OBSTETRIC SEVERE HYPERTENSION & PREECLAMPSIA

Methodist Women's Hospital Outreach

OBJECTIVES

- Discuss pathophysiological changes related to hypertensive disorders
- Identify classifications of hypertensive disease in pregnancy
- Recognize risk factors and signs and symptoms of maternal hypertensive disease
- Verbalize appropriate response to maternal hypertensive disease
- Recall discharge education and warning signs related to maternal hypertensive disease

COMPLICATIONS OF HYPERTENSION IN PREGNANCY

Maternal:

- Placental abruption
- DIC
- Cerebral hemorrhage
- Cerebral vascular accident
- Pulmonary edema
- Hepatic failure
- Acute renal failure
- Seizure
- Stroke

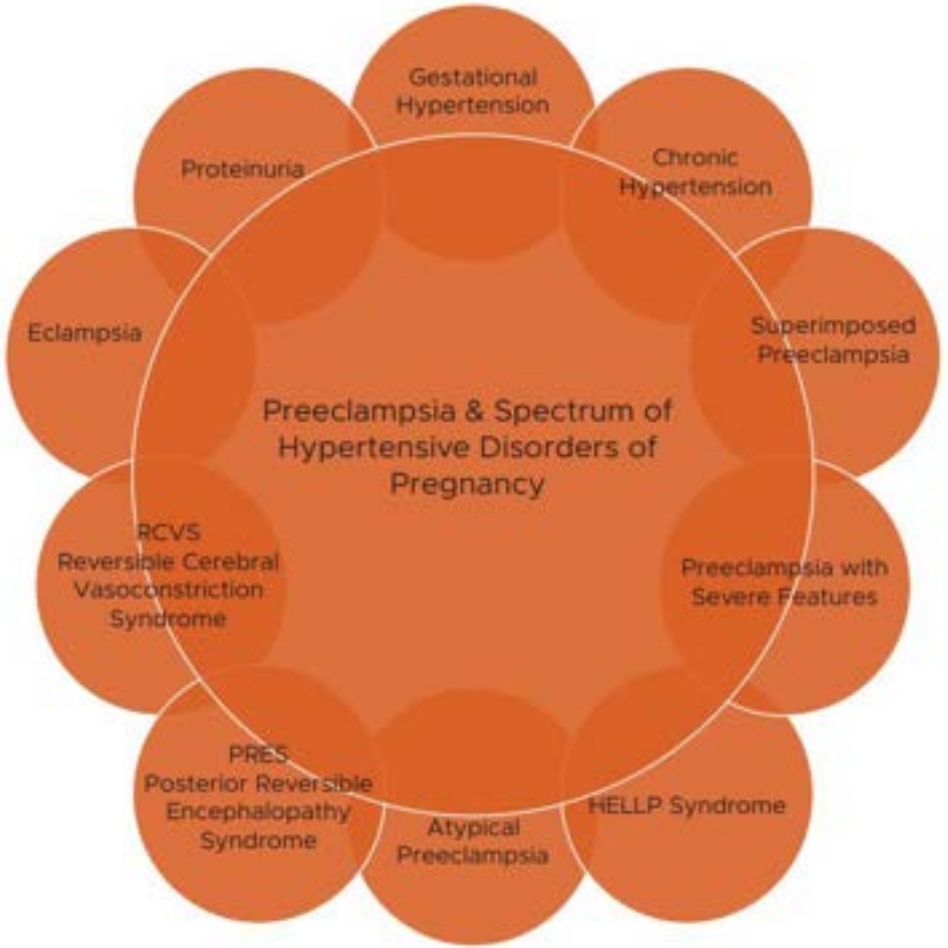
Neonatal:

- Uteroplacental insufficiency
- Chronic fetal hypoxemia
- Intrauterine growth restriction
- Prematurity
- Low Apgar scores
- Seizures
- Neonatal encephalopathy
- Fetal and neonatal death

(SIMPSON ET AL., 2021)

SPECTRUM OF HYPERTENSIVE DISORDERS

Figure 1. The spectrum of hypertensive disorders of pregnancy



This figure was adapted from the Improving Health Care Response to Preeclampsia: A California Quality Improvement Toolkit, funded by the California Department of Public Health, 2014; supported by Title V funds.

CLASSIFICATIONS

Gestational Hypertensive Disorders

Gestational Hypertension

Preeclampsia (with or without severe features)

- Early onset – < 34 weeks gestation
- Late onset – ≥ 34 weeks gestation
- Postpartum – up to 6 weeks postpartum

Eclampsia

Chronic Hypertensive Disorders

Chronic Hypertension

Superimposed Preeclampsia

(LOWDERMILK ET AL., 2024; SIMPSON ET AL., 2021)

GESTATIONAL HYPERTENSION

The onset of hypertension, generally after 20 weeks gestation, in a previously normotensive woman.

- Diagnostic Criteria:
  - Systolic BP $\geq$ 140 mmHg or diastolic BP $\geq$ 90 mmHg
  - Only 1 pressure, either systolic or diastolic needs to be elevated
  - Recorded on 2 occasions $\geq$ 4 hours apart
  - Absence of proteinuria
  - First diagnosed in pregnancy, does not progress into preeclampsia, normotensive by 12 weeks postpartum
- Formerly known as pregnancy induced hypertension (PIH)

(SIMPSON ET AL., 2021)

PREECLAMPSIA

A pregnancy specific condition defined as the development of hypertension and proteinuria after 20 weeks gestation in a woman who previously had neither condition

- May develop postpartum
- Proteinuria eliminated as a *requirement* for diagnosis (ACOG)

In the absence of proteinuria, defined as hypertension one or more of the following:

- Thrombocytopenia
- Impaired liver function
- New-onset renal insufficiency
- Pulmonary edema
- Or new-onset cerebral or visual disturbances

(LOWDERMILK ET AL., 2024)

DIAGNOSTIC CRITERIA

	Preeclampsia	Preeclampsia with Severe Features
Hypertension	BP ≥ 140/90 mmHg x2, at least 4 hours apart after 20 wks gestation in a normotensive woman	BP ≥ 160/110 mmHg x2, at least 4 hours apart while on bedrest (unless antihypertensive therapy has already been initiated)
Proteinuria	➢ 300mg in 24- hour specimen ➢ Protein/creatinine ratio ≥ 0.3 (with each measured as mg/dl) ➢ ≥ 2+ on dipstick (used only if quantitative is not available)	*No longer used as a diagnostic criteria:* Massive proteinuria (> 5g in 24-hour specimen)
Thrombocytopenia	Platelets <100,000/uL	Platelets <100,000/uL
Impaired Liver Function	↑ Blood level of liver enzymes to twice the upper level of normal concentration or higher	↑ Blood level of liver transaminases to twice the normal concentration, severe persistent epigastric pain or RUQ pain unresponsive to medication and not accounted for by alternative diagnosis, or both
Renal Insufficiency	New development of serum creatinine >1.1mg/dl or doubling of serum creatinine concentration in the absence of other renal disease	Progressive renal insufficiency (serum creatinine >1.1mg/dl or doubling of serum creatinine concentration) in the absence of other renal disease
Pulmonary Edema	Present	Present
Cerebral/Visual Disturbances	New Onset – not responsive to medication or alternative diagnosis	New Onset-not responsive to medication or alternative diagnosis

COMMON LAB CHANGE

	Normal	Preeclampsia	HELLP
Hgb & Hct	12-16 g/dl, 37-47%	May ↑	↓
Platelets	150,000-400,000/mm3	<100,000	<100,000
PT, PTT	12-14 sec, 60-70 sec	Unchanged	Unchanged
Fibrinogen	200-400 mg/dL	300-600 mg/dL	↓
FSP (fibrin split products)	Absent	Absent or present	Present
BUN	10-20 mg/dL	↑	↑
Creatinine	0.5-1.1 mg/dL	>1.1 mg/dL	↑
LDH	45-90 units/L	↑	↑ (>600 units/L)
AST	4-20 units/L	↑	↑ (>70 units/L)
ALT	3-21 units/L	↑	↑
Creatinine clearance	80-125 ml/min	130-180 ml/min	↓
Burr cells/schistocytes	Absent	Absent	Present
Uric Acid	2-6.6 mg/dL	>5.9 mg/dL	>10 mg/dL
Bilirubin	0.1-1 mg/dL	Unchanged or ↑	↑ (>1.2 mg/dL)

(LOWDERMILK ET AL., 2024, P.587

ECLAMPSIA

The development of grand mal seizures and/or coma in a woman with signs and symptoms of preeclampsia

- All other causes of seizures must be excluded
- Eclamptic seizures can antepartum, intrapartum, or postpartum
- Approximately 50% occur antepartum
- Many cases may occur greater than 48 hours postpartum

(LOWDERMILK ET AL,2024; SIMPSON ET AL., 2021)

CHRONIC HYPERTENSIVE DISORDERS

Chronic Hypertension:

- SBP ≥ 140 *or* DBP ≥ 90
- Preexisting pre-pregnancy hypertension and persists after the postpartum period
- Use of antihypertensive medications before pre-pregnancy
- Hypertension prior to 20 weeks gestation
- Hypertension diagnosed during pregnancy lasting longer than 12 weeks postpartum

Superimposed Preeclampsia:

- Chronic hypertension combined with preeclampsia
- Sudden increase in proteinuria if not present in early gestation
- Sudden increase in BP

ACOG 22020, LOWDERMILK ET AL, 2024 ; WITCHNER & AWHONN, 2021)

HELLP SYNDROME

Severe complication of preeclampsia or eclampsia in which a woman presents with a variety of complaints and exhibits common laboratory findings including:

- **H**emolysis
- **E**levated **L**iver enzymes
- **L**ow **p**latelet count

- Severity is associated with platelet count
- 5-10% of women with preeclampsia will develop HELLP syndrome

(SIMPSON ET AL., 2021)

NORMAL PHYSIOLOGICAL CHANGES IN PREGNANCY

Decreased vascular resistance and peripheral vasodilation

- Decreased systemic blood pressure and mean arterial pressures
- Peripheral edema

Increased blood volume (plasma) and hemodilution

- Physiologic dilutional anemia of pregnancy

Increased cardiac output

- Slight increased in HR

Vascular remodeling occurs

- Spiral arteries of the uterus widen in diameter
- Vessel walls become thinner

(LOWDERMILK ET AL., 2024)

PREECLAMPSIA PATHOPHYSIOLOGY

- Uterine artery vascular remodeling dose not occur or only partially occurs within the myometrium and placenta spiral arterials
  - This is process is called Angiogenesis
- Results in:
  - Decreased placental perfusion
  - Endothelial dysfunction
  - Placental ischemia

