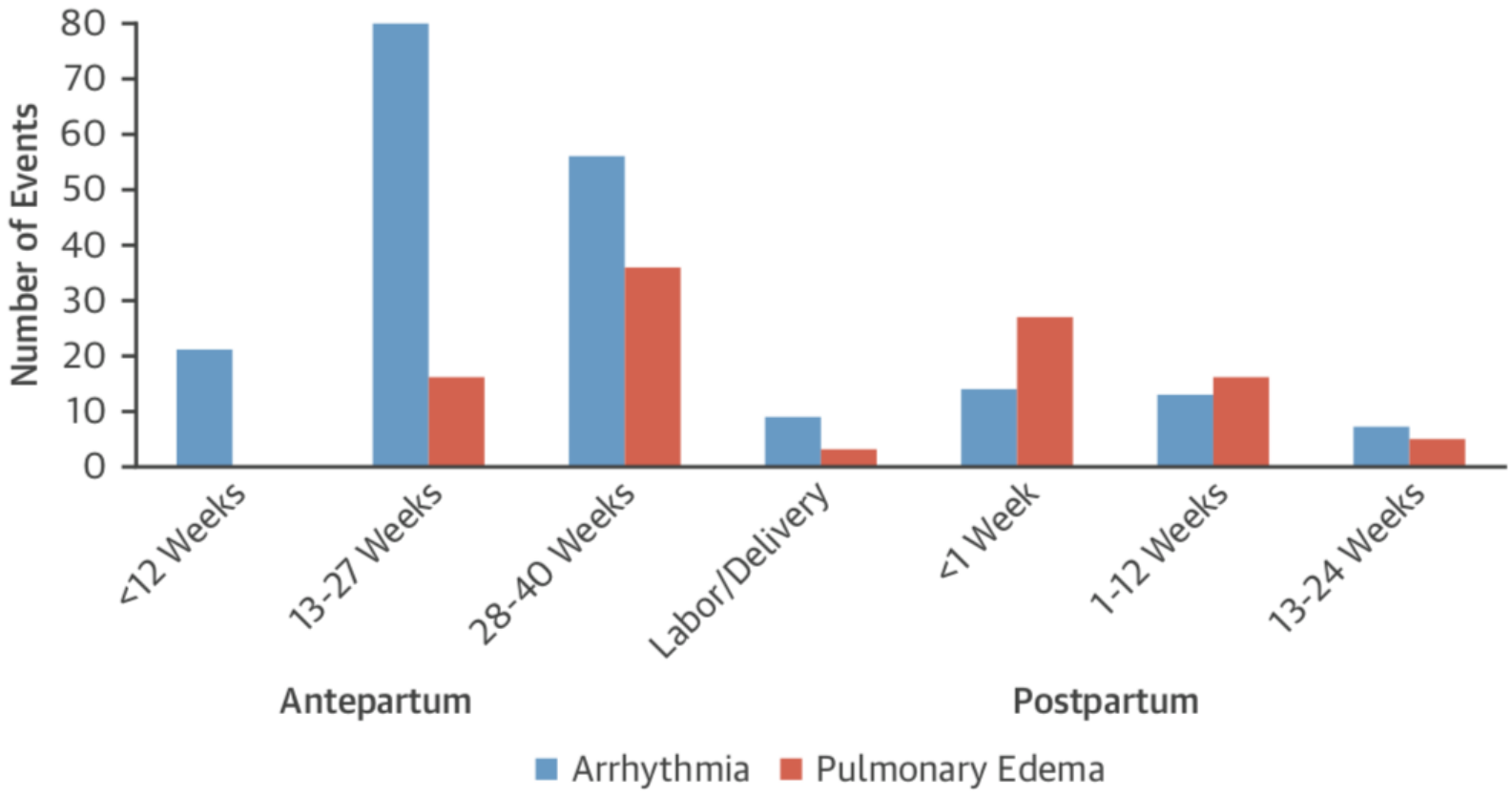
Overall Maternal Cardiac Event Rate in Pregnancy by WHO Class



Silversides et al. Outcomes of Pregnancy in Women With Heart Disease JACC 2018.71(21):2419–30

Cardiac Disease: Timing of Complications

FIGURE 1 Timing of Complications in Women Who Develop Arrhythmias or Congestive HF During Pregnancy



Silversides et al. Outcomes of Pregnancy in Women With Heart Disease JACC 2018. 71(21):2419–30

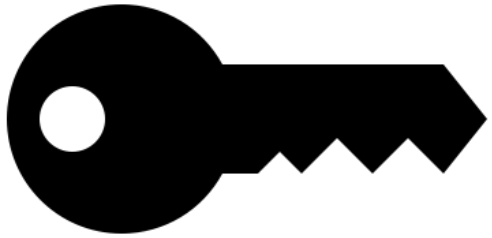
Cardiac Disease: Predictors of Neonatal Event

- ✓ Baseline NYHA Class > II
- ✓ Maternal left heart obstruction
- ✓ Maternal Cardiac event during pregnancy
- ✓ Maternal decline in CO during pregnancy
- ✓ Smoking
- ✓ Multiple gestation
- ✓ Use of oral anticoagulants during pregnancy
- ✓ Cardiac medications before pregnancy
- ✓ Mechanical valve prosthesis
- ✓ O2sat < 90%

Risk of Fetal Cardiac Abnormality

Lesion	Risk if Mother is Affected (%)
Tetralogy of Fallot	2 – 4.5
Aortic Coarctation	4 – 14.1
Atrial Septal Defect	4.6 - 11
Ventricular Septal Defect	6 – 15.6
Pulmonary Stenosis	5.3 – 6.5
Aortic Stenosis	8 – 17.9
Persistent Ductus Arteriosus	4.1
Marfan Syndrome	50

Key Management Principles



The American College of
Obstetricians and Gynecologists
WOMEN'S HEALTH CARE PHYSICIANS

ACOG PRACTICE BULLETIN

Clinical Management Guidelines for Obstetrician–Gynecologists

NUMBER 212

Presidential Task Force on Pregnancy and Heart Disease
Committee on Practice Bulletins—Obstetrics. This Practice Bulletin was developed by the American College of Obstetricians and Gynecologists' Committee on Practice Bulletins–Obstetrics in collaboration with the Presidential Task Force on Pregnancy and Heart Disease members Lisa M. Hollier, MD, James N. Martin Jr., MD, Heidi Connolly, MD, Mark Turrentine, MD, Afshan Hameed, MD, Katherine W. Arendt, MD, Octavia Cannon, DO, Lastascia Coleman, ARNP, CNM, Uri Elkayam, MD, Anthony Gregg, MD, MBA, Alison Haddock, MD, Stacy M. Higgins, MD, FACP, Sue Kendig, JD, Robyn Liu, MD, MPH, FAAFP, Stephanie R. Martin, DO, Dennis McNamara, MD, Wanda Nicholson, MD, Patrick S. Ramsey, MD, MSPH, Laura Riley, MD, Elizabeth Rochin, PhD, RN, NE-BC, Stacey E. Rosen, MD, Rachel G. Sinkey, MD, Graeme Smith, MD, PhD, Calondra Tibbs, MPH, Eleni Z. Tsigas, Rachel Villanueva, MD, Janet Wei, MD, and Carolyn Zelop, MD.