Normal pregnancy

Preeclampsia

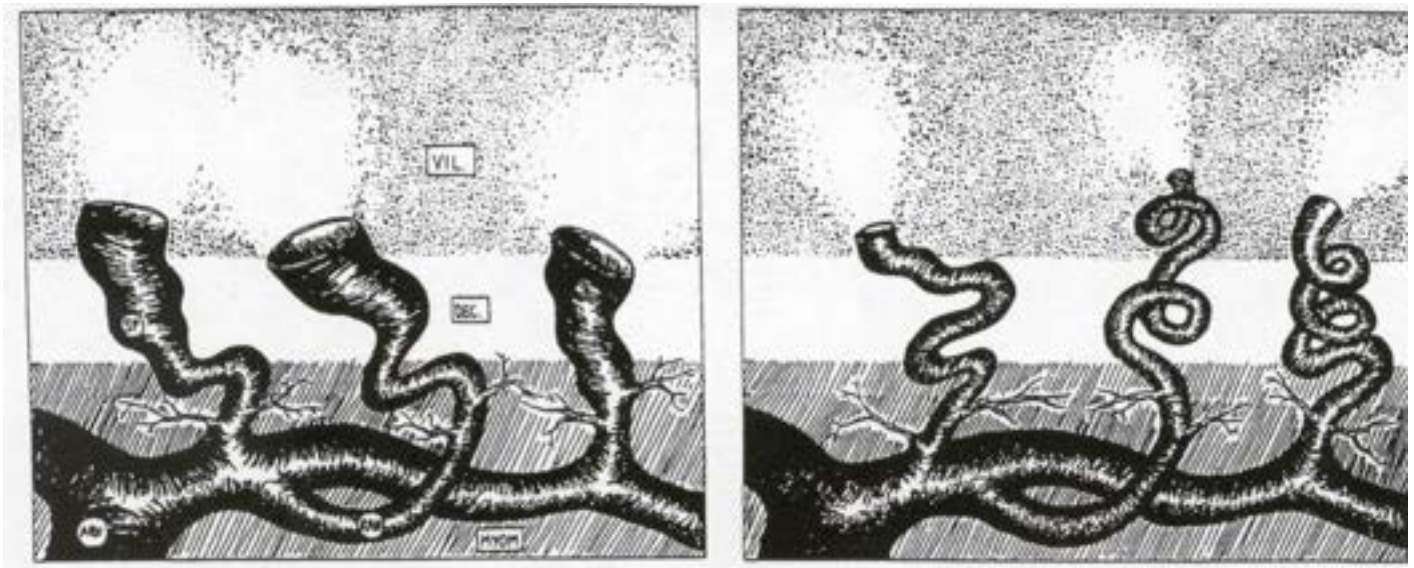
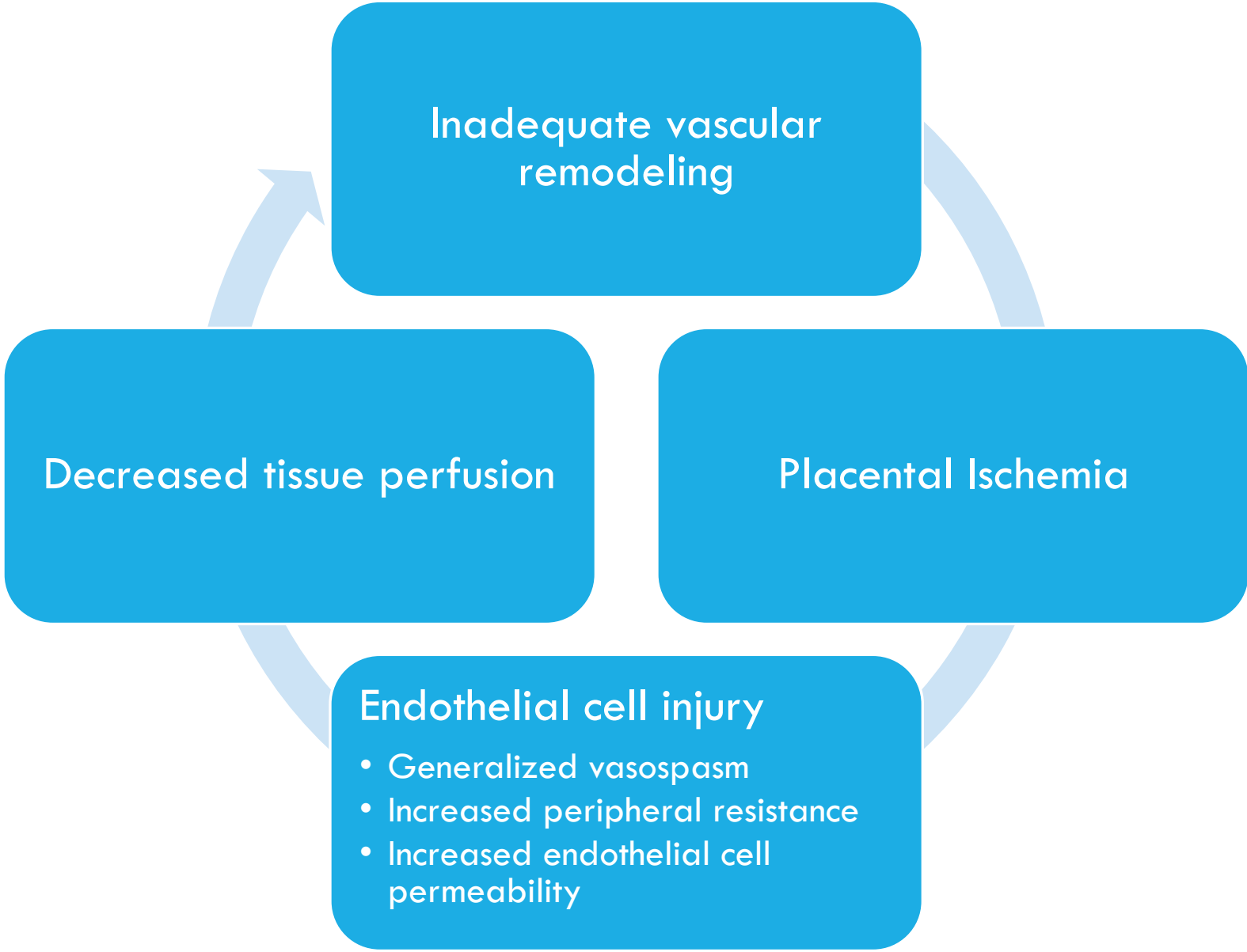


Fig. 1. Diagram illustrating defective placentation. The left side of the diagram shows normal adaptation of spiral arteries to pregnan
whereas the right side depicts this process in preeclamptics. *Vil*, intervillous space;*sp*, spiral artery;*dec*, decidua;*rad*, radial artery;
arcuate artery;*myom*, myometrium.

PREECLAMPSIA PATHOPHYSIOLOGY

Main pathogenic changes of preeclampsia are caused by inadequate *placental perfusion* and endothelia cell dysfunction.

Placental ischemia causes release of toxins to endothelial cells. Generalized vasospasm results in poor tissue perfusion to all organ systems, an increase in peripheral resistance and increased BP and increased endothelial cell permeability which leads to intravascular and protein and fluid loss and less plasma volume. ***The main pathological factor is not an increase in BP but rather poor perfusion due to vasospasm and reduced plasma volume.***



(LOWDERMILK ET AL., 2024))

ENDOTHELIAL CELL INJURY

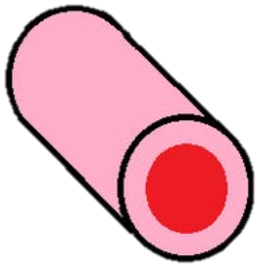
Generalized vasospasm: constricted, high resistance of blood vessels from a narrowed blood vessel lumen; ↑ systemic vascular resistance & BP

Increased peripheral vascular resistance: ↓ tissue perfusion in all organs

Endothelial cell injury and increased capillary permeability leads to intravascular protein and fluid loss; ↓ plasma volume

Intravascular volume depletion increases blood viscosity; ↓ maternal organ and fetal perfusion

Intravascular Red blood cell hemolysis: may occur as red blood cells are forced through narrowed vessels; ↓ oxygen carrying capacity, further ↓ tissue perfusion



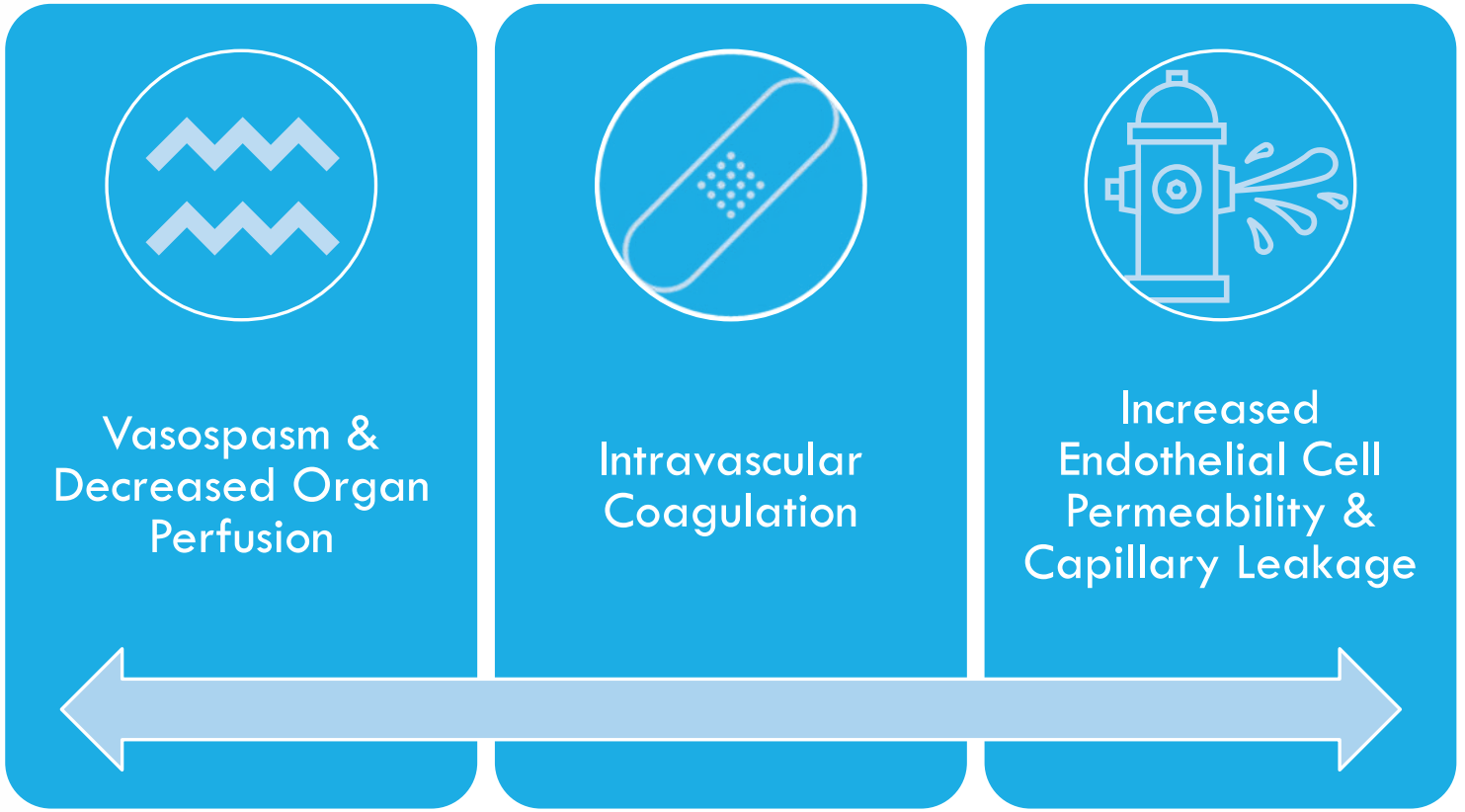
Non-pregnant

Normal Pregnancy

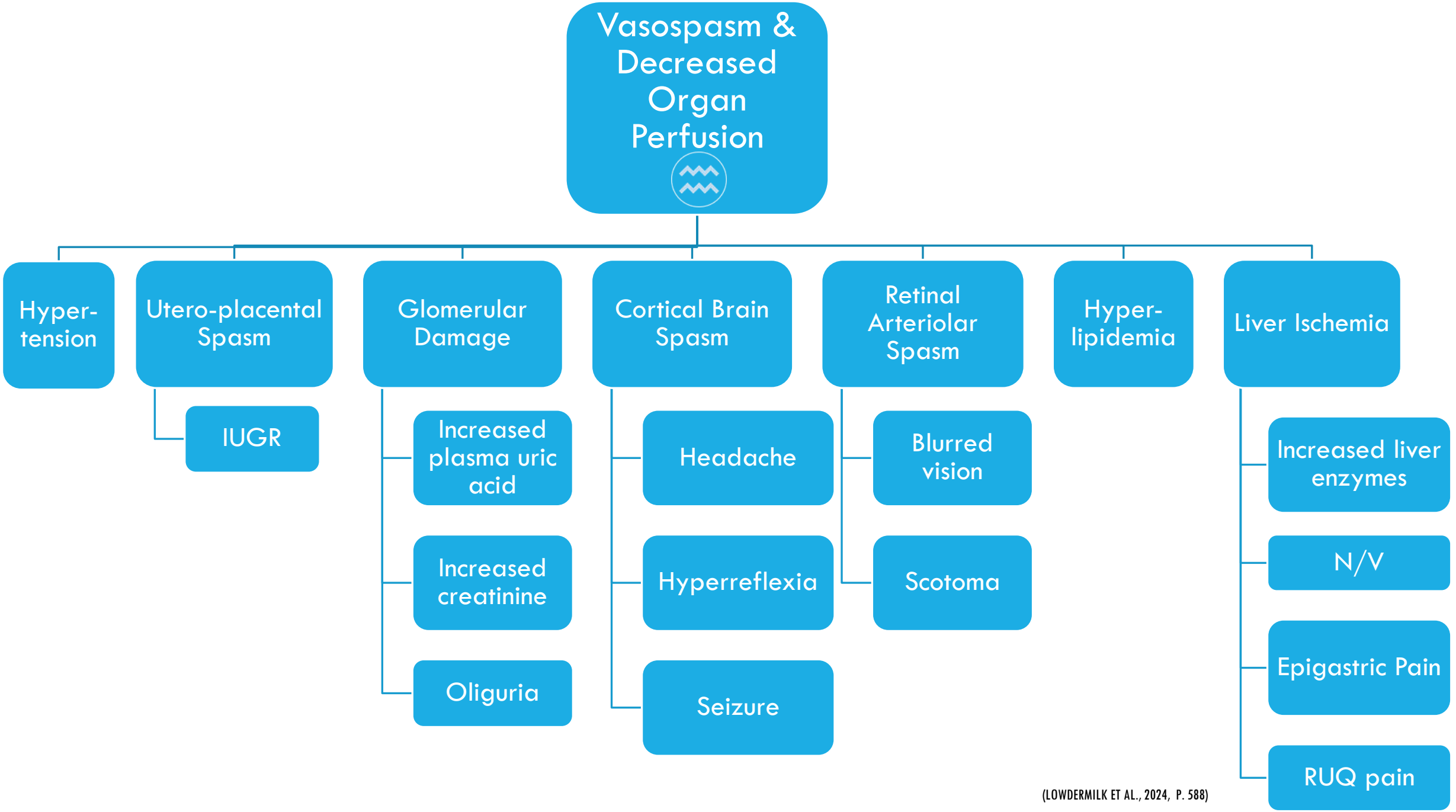
Preeclampsia

(LOWDERMILK ET AL., 2024)

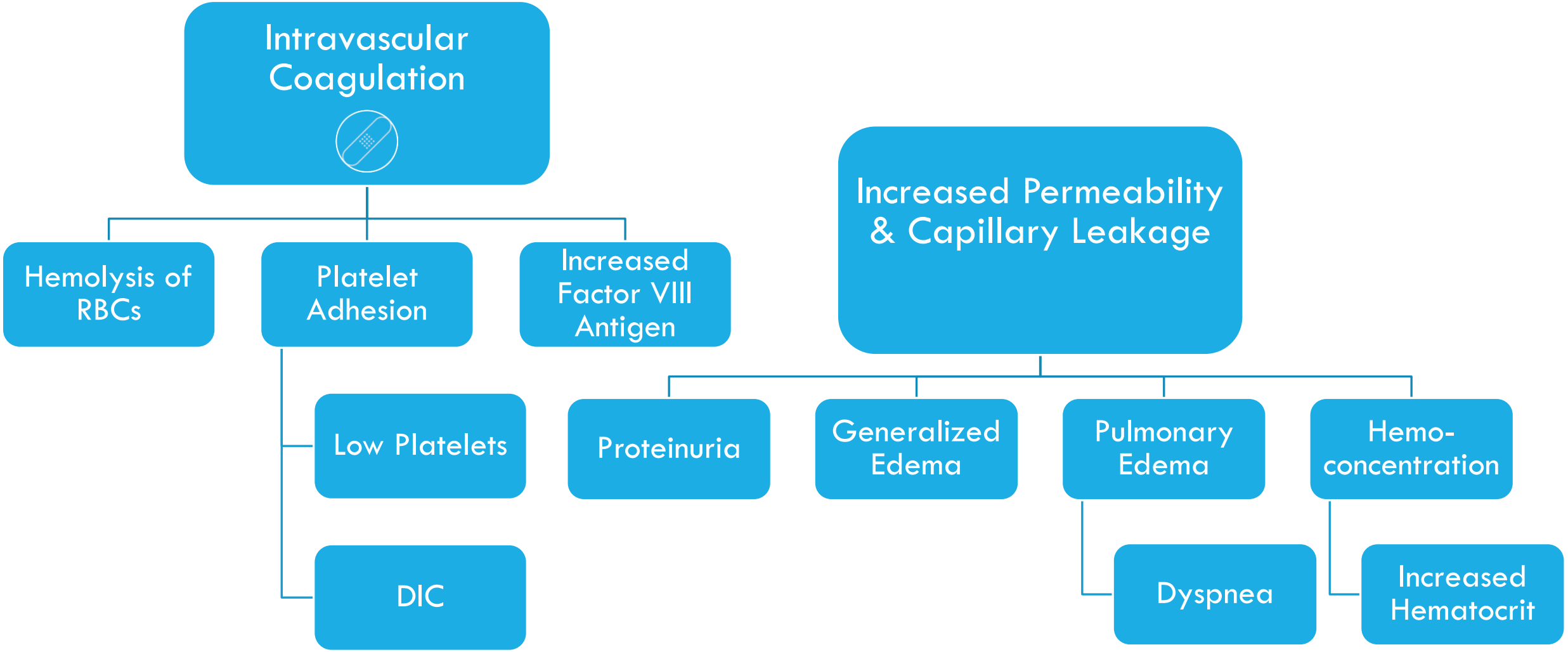
CONSEQUENCES OF ENDOTHELIAL CELL DYSFUNCTION



(LOWDERMILK ET AL., 2024)



(LOWDERMILK ET AL., 2024, P. 588)



(LOWDERMILK ET AL., 2024, P. 588))

RISK FACTORS FOR PREECLAMPSIA

- Nulliparity
- Pregnancy of new genetic makeup
- > 35 years old
- Assisted reproductive technology
- Interpregnancy interval > 7-10 years
- Personal or family history of preeclampsia (mother or sister)
- Women born small for gestational age
- Pre-pregnancy BMI > 30
- Multifetal pregnancy
- Poor outcome in previous pregnancy
- Preexisting medical or genetic conditions
- Chronic hypertension
- Preexisting renal disease
- Antiphospholipid antibody syndrome
- Systemic lupus erythematosus
- Factor V Leiden mutation
- Gestational diabetes
- Pregestational diabetes
- Fetal hydrops
- Hydatidiform mole
- African American race
- Low socioeconomic status

ACOG, 2020, LOWDERMILK ET AL., 2024; SIMPSON ET AL., 2024)

PREDICTING PREECLAMPSIA

- Preeclampsia is condition unique to human pregnancy
- Occurs in approximately 2-7% of pregnancies of healthy nulliparous
- May have a genetic component
- Paternal factors contribute to the risk for preeclampsia
  - Women with limited sperm exposure with same partner have a greater risk of developing preeclampsia
- No known legitimate screening devices – best practice is early and consistent prenatal care

(LOWDERMILK ET AL., 2024)

Level of Risk	Risk Factors	Recommendation

High	• History of preeclampsia
	• Multifetal pregnancy
	• Chronic hypertension
	• Pregestational diabetes
	• Renal disease
	• Autoimmune disease
	  • Systemic lupus erythematosus
	  • Antiphospholipid syndrome
		Recommend low-dose aspirin if mother has one or more high risk factors

Moderate	• Prepregnancy BMI >30
	• Family history of preeclampsia
	• African American race
	• Low socioeconomic status
	• ≥ 35 years of age
	• Personal history factors
	  • SGA
	  • Poor outcome in previous pregnancy
	  • >10-year interpregnancy interval
		Consider low-dose aspirin if the patient has more than one moderate risk factors

Low	• Previous uncomplicated full-term delivery	Do not recommend low-dose aspirin

ACOG 2020

PREECLAMPSIA PREVENTION STRATEGIES

Low dose aspirin (60-80mg)

- Initiated 12-28 weeks gestation, optimally before 16 weeks
- Continuing until delivery
- For women with any high-risk factors or >1 moderate risk factors

Additional methods:

- Regular prenatal exercise of moderate intensity
- Calcium supplementation

ACOG 2020, SIMPSON ET AL., 2021)

SIGNS AND SYMPTOMS OF PREECLAMPSIA

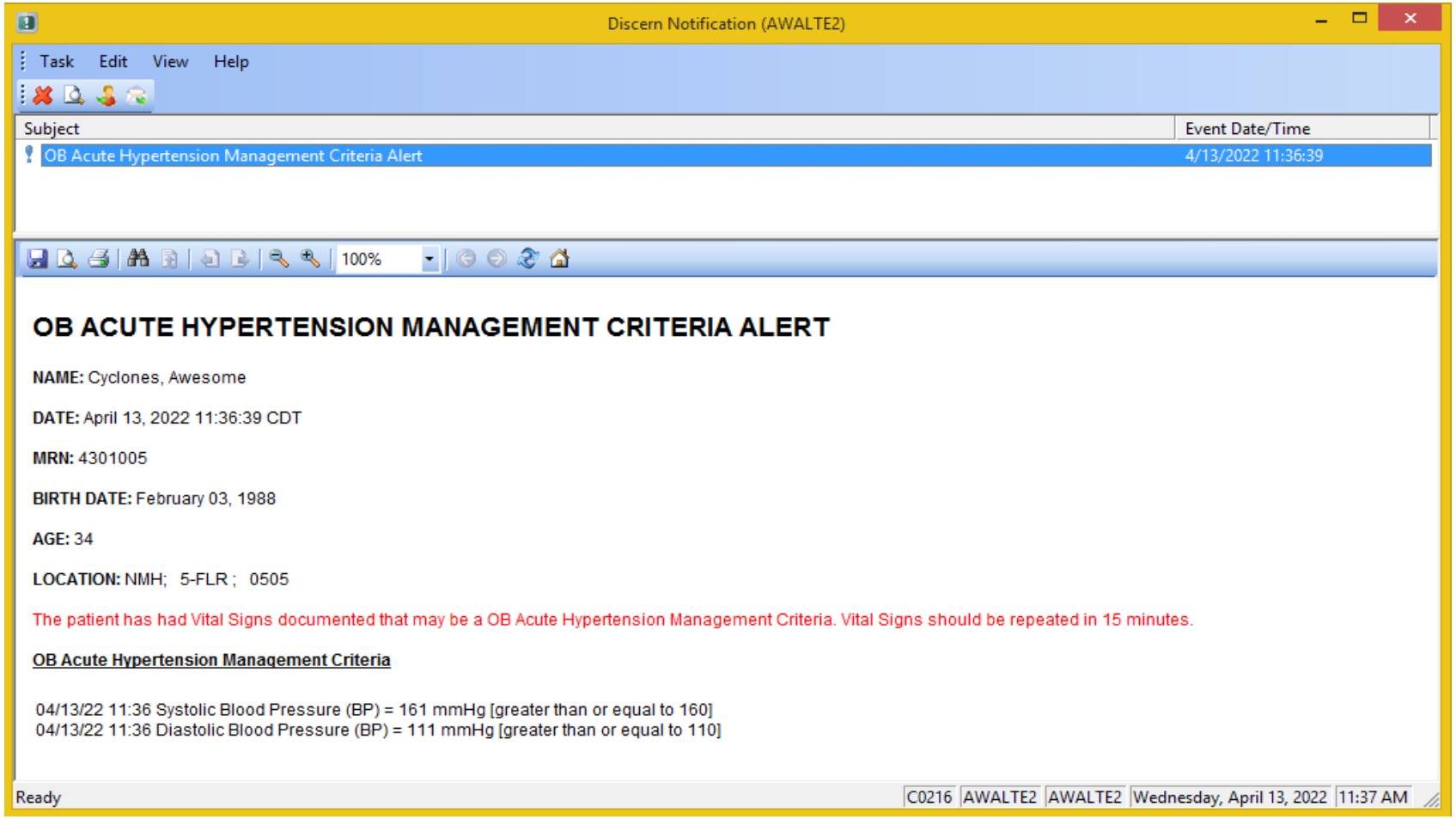
Hypertension	Proteinuria	Visible edema in face, hands, abdomen; pitting edema	Rapid weight gain
Unusual, frequent or severe headache	Cerebral or visual disturbances	Epigastric pain (heartburn)	Stomach or RUQ pain
Nausea or vomiting	Dyspnea	Renal insufficiency	Hyperreflexia

(ACOG, 2020, LOWDERMILK ET AL., 2020; SIMPSON ET AL., 2021)

READINESS
MEWS AT MHS – 1ST NURSING ALERT

After a blood pressure parameter that meets criteria (SBP ≥ 160 or DBP ≥ 110) has been documented, this screen will pop up for the RN.

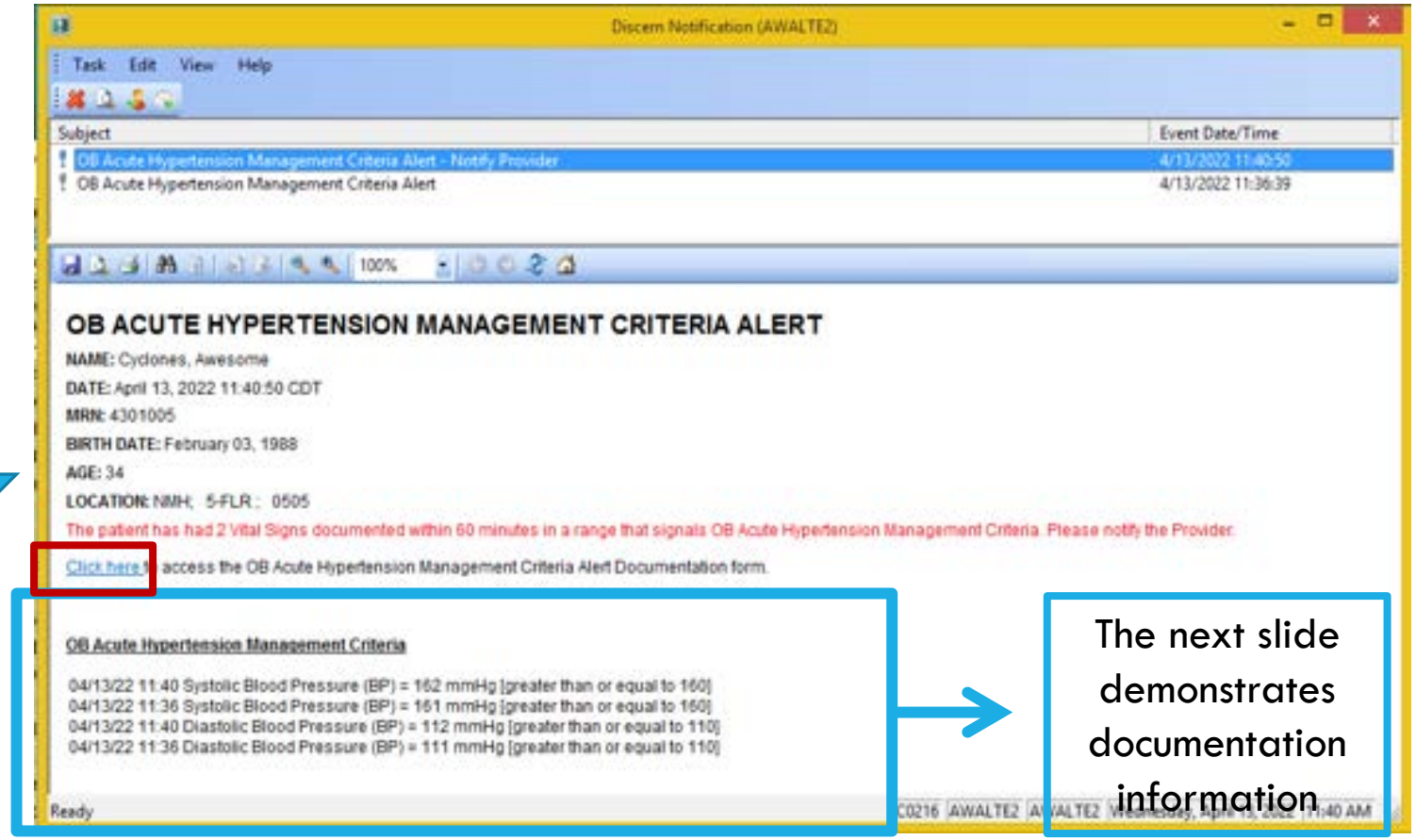
RN will be prompted to **REPEAT** vital signs in **15 minutes.**