Pregnancy and Heart Disease

Pregnancy Heart Team

	Modified WHO Pregnancy Risk Classification I	Modified WHO Pregnancy Risk Classification II	Modified WHO Pregnancy Risk Classifications III and IV
Pregnancy Heart Team Members	Obstetrician, family medicine practitioner, internist Cardiologist consultation	Obstetrician, family medicine practitioner, internist Maternal–fetal medicine subspecialist Cardiologist consultation	Obstetrician, family medicine practitioner, maternal–fetal medicine subspecialist, internist, obstetric anesthesiologist, cardiology subspecialists in adult congenital/aortopathy*, heart rhythm*, heart failure*, pulmonary hypertension*, and cardiac imaging* Interventional cardiologist* Cardiac surgeon* Neonatologist* Geneticist* Mental health specialist* Pharmacist*

Routine Care Reassurance

History of CVD	None	**Vital signs**	Normal
Self-reported symptoms	None or mild	HR (beats per minute)	<90
Shortness of breath	No interference with activities of daily living; with heavy exertion only	Systolic BP (mm Hg)	120–139
		RR (per minute)	12–15
Chest pain	Reflux related that resolves with treatment	Oxygen saturation	>97%
Palpitations	Few seconds, self-limited	**Physical examination**	Normal
		JVP	Not visible
Syncope	Dizziness only with prolonged standing or dehydration	Heart	S3, barely audible soft systolic murmur
		Lungs	Clear
Fatigue	Mild	Edema	Mild

ACOG, 2019

Caution
Non-Emergent Evaluation

History of CVD	None
Self-reported symptoms	Yes
Shortness of breath	With moderate exertion, new-onset asthma, persistent cough, or moderate or severe OSA[§]
Chest pain	Atypical
Palpitations	Brief, self-limited episodes; no lightheadedness or syncope
Syncope	Vasovagal
Fatigue	Mild or moderate

Vital signs	
HR (beats per minute)	90–119
Systolic BP (mm Hg)	140–159
RR (per minute)	16–25
Oxygen saturation	95–97%
Physical examination	
JVP	Not visible
Heart	S3, systolic murmur
Lungs	Clear
Edema	Moderate

ACOG, 2019

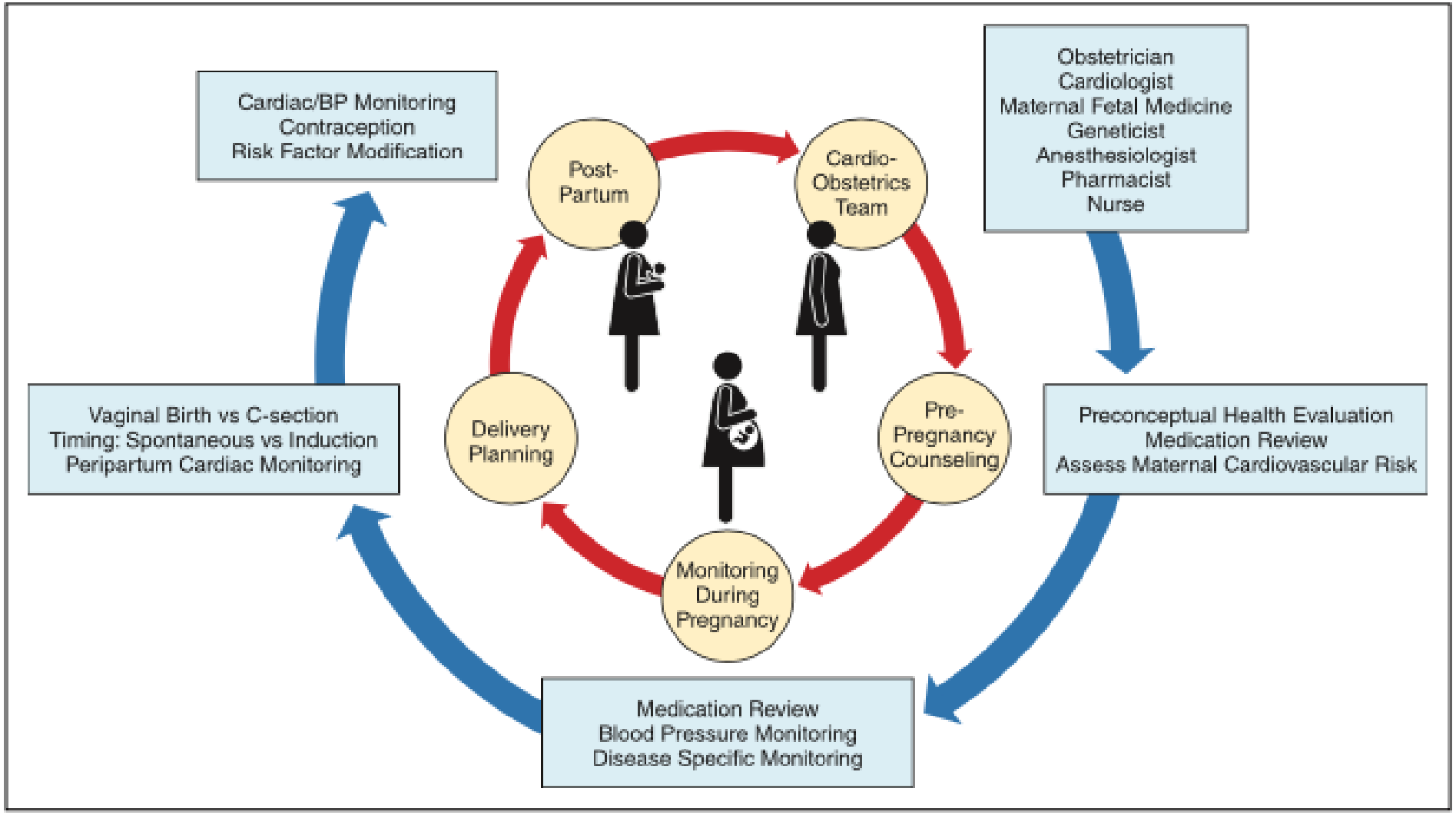
STOP
Prompt Evaluation
Pregnancy Heart Team

History of CVD	Yes
Self-reported symptoms	Yes
Shortness of breath	At rest; paroxysmal nocturnal dyspnea or orthopnea; bilateral chest infiltrates on CXR or refractory pneumonia
Chest pain	At rest or with minimal exertion
Palpitations	Associated with near syncope
Syncope	Exertional or unprovoked
Fatigue	Extreme

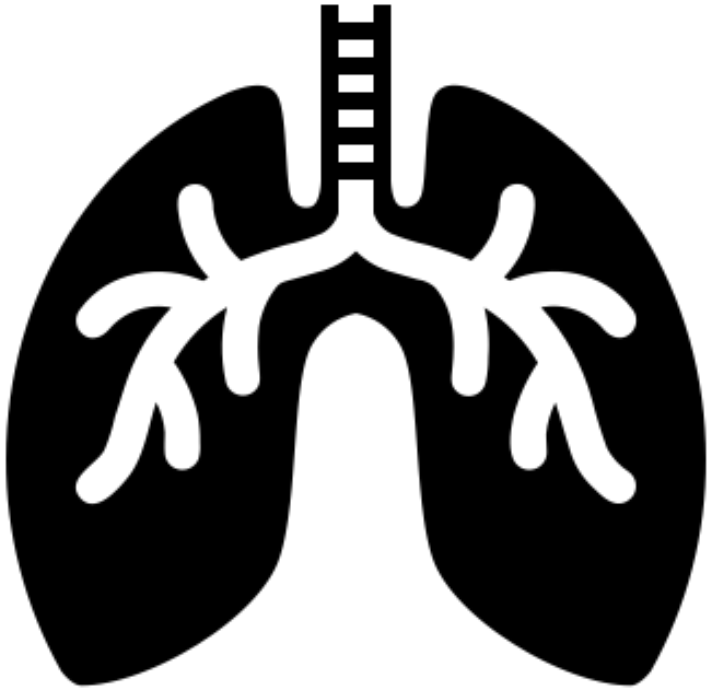
Vital signs	
HR (beats per minute)	≥120
Systolic BP (mm Hg)	≥160 (or symptomatic low BP)
RR (per minute)	≥25
Oxygen saturation	<95% (unless chronic)
Physical examination	
JVP	Visible >2 cm above clavicle
Heart	Loud systolic murmur, diastolic murmur, S4
Lungs	Wheezing, crackles, effusion
Edema	Marked

ACOG, 2019

Cardio-Obstetrics Team



AHA Scientific Statement (2020): Cardiovascular considerations in caring for pregnant patients.