MEWS AT MHS – 2ND NURSING ALERT

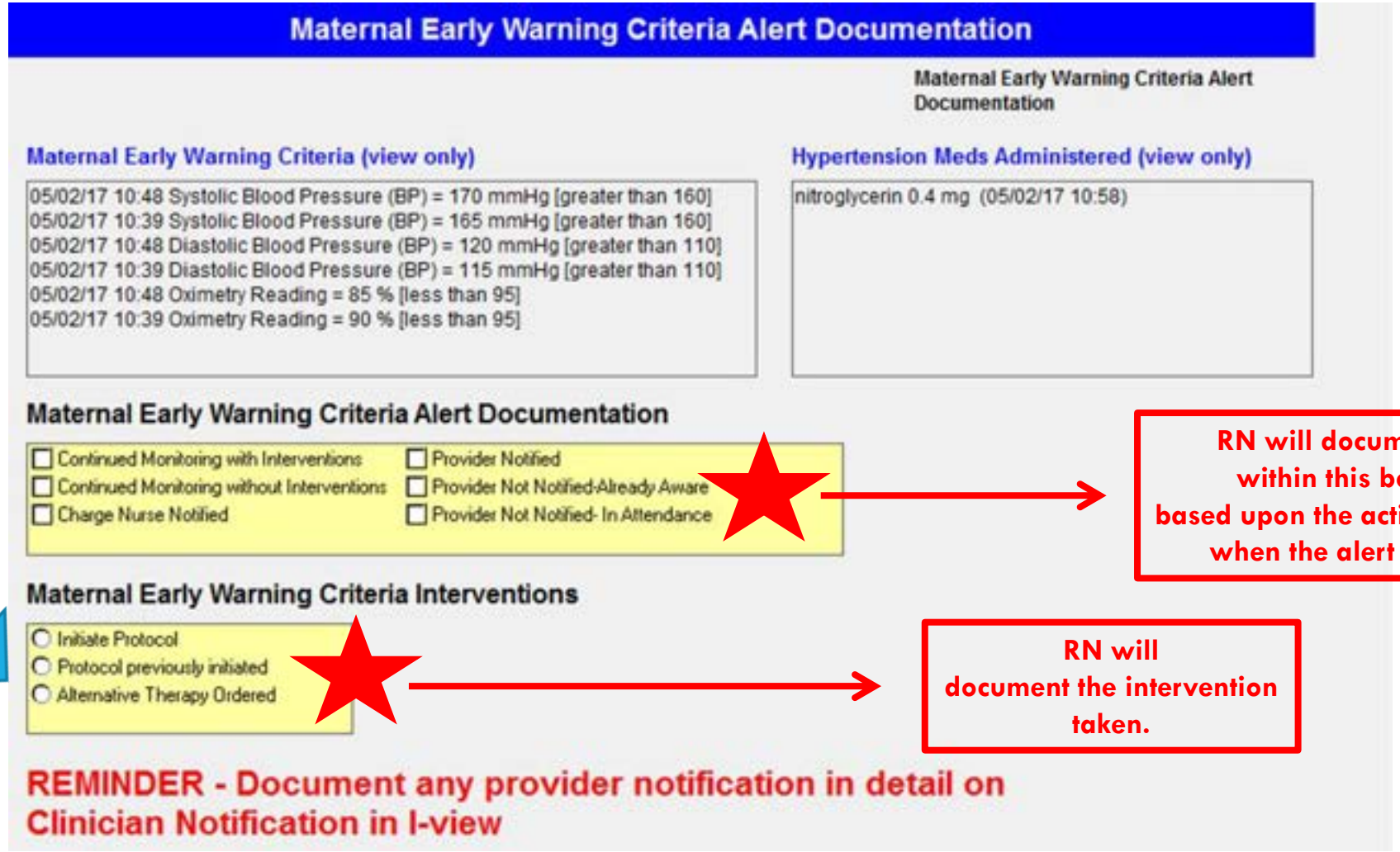
If the 2nd blood pressure parameter meets criteria (SBP ≥ 160 or DBP ≥ 110) and has been documented, this 2nd alert screen will pop up for the RN

- **RN will need to provide documentation for the alert**
- **RN notifies provider**
- **RN clears alerts**

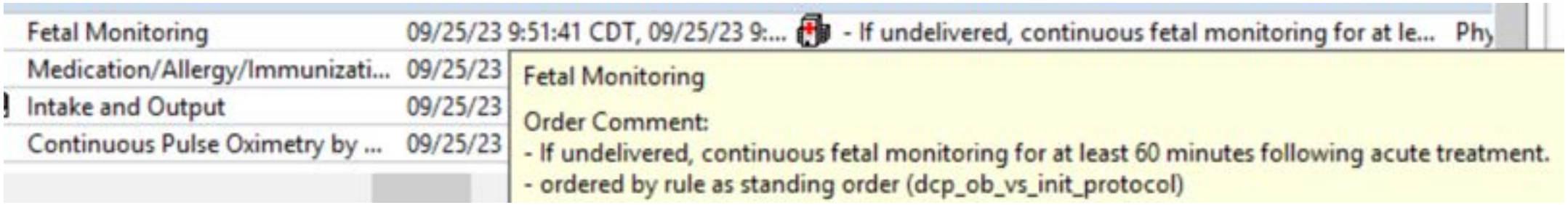


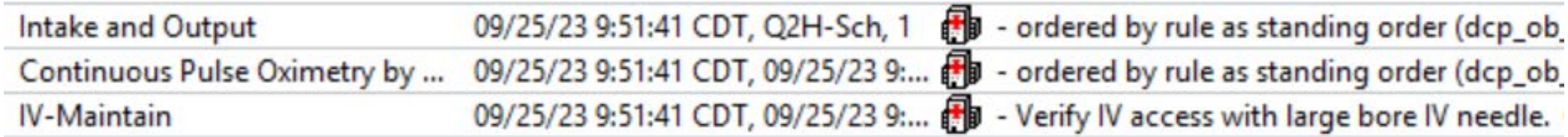
MEWS CRITERIA ALERT DOCUMENTATION ➔ LAUNCHED FROM 2ND NURSING ALERT

Selecting "initiate protocol" will fire the following orders…



NURSE ALERT PROTOCOL:
FIRST LINE ACUTE TREATMENT SEVERE OB HYPERTENSION





This is an automated order entry process.
All orders will be routed to the provider for co-signature.

RECOGNIZE
ASSESSMENT ESSENTIALS

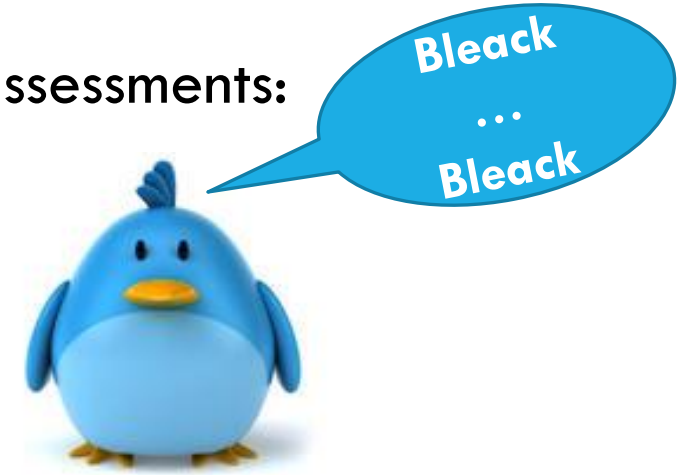
Full head to toe assessment, on every patient, every time

- Neurological: Level of consciousness, DTRs, Clonus, Headaches, Visual changes, Seizure activity
- Cardiac: VS, Heart Sounds, Weight gain, Edema, Chest Pain, Fatigue
- Respiratory: Rate, Lung Sounds, Skin & mucous membrane color, O2 Sats, Dyspnea, Orthopnea
- Gastrointestinal: N/V, Bowel sounds, Epigastric pain, RUQ pain, Anorexia, Jaundice, Flu-like symptoms
- Renal: I/O, Proteinuria, # IV fluid bags, Urine Characteristics

(LOWDERMILK ET AL., 2024; SIMPSON ET AL., 2021)

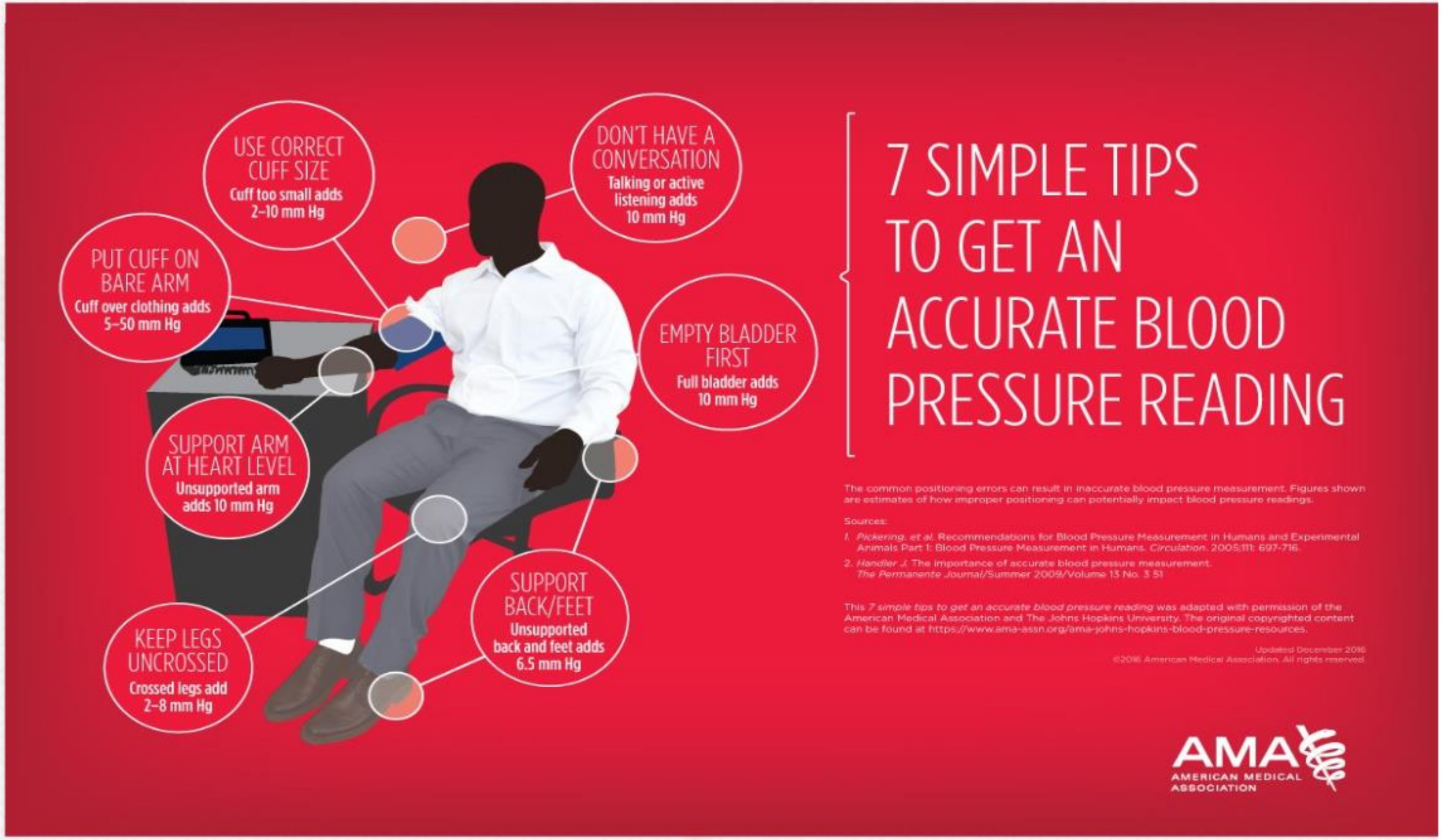
RECOGNIZE
PREECLAMPSIA ASSESSMENTS

Your patient's future may be **BLEACK** if you do not do your assessments:



- B - Blood Pressure
- L - Lungs
- E - Edema/ Weight Gain
- A - Abdomen – [Right Upper Quadrant Pain]
- C - Central Nervous System
- K - Kidneys

- Adapted from a Poster Presentation – ***Understanding Subtle Changes in the patient with Hypertension – An Educational Collaboration of Nurses and Physicians*** – Jean Amoroso-Knight - AWHONN 2019 National Conference



https://www.heart.org/-/media/files/professional/million-hearts/success-stories/7-simple-tips-to-get-accurate-blood-pressure-ucm_493556.pdf

HOW TO SUPPORT AN ARM AT HEART LEVEL

HOW TO SUPPORT THE ARM AT HEART LEVEL

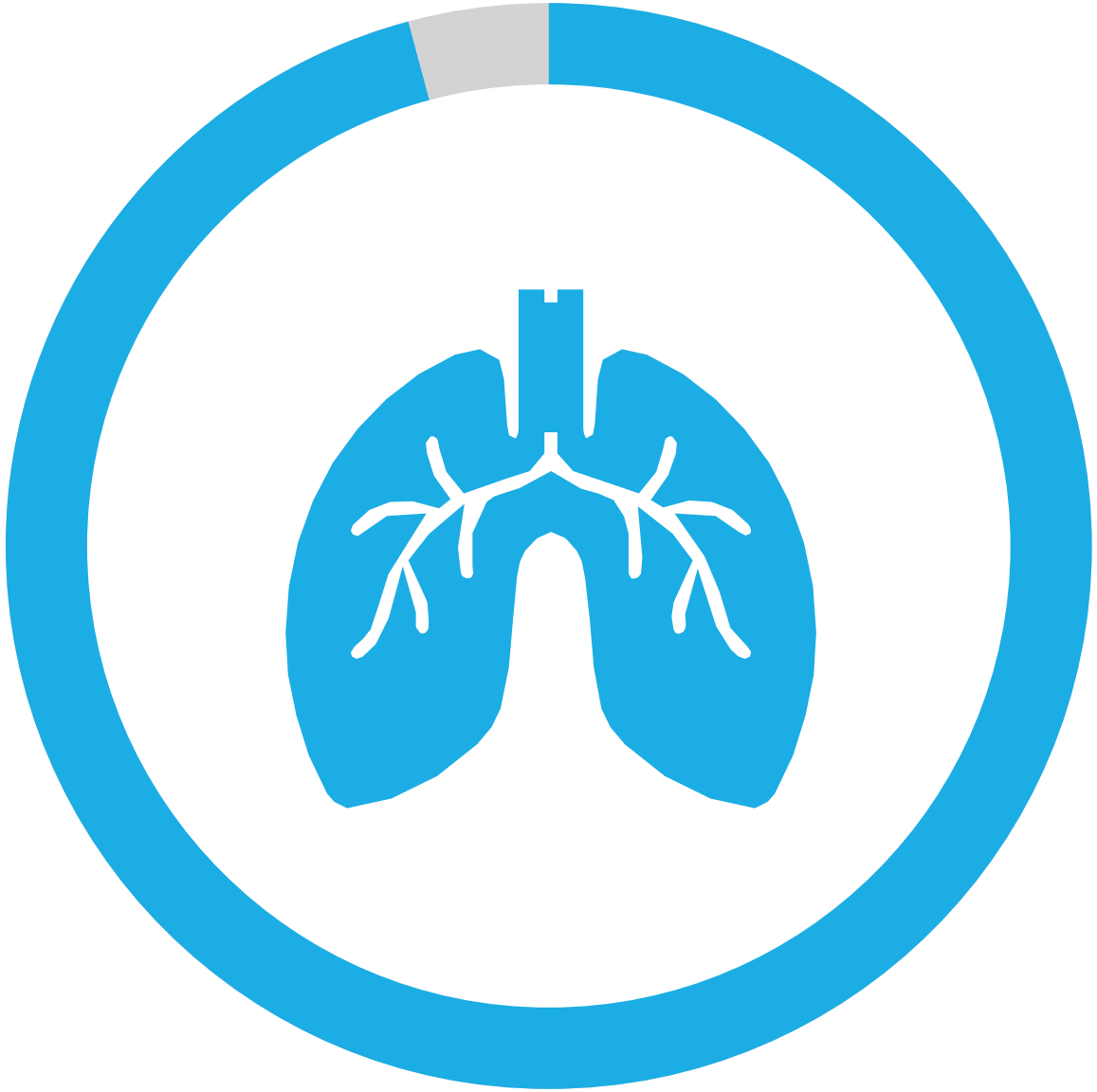
DO NOT THIS

105/49, MAP 71

121/74, MAP 88

ASSESSING FOR PULMONARY EDEMA

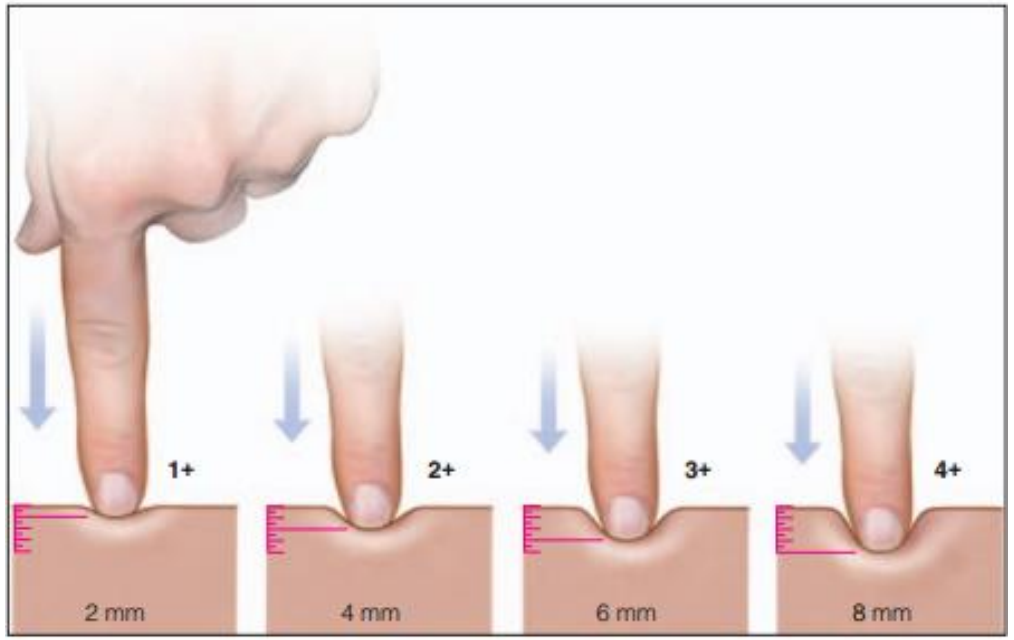
- Complaints of chest pain
- SaO2 <96%
- Cough
- Shortness of breath
- Dyspnea
- Tachypnea
- Tachycardia
- Adventitious breath sounds



(SIMPSON ET AL., 2021, P.111)

EDEMA

Pitting Edema

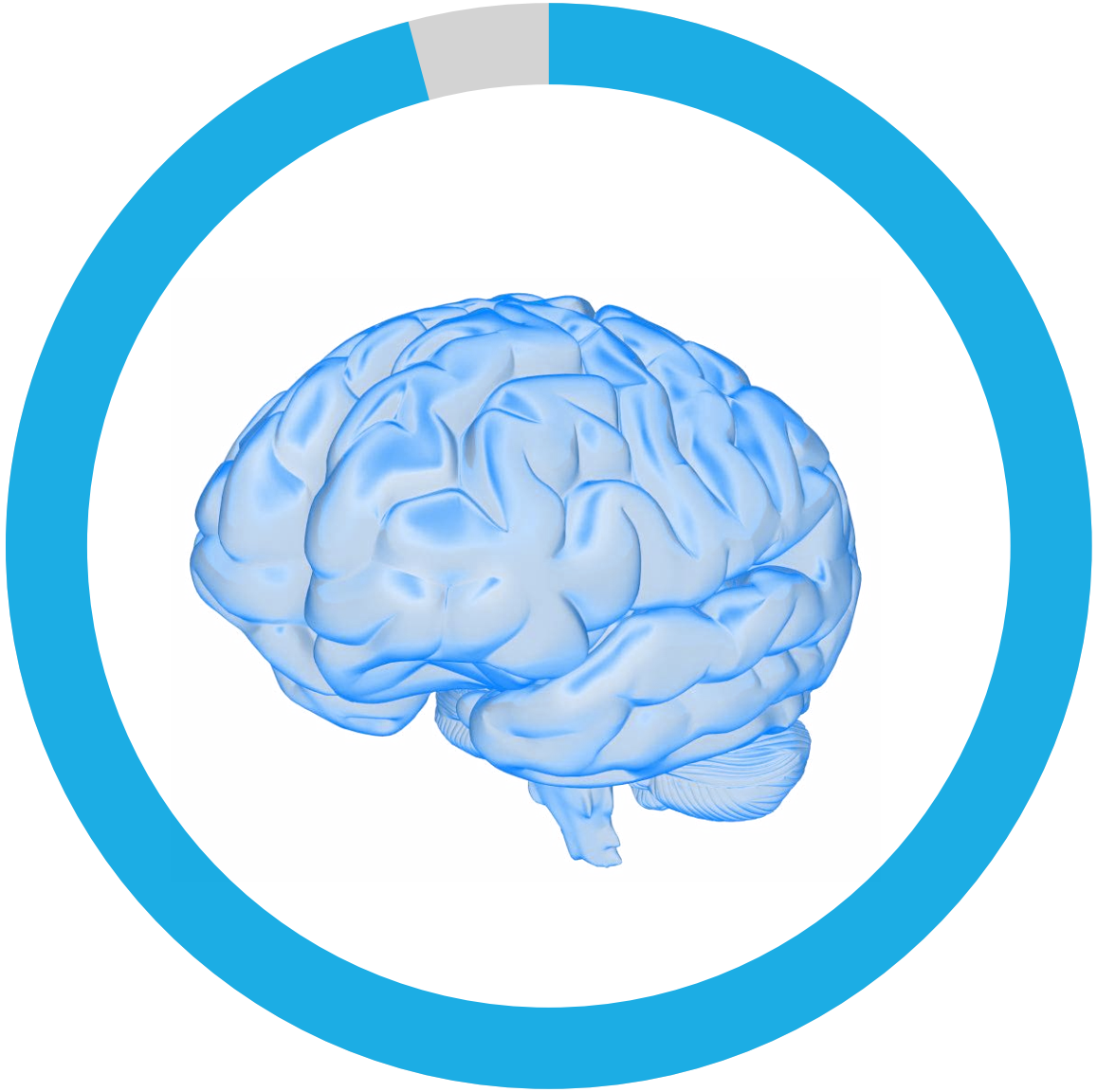


- Assess: distribution, degree, pitting
- Dependent: edema of the lowest, most dependent parts of the body
  - Ambulatory
  - Bed rest
- Degree:
  - 1st Minimal in lower extremities
  - 2nd Marked in lower extremities
  - 3rd Lower extremities, face, hands
  - 4th Generalize, including abdomen & sacrum
- Pitting:
  - 1+, 2+, 3+, 4+

(LOWDERMILK ET AL., 2024)

NEUROLOGICAL COMPLICATIONS OF HYPERTENSION

- Key Principles:
  - Preeclamptic patients with neurologic finding or s/s of headache, visual changes should be considered to have severe features and delivery is indicated
  - All patients with persistent neurological symptoms associated with hypertensive disorders of pregnancy need to be evaluated for stroke, PRES and if present should be considered an emergency- similar to “stroke alert” within the medical system
  - Requires a multidisciplinary team: ED/OB/Anesthesia/Neurology/ICU
  - Initiate established treatment algorithms to control severe hypertension in pregnancy
  - Stroke assessment tools should be incorporated into unit education and drills to prevent maternal morbidity from stroke



((CMQCC 2021)

DIAGNOSING NEUROLOGIC COMPLICATIONS

MRI is considered most appropriate in diagnosing brain lesions and PRES

- If MRI is not available CT imaging is utilized
- Neuroradiologic imaging should be strongly considered in the postpartum period with a patient who has headache, hypertension, seizures or atypical neurologic symptoms such as visual changes/blindness to rule out differential dx. Such as a mass lesion or cerebral venous thrombosis

(CMQCC 2021)

PRES (POSTERIOR REVERSIBLE ENCEPHALOPATHY SYNDROME)

- PRES is a transient clinical neuroradiological entity characterized by clinical signs and symptoms:
  - Hypertension
  - Headache
  - Generalized seizure activity
  - Altered mental status
  - Vision changes
- Pathophysiology -Attributed to failure of the cerebral auto-regulation & endothelial dysfunction. This impairment leads to disruption of the blood-brain barrier in the posterior circulation, with resultant extravasation of fluids and protein across the altered blood-brain barrier. Causes the characteristic lesions seen in the occipital and posterior parietal lobes on neuroradiologic imaging.
- Early postpartum – most often associated with severe elevated BP & eclampsia
- Usually reversible with prompt diagnosis and treatment

(CMQCC, 2021 PGS. 137-141

REVERSIBLE CEREBRAL VASOCONSTRICTION SYNDROME (RCVS)

RCSV is a distinct entity form of PRES

- Can have a similar presentation in pregnancy to PRES
- Classically presents as "***THUNDERCLAP***" Headache and maybe associated with hypertension and neurologic deficits related to brain edema, stroke or seizure
- Initial CT and MRI may appear normal
- Computed tomography angiography (CTA) and magnetic resonance angiography (MRA) are preferred imagining to document the reversible multifocal narrowing of the cerebral arteries.
  - Supportive care is usually sufficient – Chanel blockers have been utilized to relieve vasoconstriction
  - Clinical outcome is usually benign but major strokes can result in severe disability and death in a minority of patients
  - Prompt consultation with neurology is indicated with patients displaying any neurologic symptoms

(CMQCC 2021 PG140)

STROKE

Known complication of hypertension and eclampsia

Major cause of pregnancy related death

Symptoms of stroke and preeclampsia with severe features may be similar

- Elevated BP, Visual disturbances, Mental Confusion and Severe Headache
- Symptoms may be attributed to other conditions such as women's psychosis, noncompliance or drug seeking behavior
- The FAST: Face, Arm, Speech, Time assessment should be performed after any eclamptic seizure or when a patient presents with preeclampsia with sever features, and or HELLP syndrome.