Pulmonary edema

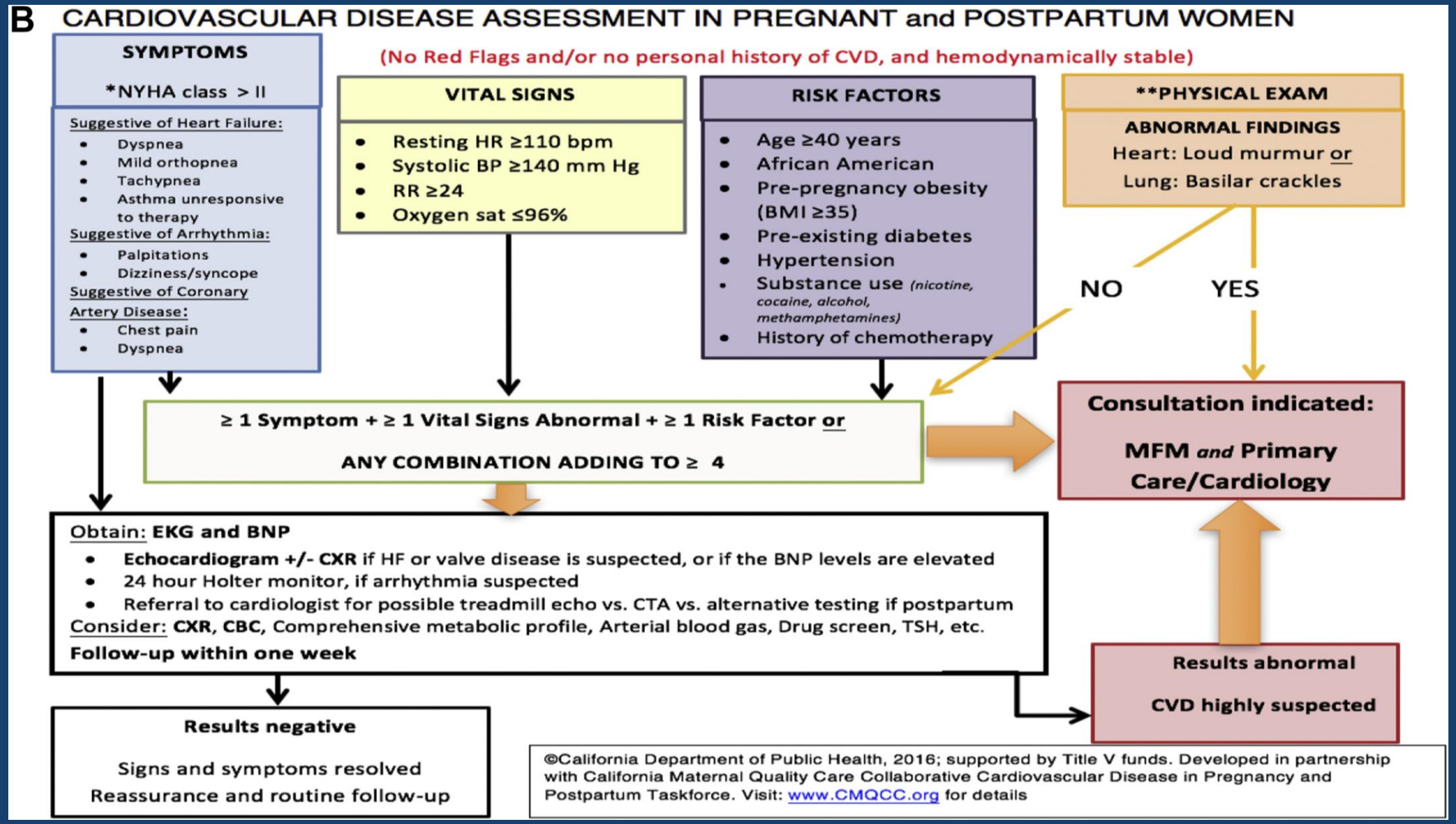
Arrhythmias

General Management: Postpartum

- Period of greatest risk and mortality
  - Both immediate and delayed
- “Elevated level of care” or prolonged period of monitoring may be necessary
  - Especially if risk for cardiogenic pulmonary edema and arrhythmias
  - If concurrent obstetric or surgical complications
    - Hemorrhage, preeclampsia, infection
- Careful and frequent monitoring for signs and symptoms of cardiovascular disease

General Management: Postpartum

- Symptoms related to physiologic changes of pregnancy should be improving in the postpartum period
- Visits to Emergency Department for dyspnea should raise suspicion for cardiovascular disease
- Postpartum dyspnea or new-onset cough is concerning for cardiovascular disease



American Journal of Obstetrics & Gynecology 2019 220, 167.e1-167.e8DOI: (10.1016/j.ajog.2018.09.035)

A

Red Flags

- Shortness of breath at rest
- Severe orthopnea ≥ 4 pillows
- Resting HR ≥120 bpm
- Resting systolic BP ≥160 mm Hg
- Resting RR ≥30
- Oxygen saturations ≤94% with or without personal history of CVD

PROMPT EVALUATION and/or hospitalization for acute symptoms
plus
CONSULTATIONS with MFM and Primary Care/Cardiology

Personal History of CVD Without Red Flags

CONSULTATIONS with MFM and Primary Care/Cardiology

2018 ESC Guidelines for the management of cardiovascular diseases during pregnancy

ESC
European Society of Cardiology

The Task Force for the Management of Cardiovascular Diseases during Pregnancy of the European Society of Cardiology (ESC).

Endorsed by: the International Society of Gender medicine (IGM), the German Institute of Gender in Medicine (DGesGM), the European Society of Anaesthesiology (ESA), and the European Society of Gynecology (ESG).

Authors/Task Force Members: Vera Regitz-Zagrosek (Chairperson) (Germany), Jolien W. Roos-Hesselink (Co-Chairperson) (The Netherlands), Johann Bauersachs (Germany), Carina Blomström-Lundqvist (Sweden), Renata Cífková (Czech Republic), Michele De Bonis (Italy), Bernard Iung (France), Mark R. Johnson (UK), Ulrich Kintscher (Germany), Peter Kranke (Germany), Irene Marthe Lang (Austria), Joao Morais (Portugal), Petronella G. Pieper (The Netherlands), Patrizia Presbitero (Italy), Susanna Price (UK), Giuseppe M. C. Rosano (UK/Italy), Ute Seeland (Germany), Tommaso Simoncini (Italy), Lorna Swan (UK), Carole A. Warnes (USA).

2018 ESC Guidelines for the management of cardiovascular diseases during pregnancy
European Heart Journal (2018) 00, 1–83- doi:10.1093/eurheartj/ehy 340

Peripartum Cardiomyopathy (PPCM)

90% cases occur 1st 2 months postpartum

High rate of recurrence in subsequent pregnancies

Peripartum Cardiomyopathy: Presentation

- Edema
- Dysrhythmia
- C/o palpitations
- S3 or S4 heart sounds or unusual heart sounds
- SOB, crackles, respiratory distress
- Fatigue
- Cough

Abnormal vital signs

BP ↑
HR ↑
RR ↑
SpO2 ↓

Peripartum Cardiomyopathy: Diagnostic Criteria

Classic	Additional

• Development of heart failure w/in the last month of gestation or 5 months postpartum
• Absence of an identifiable cause for heart failure
• Absence of recognizable cardiac disease before pregnancy
	• Left ventricular systolic dysfunction
	  • Ejection fraction <45%
	  • Shortening fraction <30%
	  • LV end-diastolic volume > 2.5 cm/m^2