(CMQCC 2021)

FAST ALGORITHM FROM THE AMERICAN HEART ASSOCIATION

Table 1: FAST algorithm from the American Heart Association

F	Assess	FACIAL droop (have patient show teeth and look for symmetry)
A	Assess	ARM drift (have patient extend both arms in front of her, looking for a drift)
S	Assess	SPEECH difficulties (e.g., have patient repeat a simple sentence, such as "The sky is blue")
T	If any of the above are present	TIME to activate the inpatient emergency response team that will allow for a thorough neurological exam and escalation to a higher level of care if needed

Used with permission from the American Heart Association 2020

(CMQCC, 2021)

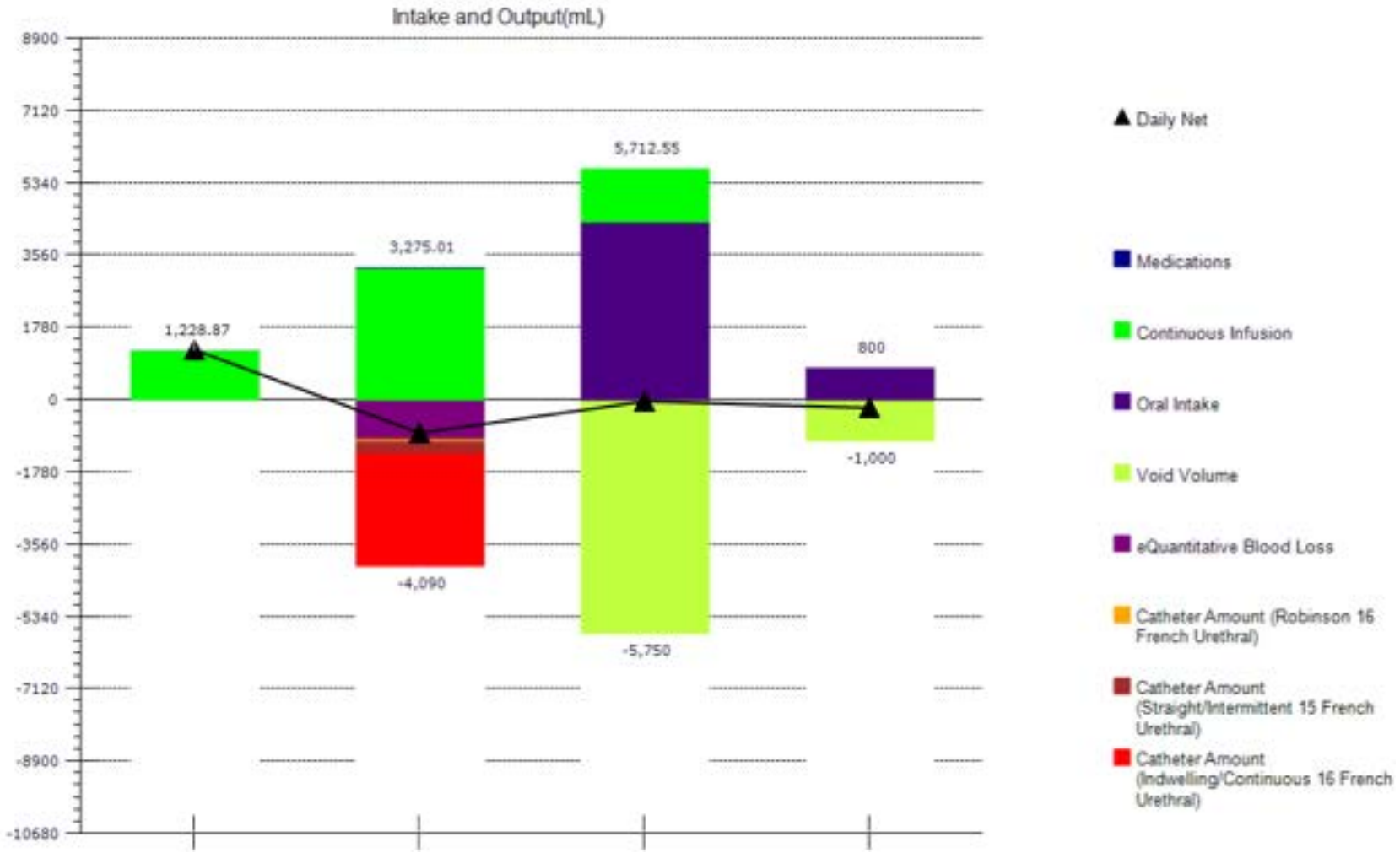
DEEP TENDON REFLEXES

- Reflect the balance between the cerebral cortex and spinal cord
- Evaluated as a baseline and thereafter
- Biceps and patellar recommended
- Classification:
  - 0 – absent, no response
  - +1 – Sluggish or diminished
  - +2 – Active or expected response
  - +3 – More brisk than expected, slightly hyperactive
  - +4 – Brisk, hyperactive, with intermittent or transient clonus

(LOWDERMILK ET AL., 2024)

IMPORTANCE OF ACCURATE I/O

- I and O balance
- Net negative vs. net positive
- Trends



LAB VALUES ASSESSED WITH HYPERTENSION DURING PREGNANCY

Complete Blood Count: hemoglobin, hematocrit, platelet count

Chemistry: electrolytes, blood urea nitrogen, serum creatinine, serum albumin, uric acid, serum calcium, serum sodium, serum magnesium, serum glucose, liver function tests, may consider amylase, lipase, and cardiac enzymes

Urine: urinalysis for protein, 24hr creatinine clearance (chronic htn or renal disease), 24hr urine for sodium excretion, specific gravity. ***. Protein Creatine Ratio ratio > 0.3 mg/dL has been shown to meet or exceed 300 mg protein on a 24 hr urine*** (Wheeler TL, 2nd, Blackhurst DW, Dellinger EH, Ramsey PS. Usage of spot urine protein to creatinine ratios in the evaluation of preeclampsia. American journal of obstetrics and gynecology. May 2007;196(5):465 e461-464.

Coagulation profile: platelet count and function, prothrombin and partial thromboplastin times, fibrinogen, fibrin split or fibrin degradation products, bleeding time, d-dimer

(SIMPSON ET AL., 2021, P. 113)

PRECAUTIONARY MEASURES FOR WOMEN WITH PREECLAMPSIA

Environmental

- Quiet
- Non-stimulating
- Lighting subdued

Seizure Precautions

- Suction equipment tested and ready to use
- Oxygen administration equipment tested and ready to use
- Call button within reach

Emergency Meds Available

- Hydralazine
- Labetolol,
- Nifedipine
- Magnesium sulfate
- Calcium gluconate

(LOWDERMILK ET AL., 2024, P.597-8

SEVERE HYPERTENSION AND HYPOTENSION IN WOMEN WITH AMPHETAMINE OR COCAINE USE

Pregnant or postpartum patients with a history of amphetamine/methamphetamine use or who have an exaggerated response to standard hypertensive medication – recommendation to notify and consult with anesthesiologist

Cocaine and amphetamine use can lead to life threatening hemodynamic instability, seizures, hyperthermia and placental abruption

Actue intoxication can resemble preeclampsia/eclampsia or malignant hyperthermia

Management of both hypertension and hypotension in patients with chronic abuse of amphetamine/cocaine may be difficult

(CMQCC 2022 – PAGES 149-151

SEVERE HYPERTENSION AND HYPOTENSION IN WOMEN WITH AMPHETAMINE OR COCAINE USE

Cocaine may cause intense vasoconstriction producing hypertension, tachycardia, ↓in uterine blood flow, arrhythmias and hyperthermia

Chronic abuse of cocaine may deplete sympathomimetic neurotransmitters resulting in hypotension and lethargy

Amphetamines cause similar effect to those of cocaine

- Overdoses may mimic preeclampsia and eclampsia and hypertension and hyperthermia may be fatal

Use of alpha and beta-blockers such as labetalol and carvedilol have not increased vasoconstriction and appear to be reasonable medications for treatment of hypertension with tachycardia

Use of hydralazine may increase maternal tachycardia

(CMQCC 2022 – PAGES 149-151

PHARMACOLOGIC TREATMENT

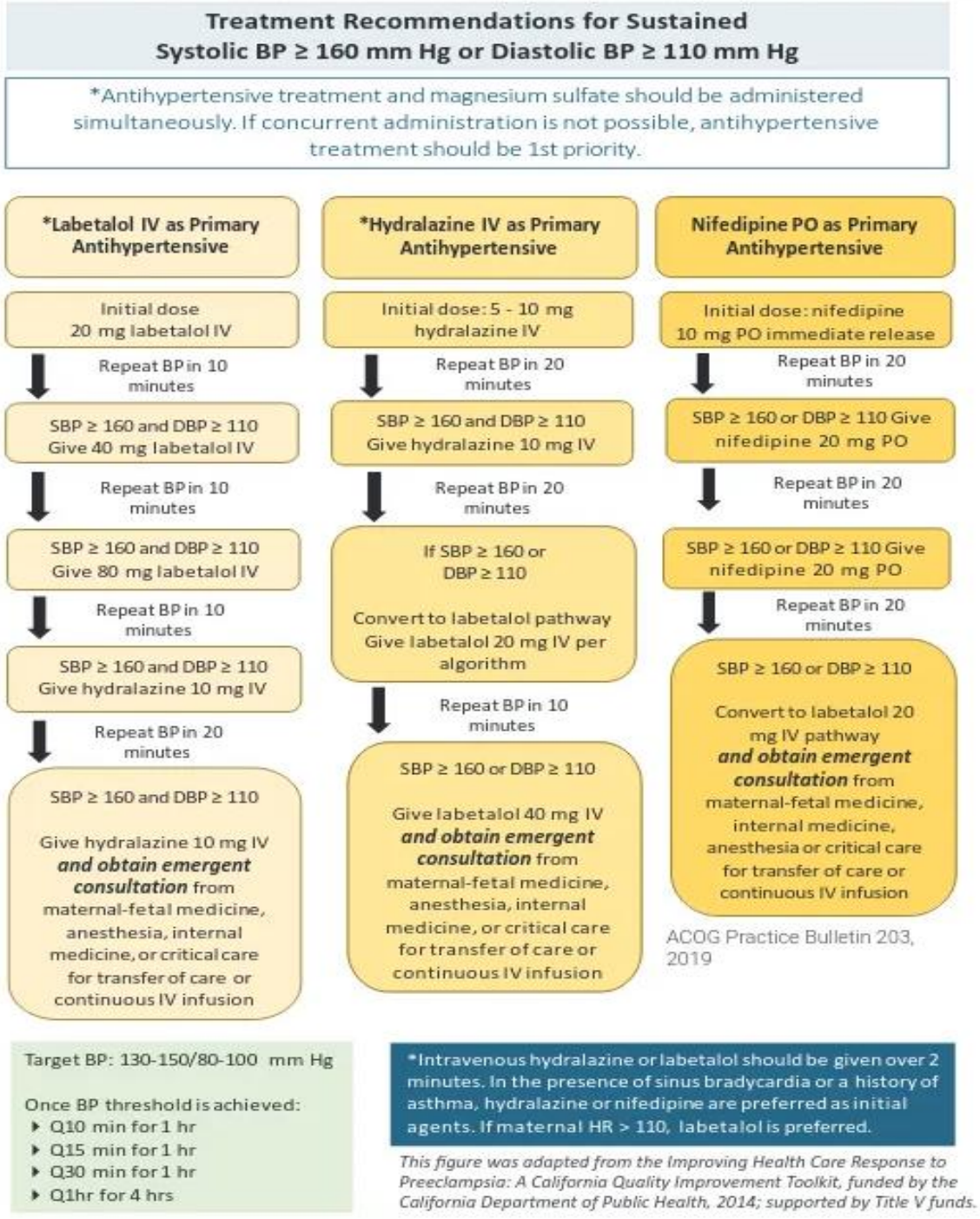
Antihypertensive therapy

- Persistent blood pressure elevations for 15 mins
- Systolic BP ≥160 mmHg, diastolic BP ≥110 mmHg
- Goal to maintain BP between 140-150/90-100 mmHg
- Management with antihypertensive therapy in women with preeclampsia **without** severe features is **not** recommended
- hydralazine, labetalol, nifedipine

Anticonvulsant therapy

- Magnesium sulfate – may initially decrease the blood pressure but the reason for administration is to decrease neurologic stimulation.
- Other anticonvulsants

(LOWDERMILK AT AL., 2024; SIMPSON ET AL., 2021)



- In the presence of sinus bradycardia or a history of asthma, hydralazine or nifedipine are preferred as initial agents.
- If maternal HR greater than 110, labetalol is preferred
  - CMQCC (2021) pg. 123

(2021) IMPROVING HEALTH CARE RESPONSE TO HYPERTENSIVE DISORDERS OF PREGNANCY CMQCC QUALITY IMPROVEMENT TOOLKIT

HYPERTENSIVE MEDICATIONS TO AVOID

Some agents, such as the angiotensin converting enzyme (ACE) inhibitors and angiotensin II receptor antagonists (ARB), are contraindicated in pregnancy:

ACE inhibitors (Ex.- Captopril, Lisinopril) – Action - ↓ blood volume and relax blood vessels. They have been associated with reduced placental circulation, intrauterine growth restriction, pulmonary hypoplasia, and fetal demise.

ARBs (Ex. Avapro, Cozaar) Action – block the effects of Angiotensin II (vasoconstrictor). They have been associated with congenital malformations of the skull and skeletal system, oligohydramnios, irreversible fetal-neonatal renal failure, and in some cases fetal demise (Leavitt, Obican, Yankowitz, 2019)

(ADAPTED FOR EDUCATIONAL PURPOSES ONLY FROM WITCHNER & AWHONN, 2021)

MAGNESIUM SULFATE

- High alert medication
- First line therapy for seizure prophylaxis
- Should be used in all patients with preeclampsia with severe features or with HELLP syndrome during labor or postpartum

(SIMPSON ET AL., 2021, P. 113)

MAGNESIUM SULFATE TOXICITY CASCADE

- Hypotension
- Absent DTRs
- Shortness of breath
- Respiratory depression or arrest
- Chest pain- Cardiac Arrest
- ECG changes (↑ PR interval, widened QRS complex, prolonged QT interval, heart block)
- If suspected, discontinue infusion, obtain serum magnesium level, & notify provider
- Antidote: Calcium Gluconate 1 g of a 10% solution

(SIMPSON ET AL., 2021)

SERUM MAGNESIUM LEVELS

mEq/L	mg/dl	Interpretation
4 – 7	5 – 9	Therapeutic
> 7	> 9	Loss of patellar reflexes
> 10	> 12	Respiratory paralysis
> 25	> 30	Cardiac Arrest

ACOG Practice Bulletin #222
Gestational Hypertension and Preeclampsia
June, 2020 and reaffirmed 2023 – Replaces PB# 202

OTHER ANTICONVULSANTS

- Should be considered if seizure reoccurs after the second loading dose of magnesium sulfate
- May be considered when use of magnesium sulfate is contraindicated or associated with increased risk of maternal complications (i.e. myasthenia gravis, markedly reduced renal function)
- If other meds are used, extreme care must be taken, and staff must be familiar with the expected side effects and potential complications
  - phenytoin (Dilantin) may cause QRS or QT prolongation and resuscitation equipment must be immediately available

(SIMPSON ET AL., 2021)

INPATIENT MANAGEMENT OF PREECLAMPSIA: POSTPARTUM

- **Delivery is not the cure!**
- Continue careful maternal assessments
- Intensity of monitoring & progression of activity vary by patient's condition
- Monitor for clinical signs demonstrating resolution of preeclampsia including diuresis and decreased edema
- Magnesium sulfate infusion continued after birth, for 24-48 hours
- Initiation of hypertensive agent if BP $\geq$ 150/100 mmHg, on 2 occasions 4-6 hours apart
- Collaborate with healthcare team to facilitate bonding and attachment if infant is in NICU
- Encourage and support lactation
- Monitor inpatient for at least 72 hours (or equivalent monitoring outpatient)
- (Follow-up with healthcare provider addressed later in the presentation)

(LOWDERMILK ET AL., 2024; SIMPSON ET AL., 2021)

ECLAMPSIA

ECLAMPSIA

- Prevalence has declined due to improved medical management of preeclampsia
- May be preceded by warning signs and symptoms or may appear suddenly in a patient with only minimal BP elevations
- Risk of neurologic deficits, aspiration pneumonia, and placental after an eclamptic seizure

(SIMPSON ET AL., 2021)

ECLAMPSIA WARNING SIGNS

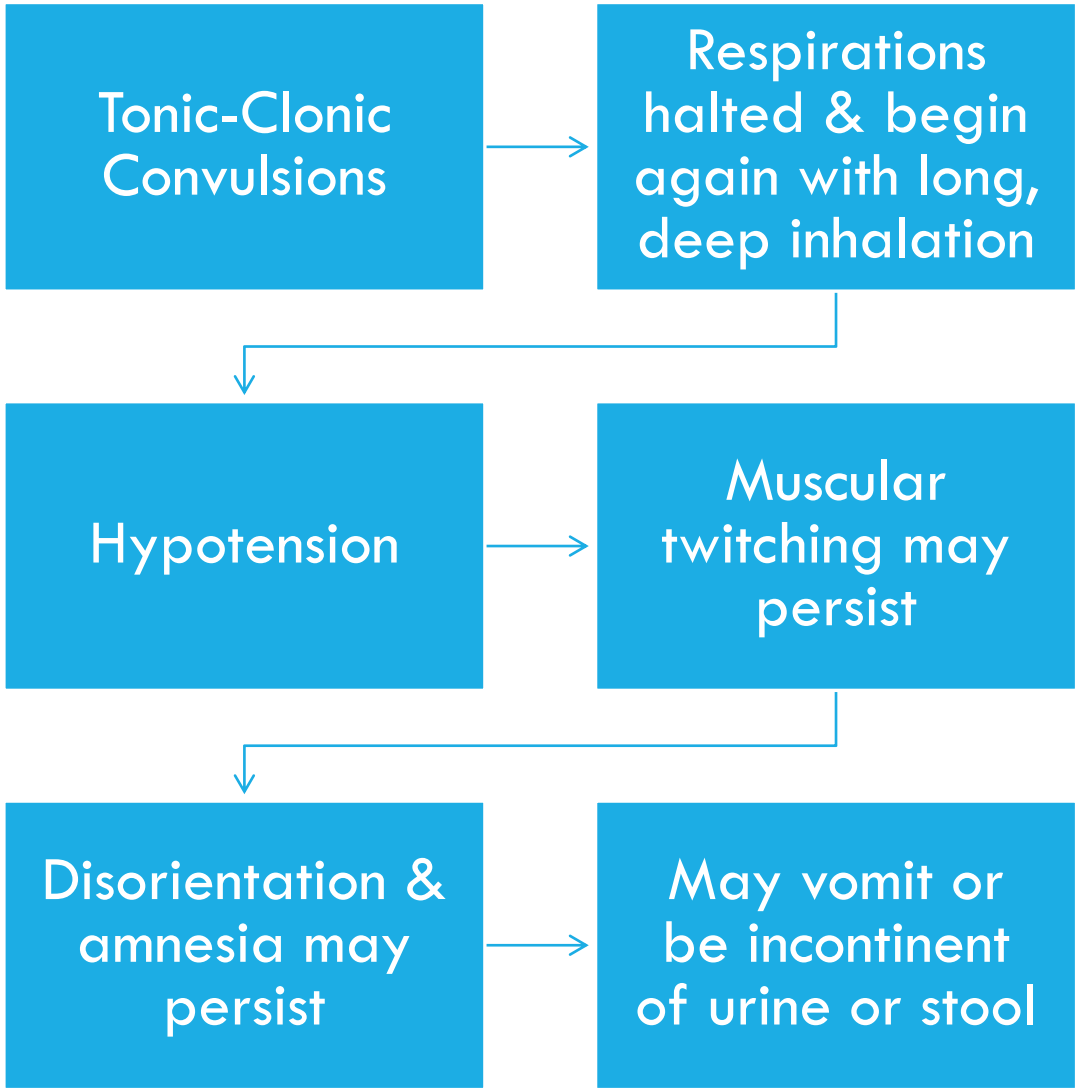
- Headache
- Blurry vision
- Photophobia
- Altered mental status
- Epigastric pain
- RUQ pain

(SIMPSON ET AL., 2021)

ECLAMPSIA CONVULSIONS

Tonic-Clonic Convulsion Signs:

- Stage of invasion: 2-3 secs eyes fixed, twitching of facial muscles
- Stage of contraction: 15-20 secs, eyes protrude and are bloodshot, all body muscles in tonic contraction
- Stage of convulsion: Muscles relax and contract alternately (clonic), respirations halted and then begin again with long, deep inhalation, coma ensues



(LOWDERMILK ET AL., 2024, P. 597-598)

WHAT IS YOUR PRIORITY FOR THE PREGNANT PATIENT WHO IS HAVING A SEIZURE?

https://i.etsystatic.com/41552120/r/il/32d8d7/5164291093/il_fullxfull.5164291093_tt4z.jpg

ECLAMPSIA INTERVENTIONS

- **Keep airway patent**
  - Turn head to one side
  - Place pillow under one shoulder or back if possible
- Call for help – *Do not* leave the bedside
- Side rails raised and padded with folded blanket or pillow
- Lower head of the bed and turn woman onto her side
- Note time of onset and duration of seizure

(LOWDERMILK ET AL., 2024)

POST CONVULSION PRECAUTIONS

https://www.google.com/url?sa=i&url=https%3A%2F%2Fappadvice.com%2Fapp%2Fguess-their-answers%2F1554731208&psig=AOvVaw0QD42F8U7Xncy0uU_0nzbx&ust=1715261213754000&source=images&cd=vfe&opi=89978449&ved=0CBIQjRxqFwoTCIjTipGU_oUDFQAAAAAdAAAAABAE

ECLAMPSIA POST CONVULSION INTERVENTIONS

- Do not leave unattended
- Observe for post-convulsion confusion, coma and incontinence
- Assess airway, breathing, pulse
- Suction as needed
- O2 10L/min via nonrebreather face mask
- Insert IV if not already in place
- Start IV fluids & monitor for potential fluid overload
- Magnesium sulfate as ordered

(LOWDERMILK ET AL., 2024)

ECLAMPSIA POST CONVULSION INTERVENTIONS (CONT.)

- Administer additional anticonvulsants if seizure reoccurs
- Vital signs until stable
- Monitor fetal, cervical, & uterine status
- Insert foley and accurate intake and output
- Expedite labs work – kidney function, liver function, coagulation studies, drug levels
- Provide hygiene and quiet environment
- Provide support to patient and family
- Prepare to assist with birth when woman is in stable condition

(LOWDERMILK ET AL., 2024)

HELLP SYNDROME

Hemolysis

- Abnormal peripheral smear
- LDH > 600 U/L
  Total bilirubin $\geq$ 1.2 mg/dL

Elevated Liver enzymes

- Serum AST $\geq$ 70 U/L
- LDH > 600 U/L

Low platelet count

- < 100,000/uL

(SIMPESON ET AL., 2021)

HELLP SYNDROME

- Women often rapidly progress from preeclampsia to the development of multiple organ involvement and damage
- Signs & symptoms: range from malaise, epigastric pain, nausea, vomiting, to non-specific viral symptoms
- High risk for maternal and fetal morbidity and mortality
  - Including DIC, pulmonary edema, renal failure, stroke
- Immediate delivery is often required, especially if patient is >34 weeks gestation or if symptoms are severe
- Assessment and management are the same as those for preeclampsia with severe features

(SIMPSON ET AL., 2021)

POSSIBLE FHR PATTERNS IN PATIENTS WITH HYPERTENSIVE DISORDERS

https://encrypted-tbn0.gstatic.com/images?q=tbn:ANd9GcQzuFrwIQbGPM_n6Tg70SRhG_CumlPONAvTHw&usqp=CAU

LATE DECELERATIONS

Chronic hypertension

- May result in chronic suboptimal transfer of oxygen and nutrients to the fetus

Preeclampsia

- Associated with abnormal vascular remodeling at the level of the spiral arteries

Can impede normal perfusion of the intervillous space

- Miller, Miller and Cypher (2022) pp. 15-21

DECREASED VARIABILITY

- Uteroplacental insufficiency may result in hypoxia and acidosis causing decreased variability
- May see IUGR and oligohydramnios
- Watch for both variables and lates
- Minimal variability
- Variability is the result of the push and pull of the parasympathetic and the sympathetic nervous system
- Remember – The autonomic nervous system requires ***oxygen*** to work at it's best

IN THE PRESENCE OF A SEIZURE WHEN THE WOMAN IS PREGNANT, THE FETAL MONITOR STRIP MAY DISPLAY A BRADYCARDIA WITH MINIMAL TO ABSENT VARIABILITY

https://st2.depositphotos.com/3837271/8402/i/450/depositphotos_84020852-stock-photo-hand-with-marker-writing-the.jpg

LONG TERM CONSEQUENCES OF PREECLAMPSIA

Preeclampsia is a significant risk factor for cardiovascular disease later in life

Education should be provided postpartum regarding cardiovascular risk reduction measures

- Smoking cessation
- Weight management
- Physical activity
- Healthy diet

Follow up with primary provider should occur within 6 months – 1 year postpartum

(SIMPSON ET AL., 2021)

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THE END

CARDIOVASCULAR DISEASE SECTION

Cardiovascular Diseases in Pregnancy and Postpartum

ACOG PRACTICE BULLETIN #212
Pregnancy and Heart Disease

Physiologic Changes in Pregnancy That Affect Cardiovascular Stress

Pregnancy is a natural stress test because the cardiovascular system undergoes structural and hemodynamic adaptations to sustain a high-volume load. An understanding of these physiologic changes is essential for health care providers.

What are those Normal Physiological Changes in Pregnancy?

As a Review
Normal Physiological changes in pregnancy

Decreased vascular resistance and peripheral vasodilation

- Decreased systemic blood pressure and mean arterial pressures [MAP]
- Peripheral edema
- Allows for adequate perfusion to end organs- The placenta is an end organ!