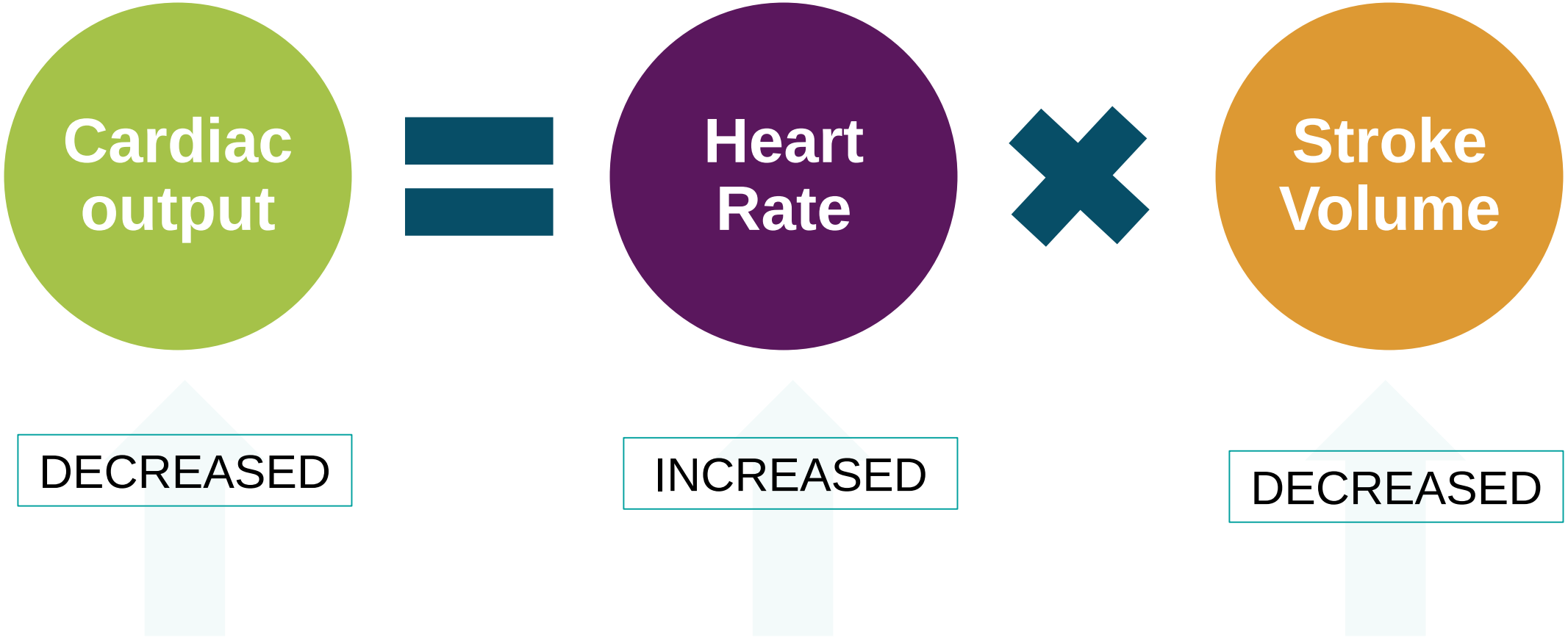
Peripartum Cardiomyopathy: Diagnosis and Management

1. Echocardiogram
2. Brain natriuretic peptide
3. Chest x-ray
4. EKG

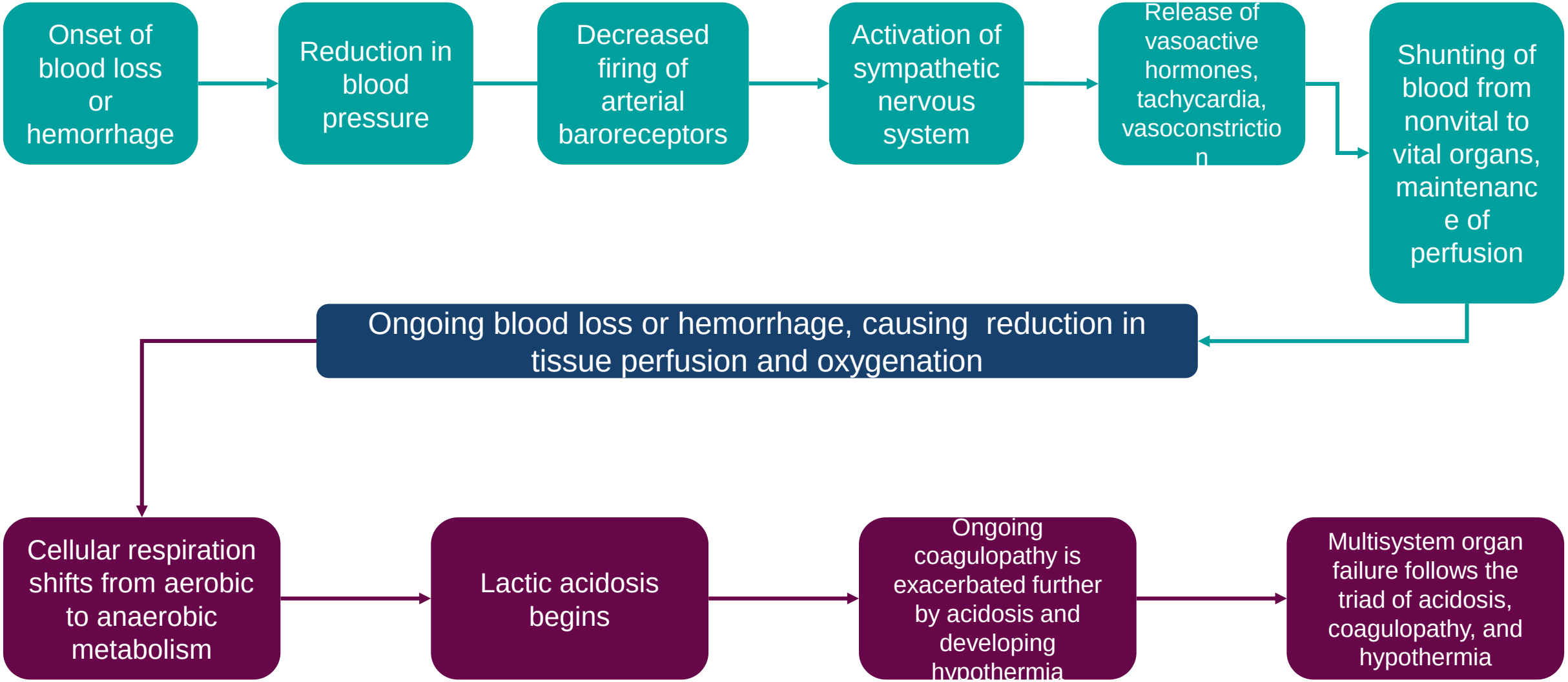
- Afterload reduction
- Diuretics
- Rhythm control
- Inotrope
- Contraception

Postpartum Hemorrhage

Hemorrhage: Pathophysiology



Hemorrhage: Pathophysiology



Advanced Trauma Life Support Classification

	Class I	Class II	Class III	Class IV
Blood loss (mL)	≤750 mL	750-1500 mL	1500-2000 mL	≥ 2000 mL
Blood loss (% of blood volume)	≤ 15%	15-30%	30-40%	≥ 40%
Pulse rate(bpm)	≤ 100	> 100	> 120	≥ 140
Blood pressure	Normal	Normal	Decreased	Decreased
Pulse pressure	Normal	Decreased	Decreased	Decreased
Capillary refill	Normal	Positive	Positive	Positive
Respiratory rate	14-20	20-30	30-40	>35
Urine output (mL/hr)	≥30	20-30	5-15	Negligible

Adapted from the American College of Surgeons.

Postpartum Hemorrhage Etiologies

Postpartum Hemorrhage: Data

Affects 4-6% of births in U.S.

140,000 women die of PPH each year

1 death every 4 minutes

45% of serious maternal morbidity is associated with PPH

Postpartum Hemorrhage: Definitions

Primary

- 1-5% of all births
- Cumulative blood loss of > 1000 mL or blood loss accompanied by signs and symptoms of hypovolemia within 24 hours of the birth
- 500 – 1000 mL trigger increased surveillance

Secondary or Delayed

- 0.2-2% of all births
- Excessive vaginal bleeding between 24 hours and 12 weeks postpartum
- Peak incidence in first or second week postpartum

Etiologies: Primary Postpartum Hemorrhage

Uterine Atony ★

Genital Tract Trauma

Retained Placenta

Uterine Inversion

Uterine Atony: Predisposing factors

- Enlargement of the uterus
  - Multifetal gestation
  - Polyhydramnios
  - LGA fetus
- Labor induction or augmentation
- Labor dystocia

- Conditions that interfere with uterine contraction
  - Chorioamnionitis
  - Uterine relaxing agents
    - Terbutaline
    - Magnesium sulfate

Secondary/Delayed Postpartum Hemorrhage

- Retained placenta or fetal tissue
- Infection

- Subinvolution of placental site
  - Inadequate physiologic closure and sloughing of the modified spiral arteries at placental site

Secondary/Delayed Postpartum Hemorrhage: History

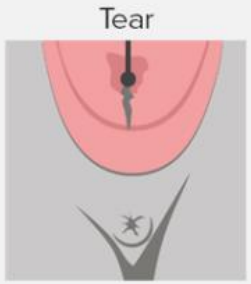
Severity of bleeding

- QBL at birth
- Pattern of bleeding since birth
- Previous interventions

Predisposing factors

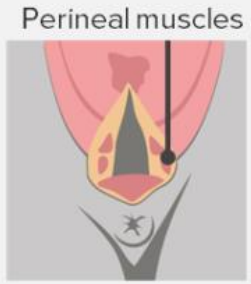
- Placental abnormalities
- Abruption
- Rapid birth
- Fetal demise
- Preeclampsia
- Smoking
- Infection

Genital Tract Trauma



1st-degree

Injury to the vaginal epithelium and vulva skin only

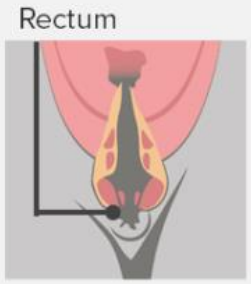


2nd-degree

Injury to the perineal muscles but not the anal sphincter

3rd-degree

Injury to the perineum involving the anal sphincter complex



4th-degree

Injury to the perineum involving the anal sphincter complex and anal/rectal mucosa

Risks
- Operative vaginal birth
- Precipitous birth

- Episiotomy
- Lacerations
  - Cervical
  - Vaginal
  - Perineal
- Uterine Rupture

Genital Tract Trauma: Hematoma

Retained Placenta

- Risk Factors
  - Succenturiate lobe
  - Manual removal
  - Previous uterine surgery
  - Incomplete placenta delivery at birth
- Detailed examination of placenta at all births

Suspicion: Possibility of Placenta Accreta Spectrum

UTERINE INVERSION

Collapse of fundus into uterine cavity

- **Incomplete:** Fundus inverts; does not herniate through cervix
- **Complete:** Internal lining of fundus comes through cervix; fundus not palpable
- **Prolapsed:** Entire uterus prolapses through cervix with fundus through the introitus

Uterine Inversion

- 1 in 2,000-23,000 births
- Incidence decreased 4-fold with introduction of active management of 3rd stage of labor

Etiology

- Fundal placental implantation
- Inadequate contractions
- Cord traction before separation
- Placenta Accreta Spectrum Disorder

Assessment

- Loss of palpable fundus
- Sudden onset of hemorrhage
- Hemodynamic instability - Shock

Hemorrhage Management

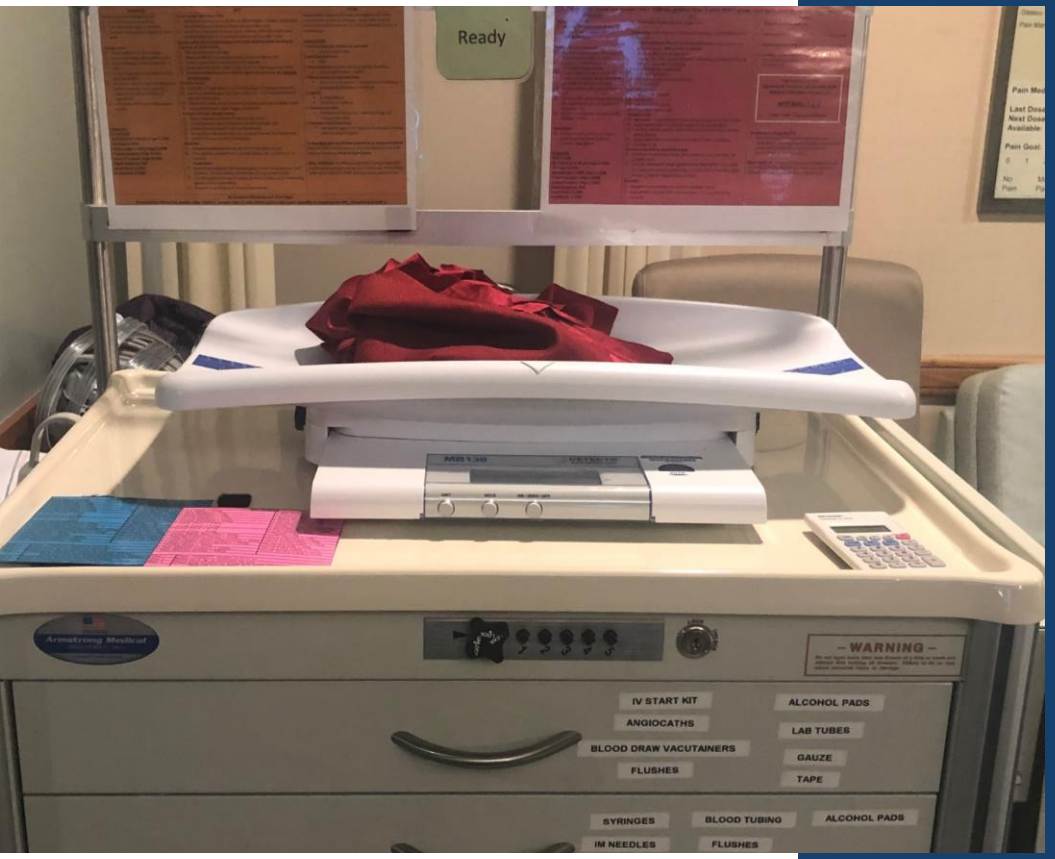
Hemorrhage: Management

Unit-standard, Stage-based OB Hemorrhage Emergency Management Plan

Checklists

Interprofessional Practice

HEMORRHAGE: GENERAL MANAGEMENT



Quantified Blood Loss

- Use graduated collection containers
- Account for other fluids
- Weigh all products
  - Wet weight– Dry weight
  - 1 gram = 1 mL
- Cumulative

Hemorrhage: General Management

Non-Invasive Hemodynamic Monitoring

- Frequent assessments
- Continuous SpO_2

Indwelling Urinary Catheter Placement

- Strict I/O's

IV Access

- 2nd IV line
- 16 or 18 gauge

Communication

- Get team to bedside

Hemorrhage: Uterine Atony Management

- **Assessment**
  - Empty bladder, insert indwelling catheter
  - Examine placenta
- **Medications**
  - Uterotonics
  - Tranexamic Acid
- **Uterine Massage and Tamponade**
  - Bimanual compression
  - Tamponade Balloon
  - Intrauterine vacuum
- **Examination**
  - Lower genital tract lacerations
  - Uterine exploration, uterine inversion, rupture, retained products
- **Interventions**
  - D&C
  - Compression Sutures
  - Hysterectomy

Hemorrhage: Uterine Atony Management

Drug	Dose and Route	Frequency	Contraindications
Oxytocin	IV: 10-40 units per 500-1000 mL IM: 10 units	Continuous	Rare, hypersensitivity to medication
Methylergonovine	IM: 0.2 mg	Every 2-4 hours	Hypertension, preeclampsia, cardiovascular disease
15-methyl $PGF_{2\alpha}$	IM: 0.25 mg	Every 15-90 min; 8 doses max	Asthma; relative contraindication for hypertension, active hepatic, pulmonary, or cardiac disease
Misoprostil	600-1000 mcg	One time	Hypersensitivity to

Hemorrhage: Uterine Atony Management

- Tranexamic Acid 1 gram IV
- 2nd dose after 30 minutes if bleeding continues

Tranexamic acid v. Misoprostol for management of postpartum hemorrhage: A systemic review and meta-analysis of randomized controlled trials
Conclusion: no significant antihemorrhagic efficacy between adjunct TXA and misoprostol for management of postpartum hemorrhage. The safety profile was comparable between both agents.

Abu-Zaid, A, Baradwan, S, Albouq, B, Ghazi, A, Khodaward, K, et al (2023).

Hemorrhage: Uterine Atony Management

Tamponade balloon

Outward pressure on uterus

12–24-hour placement

75-87% effective

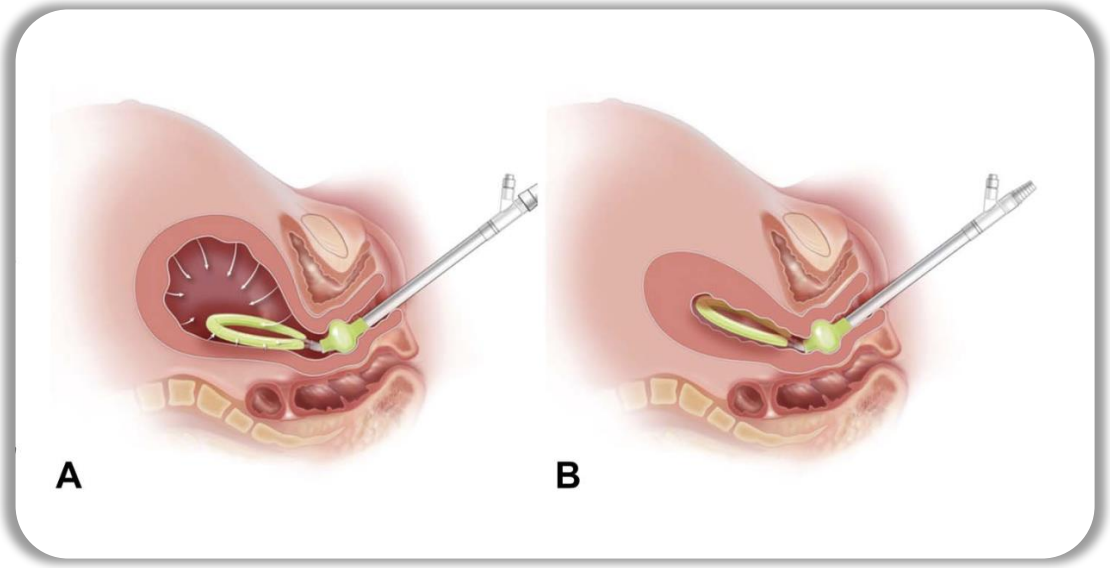
Potential complications 6.5%

- Cervical tears
- Vaginal laceration
- Acute colonic pseudo-obstruction
- Uterine incision rupture
- Uterine perforation
- Infection

Hemorrhage: Uterine Atony Management

Intrauterine vacuum

- Continuous low pressure (80 ± 10 mmHg) simulates force of uterine contraction, constriction of myometrial blood vessels
- Remains in place for at least 1 hour following control of hemorrhage
- 94% effective
- Potential Complications



https://www.thejadasystem.com

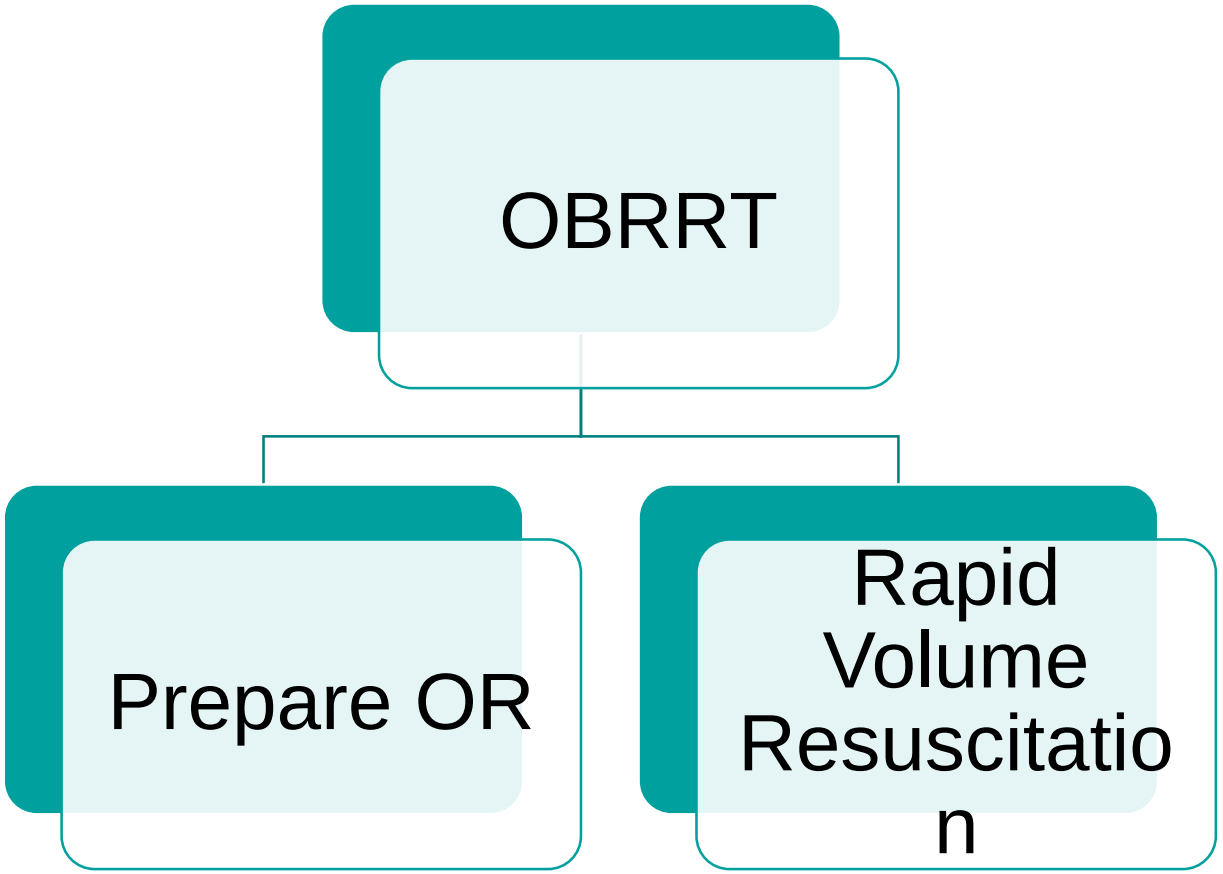
Uterine Artery Embolization

- Candidates
  - Hemodynamically stable
  - Appear to have slow, persistent bleeding
  - Failed less invasive therapy
- Success 58-98%
- Risks
  - Uterine necrosis
  - DVT
  - Peripheral neuropathy

Hemorrhage: Peripartum Hysterectomy

Complications	Percentage
Death	0.5-6%
ICU admission	20.1-84%
Reoperation	11.6-33.3%
Mechanical Ventilation	7-13%
Cystotomy	6-28%
Blood Transfusion	83%
DON’T DELAY	

Hemorrhage: Uterine Inversion



Placenta still attached

- Uterine relaxation
  - Halogenated inhalation agent
  - Magnesium sulfate
  - Beta-mimetic
  - Nitroglycerine

Placenta removed

- Uterine replacement
- Uterotonics

Hemorrhage: Management

System	Lab	Notes
Hematologic	Fibrinogen	Goal: ≥ 100 mg/dL
	Thromboelastography or rotational thromboelastography	Reduced mortality in trauma patients
	Platelets	Goal: ≥ 50,000
	Prothrombin Time (PT)/International Normalized Ratio (INR)	Goal: ≤ 1.5 x control
	Partial Thromboplastin Time (PTT)	Goal: ≤ 1.5 x control

Hemorrhage: Management

System	Lab	Notes
Renal	Creatinine	Renal perfusion
	BUN	Renal perfusion
Other	Lactate	Tissue perfusion
	Electrolytes	Calcium for contractility Tissue perfusion Renal perfusion
	Blood gas	Tissue perfusion

Hemorrhage: Timing of Transfusion Therapy

Transfusion Need Based On:

- QBL
- Ongoing bleeding
- Vital signs

Hematocrit or hemoglobin cannot be used to manage transfusion in the setting of acute blood loss.

Hemorrhage: Interventional Radiology

- Candidates and Success Rate
  - Hemodynamically stable
  - Selective arterial embolization

- Potential Complications
  - Angiography: Hematoma, contrast nephrotoxicity
  - Pelvic infection
  - Ischemic phenomena (necrosis, buttock claudication)

Secondary/Delayed Postpartum Hemorrhage

Speculum Exam
- Rule out cervical or vaginal laceration

Pelvic US
- Rule out intrauterine tissue

Labs
- CBC with differential
- Fibrinogen

Hemorrhage: Management

- Support for patient, family, clinicians, and staff

Hemorrhage: Potential Complications

Shock

Metabolic Acidosis

Disseminated Intravascular Coagulopathy (DIC)

- **Additional blood loss**
- **Tissue hypoperfusion**

End organ damage and failure

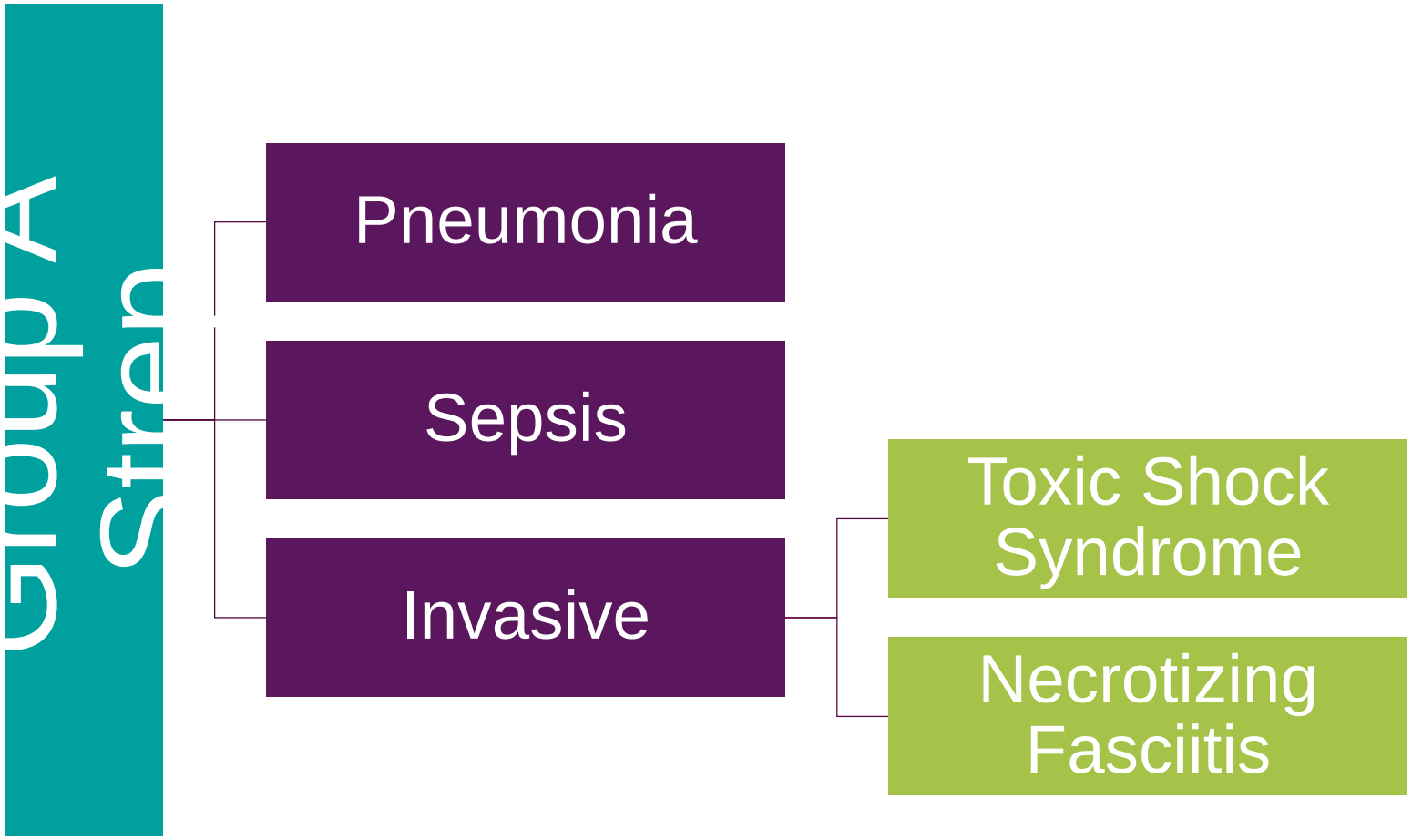
- **ARDS**
- **Acute kidney injury**

Other Postpartum Complications

Group A Streptococcus (GAS)

- 20 x increased risk of GAS in pregnant/postpartum patients compared to general population
- 85-93% of GAS infections occur postpartum
  - 60% mortality rate when infection develops w/in 4 days of childbirth
- Risk Factors
  - Upper respiratory tract infection – pharyngeal colonization prior to birth
  - Contact with carriers of GAS

Shinar, S., Fouks, Y., Amit, S., et al., 2016
Anderson, 2014


Group A Stren
Pneumonia
Sepsis
Invasive
Toxic Shock Syndrome
Necrotizing Fasciitis

Group A Streptococcus: Invasive Symptoms

- Usually develops w/in 24 hours of birth and becomes fulminate w/in 48-96 hours after birth
- 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

Chuang et al, 2002
Sosa, M.E., 2016

Group A Streptococcus: Invasive Necrotizing Fasciitis

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

Barton, J.R., Sibai, B.M. (2012) Severe sepsis and septic shock in pregnancy. Obstetrics & Gynecology, 120(3), 689-705.

Sosa, M.E. (2016) Group A Streptococcal infection in pregnancy and puerperium. JPNN, 30(2), 124-130.

Other Postpartum Considerations

Lower Extremity Nerve Injury (LENI)

- Compression + Stretching x Time = Injury
  - Duration of time
- Incidence 0.3-2.3% (5 studies)
- Symptoms
  - Numbness
  - Paresthesia
  - Pain
  - Loss of muscle function - inability to bear weight or walk
- Prognosis
  - Usually resolves in 2-6 months
  - May persist for years or be permanent

Types of Childbirth-Related LENI

- Femoral nerve injury
  - Loss of motor strength/function (primarily quad and knee)
- Lateral femoral cutaneous nerve injury
  - Loss of sensation mid-thigh to mid-calf
  - No motor component, but may have pain
- Peroneal (fibular) nerve injury
  - Foot drop
- Sciatic nerve injury
  - Burning/tingling down leg
  - Weakness, numbness, or difficulty moving leg or foot

LENI Risk Factors

- Nulliparous
- Prolonged lithotomy positioning
  - 2nd stage
  - Placenta Accreta Spectrum Disorder delivery
- Operative vaginal birth
- Frequently occurs with regional anesthesia

LENI Etiology

- Femoral Nerve Injury
  - Stretch, compression, or vascular (ischemia) injury of femoral nerve
  - Hyper-flexed thighs compress the femoral nerve under the inguinal ligament
- Peroneal (fibular) ischemic nerve injury
  - Hand/finger placement in 2nd stage

Strategies to Prevent LENI

- Avoid hyperflexion > 90 degrees of knees and thighs
  - Especially with abduction and external rotation of hips
  - Use for only emergent positioning (McRoberts) for shoulder dystocia
- Frequent repositioning during 2nd stage (every 10-15 minutes)
- Avoid lithotomy position and/or stirrups when possible
- Avoid ”frog” position
- Do not lean patient’s legs against hard surfaces (side rails, edge of stirrups)
- Rotate hand positioning; no deep, prolonged pressure
- Document positioning

“I was sent home with no diagnosis, a walker, instructions not to use the shower or to get into a bathtub, and make sure someone is with me at all times”

https://nervedamagefromchildbirth.com/blog/page/2/

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ALLIANCE FOR INNOVATION
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Perinatal Mental Health Conditions

RECOGNITION & PREVENTION

Every Woman

- Obtain individual and family mental health history (including past and current medications) at intake, with review and update as needed.
- Conduct validated mental health screening during appropriately timed patient encounters, to include both during pregnancy and in the postpartum period.
- Provide appropriately timed perinatal depression and anxiety awareness education to women and family members or other support persons.

Postpartum: Depression

Risk Factors for Postpartum Depression	
• Personal history of major or postpartum depression • Family history of postpartum depression • Gestational diabetes • Difficulty breastfeeding • Fetal/newborn loss • Lack of personal or community resources • Financial challenges • Substance use/addiction	• Complications of pregnancy, labor, birth, or infant's health • Teen pregnancy • Unplanned pregnancy • Major life stressors • Violent or abusive relationship • Isolation from family or friends

MCPAP for Moms, 2017

Massachusetts Child Psychiatry Access Program
MCPAP For Moms

Depression Screening Algorithm for Obstetric Providers

The EPDS should be administered during:

- Initial intake or first obstetrics visit
- Visit following Glucola test
- *If high-risk patient,** 2 weeks postpartum
- 6 weeks postpartum visit

If first EPDS screen

↓

Clinical support staff explains EPDS

→

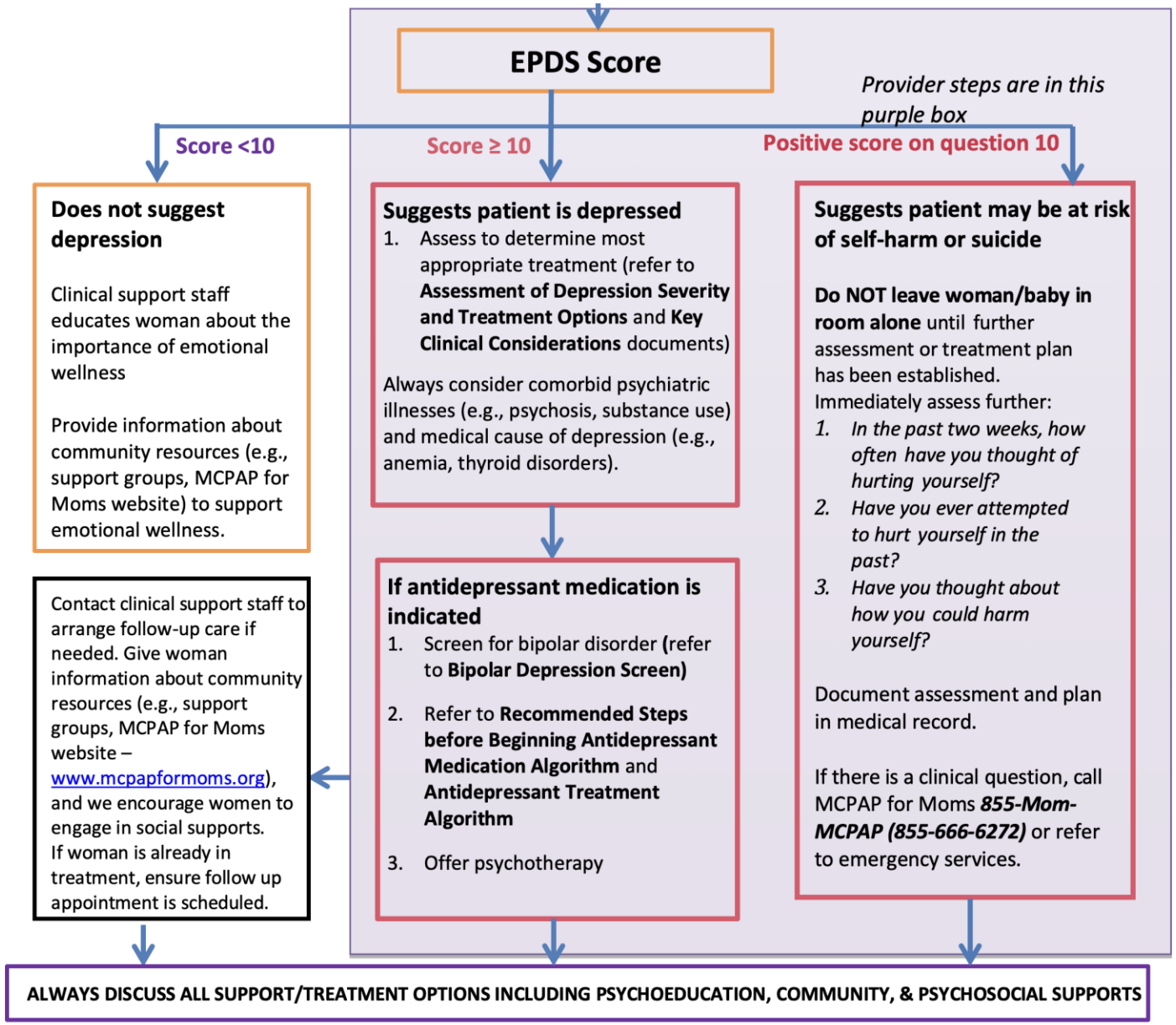
Woman completes the EPDS. Staff tallies score and enters into medical record. Staff informs OB provider of score prior to patient appointment.

←

Give EPDS to woman to complete

↓

If subsequent EPDS screen


EPDS Score
Provider steps are in this purple box
Score <10
Score ≥ 10
Positive score on question 10
Does not suggest depression
Clinical support staff educates woman about the importance of emotional wellness
Provide information about community resources (e.g., support groups, MCPAP for Moms website) to support emotional wellness.
Suggests patient is depressed
1. Assess to determine most appropriate treatment (refer to Assessment of Depression Severity and Treatment Options and Key Clinical Considerations documents)
Always consider comorbid psychiatric illnesses (e.g., psychosis, substance use) and medical cause of depression (e.g., anemia, thyroid disorders).
If antidepressant medication is indicated
1. Screen for bipolar disorder (refer to Bipolar Depression Screen)
2. Refer to Recommended Steps before Beginning Antidepressant Medication Algorithm and Antidepressant Treatment Algorithm
3. Offer psychotherapy
Suggests patient may be at risk of self-harm or suicide
Do NOT leave woman/baby in room alone until further assessment or treatment plan has been established.
Immediately assess further:
1. In the past two weeks, how often have you thought of hurting yourself?
2. Have you ever attempted to hurt yourself in the past?
3. Have you thought about how you could harm yourself?
Document assessment and plan in medical record.
If there is a clinical question, call MCPAP for Moms 855-Mom-MCPAP (855-666-6272) or refer to emergency services.
Contact clinical support staff to arrange follow-up care if needed. Give woman information about community resources (e.g., support groups, MCPAP for Moms website – www.mcpapformoms.org), and we encourage women to engage in social supports. If woman is already in treatment, ensure follow up appointment is scheduled.
ALWAYS DISCUSS ALL SUPPORT/TREATMENT OPTIONS INCLUDING PSYCHOEDUCATION, COMMUNITY, & PSYCHOSOCIAL SUPPORTS

Postpartum: Depression

- How are you feeling about being a mother?
- What things are you most happy about?
- What things are you most concerned about?
- Do you have anyone you can talk to that you trust?
- How is your partner doing?
- Are you able to enjoy your baby?

Massachusetts Child Psychiatry Access Program
MCPAP For Moms

Summary of Emotional Complications During Pregnancy and the Postpartum Period

	Baby Blues	Perinatal Depression	Perinatal Anxiety
What is it?	Common and temporary experience right after childbirth when a new mother may have sudden mood swings, feeling very happy, then very sad, or cry for no apparent reason.	Depressive episode that occurs during pregnancy or within a year of giving birth.	A range of anxiety disorders, including generalized anxiety, panic, social anxiety and PTSD, experienced during pregnancy or the postpartum period.
When does it start?	First week after delivery. Peaks 3-5 days after delivery and usually resolves 10-12 days postpartum.	Most often occurs in the first 3 months postpartum. May also begin during pregnancy, after weaning baby or when menstrual cycle resumes.	Immediately after delivery to 6 weeks postpartum. May also begin during pregnancy, after weaning baby or when menstrual cycle resumes.
Risk factors	N/A	Personal history of depression or postpartum depression. Family history of postpartum depression. Fetal/newborn loss. Lack of personal/ community resources. Substance use/addiction. Complications of pregnancy, labor/delivery, or infant's health. Unplanned pregnancy. Domestic violence or abusive relationship.	Personal history of anxiety. Family history of anxiety. Life changes, lack of support and/or additional challenges (e.g., difficult pregnancy, birth, health challenges for mom or baby). Prior pregnancy loss.

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Postpartum Discharge Transition Bundle

https://saferbirth.org/wp-content/uploads/U3-FINAL_AIM_Bundle_PPDT.pdf

Postpartum Education

- Suplee, P.D., Kleppel, L., & Bingham, D. (2016) Discharge education on maternal morbidity and mortality provided by nurses to women in the postpartum period. *JOGNN,* 45(6), 894-904.
  - 6 hospitals in GA and NJ
  - Inconsistent information provided re. post-birth warning signs and what to do about them if they occurred
- Suplee, P.D., Kleppel, L., Santa-Donato, A., Bingham, D. (2017) Improving postpartum education about warning signs of maternal morbidity and mortality. *Nursing for Women's Health*, 20(6), 552-567.

Postpartum: Example Discharge Criteria

- ✓Normal vital signs (taken w/in 1 hour of discharge)
- ✓No shortness of breath
- ✓No dizziness
- ✓Normal lochia
- ✓Tolerates PO

Care During the 4th Trimester

- Traditional 4-6 weeks
  - Current: Within 3 weeks postpartum
- BP evaluation
  - HTN disorders of pregnancy: no later than 7–10 days PP
  - Severe HTN: within 72 hours
- Home visits
  - Environment
  - Postpartum depression
  - Infection
  - Bleeding
  - DVT

https://www.cdc.gov/hearher/healthcare-providers/index.html?s_cid=DRH_HearHer_F3_HCPs_Ad3

Postpartum Case Studies

Summary

- Heightened awareness of postpartum complications
- HEAR her
- Assessment
- Follow up visit for patients with risk factors
- Emergency Department screening and algorithm for care