Increased blood volume (plasma) and hemodilution

- Dilutional anemia of pregnancy – increase in intravascular volume – Plasma is increased more than red blood cells

Increased cardiac output

- Slight increased in HR

Vascular remodeling occurs

- Spiral arteries of the uterus widen in diameter
- Vessel walls become thinner

(LOWDERMILK ET AL., 2024)

Risk Factors for Cardiovascular Disease Across the Maternal Care Continuum:

1. Race and ethnicity – non-Hispanic black women have a 3.4 times increase as compared to other ethnicities
2. Age – over 40 years of age increases maternal death from cardiac disease by 30 times
3. Hypertension in pregnancy
4. Obesity – prepregnancy especially if associated with sleep apnea

Cardiovascular Disease in Relation to Pregnancy

- Cardiovascular pathophysiologic changes of pregnancy persist for weeks postpartum.
- Normally, the heart compensates for the increased workload allowing pregnancy, labor, and the postpartum period to be well tolerated.
- If myocardial disease develops, valvular disease exists, or a congenital heart defect is present, *cardiac decompensation* may occur.

(CMQCC, 2017; Lowdermilk et al., 2024

Cardiovascular Disease

- The first presentation of cardiovascular disease may be during pregnancy or in the early postpartum period.
- ***The highest risk period for a preexisting cardiac condition to manifest is generally in the late second trimester, i.e., 24-28 weeks, or in the postpartum period.***
- Healthcare providers should maintain a high index of suspicion for underlying cardiovascular disease when a woman presents with symptoms, signs, and risk factors concerning for heart disease for as long five months postpartum.

(CMQCC, 2017)

CVD Signs and Symptoms

- Extreme fatigue
- Extreme swelling
- Weight gain
- Dyspnea
- Mild orthopnea - how many pillows does she prop with at night?
- Tachypnea
- Persistent cough
- Asthma unresponsive to therapy
- Palpitations
- Dizziness
- Syncope
- Tachycardia
- Chest pain

(CMQCC, 2017)

Cardinal Rule.....

When a woman presents to the unit and or emergency department who is pregnant or has been pregnant within the last year with any of the following symptoms:

- Shortness of Breath – Unable to complete a sentence without taking a breath
- Extreme fatigue – Example- activities of daily living which are not influenced by lack of sleep from taking care of a newborn
- Inability to lie flat when resting – Example- using 4 pillows or sleeping in a recliner to be able to breathe adequately
- Chest pain

Should Prompt Concern and Immediate Assessment of the Patient

Concerning Assessments

Vital Sign Changes:

- Resting HR $\geq$ 110 bpm
- Systolic BP $\geq$ 140 mmHg
- Respiratory rate $\geq$ 24
- O2 sats $\leq$ 95%

Assessment:

- Murmur
- Crackles in lung bases

(CMQCC, 2017; Hameed et al., 2015)

Diagnosis of Cardiovascular Disease

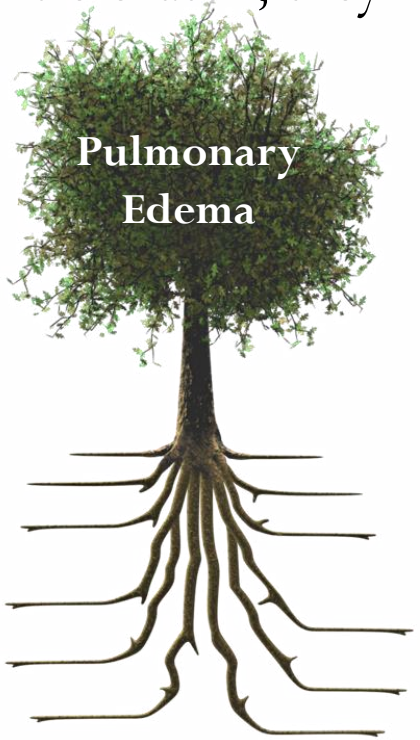
- EKG
- BNP
- Echocardiogram
  - If BNP is elevated
- Chest X-ray
  - Be aware that pulmonary edema or changes on a Chest X-ray may be misinterpreted if the root cause is not investigated and pregnancy conditions are not considered. A new diagnosis of asthma is highly unusual for an adult patient
    - This is when a consult with Maternal Fetal Medicine can be beneficial

What is a BNP

- BNP is a neurohormone secreted predominantly by the cardiac ventricles in response to volume expansion or pressure overload
- Normal levels
  - CMQCC considers anything <100 pg/ml is normal
  - Cardiologists typically use >500 pg/ml as indicative of heart failure
    - BNP levels are higher predictor value of cardiomegaly compared to chest x ray
      - CMQCC (2017) pg. 13

What if the BNP is Normal.....

- If the pregnant or post-partum patient has signs of pulmonary edema and the BNP is normal, suggesting lack of congestive heart failure, or pump failure, look for the **ROOT** cause and in this patient population, consider non-cardiogenic pulmonary edema.
  - This condition can be found in women who have hypertensive disorders in pregnancy where the vessels are "leaky" and fluid escapes from within the confines of the vessels and escapes to surrounding tissues. So even if the person's BP is elevated, they may be intravascular depleted.



Is the root cause of pulmonary edema from pump failure of the heart (cardiogenic) or leaky vessels related to hypertensive disorders of pregnancy?????

A Great Podcast

For an in-depth, easy listening explanation of Cardiac Disease in Pregnancy please access the following Podcasts:
https://www.clinicalconceptsinob.com/the-critical-care-obstetrics-podcast/

Prompts for further assessment
CVD in Pregnancy and Postpartum

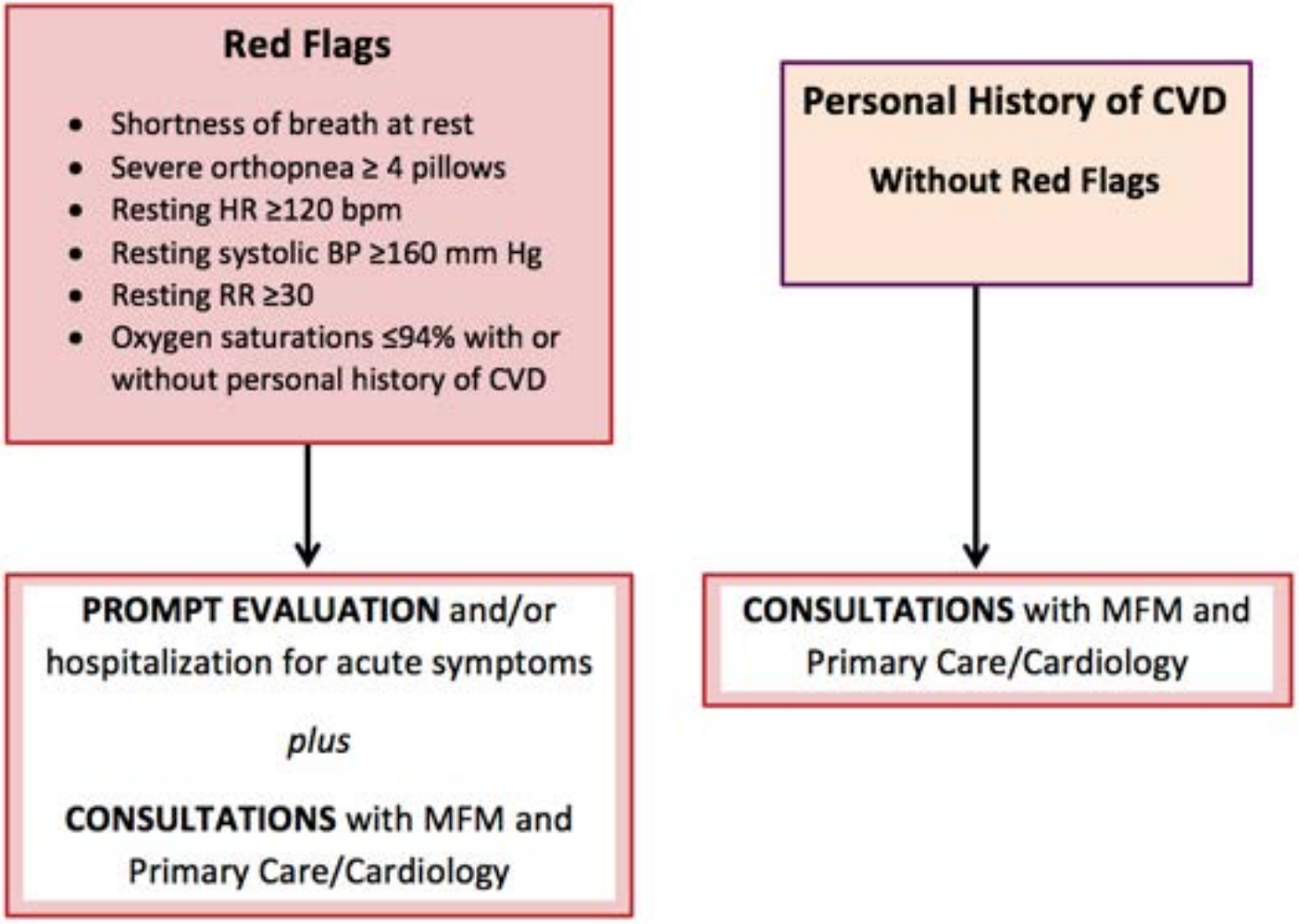
- When a pregnant or postpartum woman presents with complaints of shortness of breath, ask if she has experienced:
  - Worsened level of exercise tolerance
  - Difficulty performing activities of daily living; Unexpected fatigue
  - Symptoms that are deteriorating, especially chest pain, palpitations, or dizziness
  - New onset of cough or wheezing
  - Leg edema and if it is improving or deteriorating
  - Inability to lay flat; if this is a change; how many pillows she uses to sleep
  - Failure to lose weight or unusual weight gain, and how much
  - A history of cardiac or pulmonary conditions
  - A history of substance abuse and/or cigarette use
  - Or has been seen by other providers or in other Emergency Departments for these complaints.
    - Especially if she is post partum

(CMQCC, 2017)

Normal Pregnancy/Postpartum	Cardiac Disease
Chest discomfort	Chest discomfort with myocardial ischemia
Dyspnea	Severe dyspnea limiting activity; paroxysmal nocturnal dyspnea
Orthopnea	Progressive orthopnea
Palpitations	Cardia arrhythmia
Fatigue	Fatigue with chest pain and syncope
Dizzy spells	Dizziness in conjunction with other signs and symptoms
Syncope	Syncope with exertion/activity
Systolic murmurs	Loud, harsh, systolic murmurs, diastolic murmurs, grade III intensity
Dependent edema	Both dependent and nondependent edema
Rales in lower lungs	Rales that don't clear with deep inspiration; hemoptysis
Visible neck veins	Persistent neck vein distention
Cardiomegaly	Cardiomegaly plus hepatomegaly and ascites

(Mattson & Smith, 2016)

CVD Assessment Algorithm
For Pregnant and Postpartum Women



CARDIOVASCULAR DISEASE ASSESSMENT IN PREGNANT and POSTPARTUM WOMEN

(No Red Flags and/or no personal history of CVD, and hemodynamically stable)

SYMPTOMS

*NYHA class > II

Suggestive of Heart Failure:
- Dyspnea
- Mild orthopnea
- Tachypnea
- Asthma unresponsive to therapy

Suggestive of Arrhythmia:
- Palpitations
- Dizziness/syncope

Suggestive of Coronary Artery Disease:
- Chest pain
- Dyspnea

VITAL SIGNS
- Resting HR ≥110 bpm
- Systolic BP ≥140 mm Hg
- RR ≥24
- Oxygen sat ≤96%

RISK FACTORS
- Age ≥40 years
- African American
- Pre-pregnancy obesity (BMI ≥35)
- Pre-existing diabetes
- Hypertension
- Substance use *(nicotine, cocaine, alcohol, methamphetamines)*
- History of chemotherapy

****PHYSICAL EXAM**

ABNORMAL FINDINGS

Heart: Loud murmur or

Lung: Basilar crackles

NO

YES

≥ 1 Symptom + ≥ 1 Vital Signs Abnormal + ≥ 1 Risk Factor or

ANY COMBINATION ADDING TO ≥ 4

Consultation indicated:

MFM *and* Primary Care/Cardiology

Obtain: **EKG and BNP**
- **Echocardiogram +/- CXR** if HF or valve disease is suspected, or if the BNP levels are elevated
- 24 hour Holter monitor, if arrhythmia suspected
- Referral to cardiologist for possible treadmill echo vs. CTA vs. alternative testing if postpartum

Consider: **CXR**, **CBC**, Comprehensive metabolic profile, Arterial blood gas, Drug screen, TSH, etc.

Follow-up within one week

Results negative

Signs and symptoms resolved

Reassurance and routine follow-up

Results abnormal

CVD highly suspected

©California Department of Public Health, 2016; supported by Title V funds. Developed in partnership with California Maternal Quality Care Collaborative Cardiovascular Disease in Pregnancy and Postpartum Taskforce. Visit: www.CMQCC.org for details

Key points

Symptoms related to physiologic changes of pregnancy should be improving in the postpartum period.

Any visits to Emergency Department for dyspnea should raise suspicion for cardiovascular disease.

Women of childbearing age should be questioned about recent pregnancies, in addition to their last menstrual period (LMP).

(CMQCC, 2017)

Key points

Postpartum dyspnea or new onset cough is concerning for cardiovascular disease

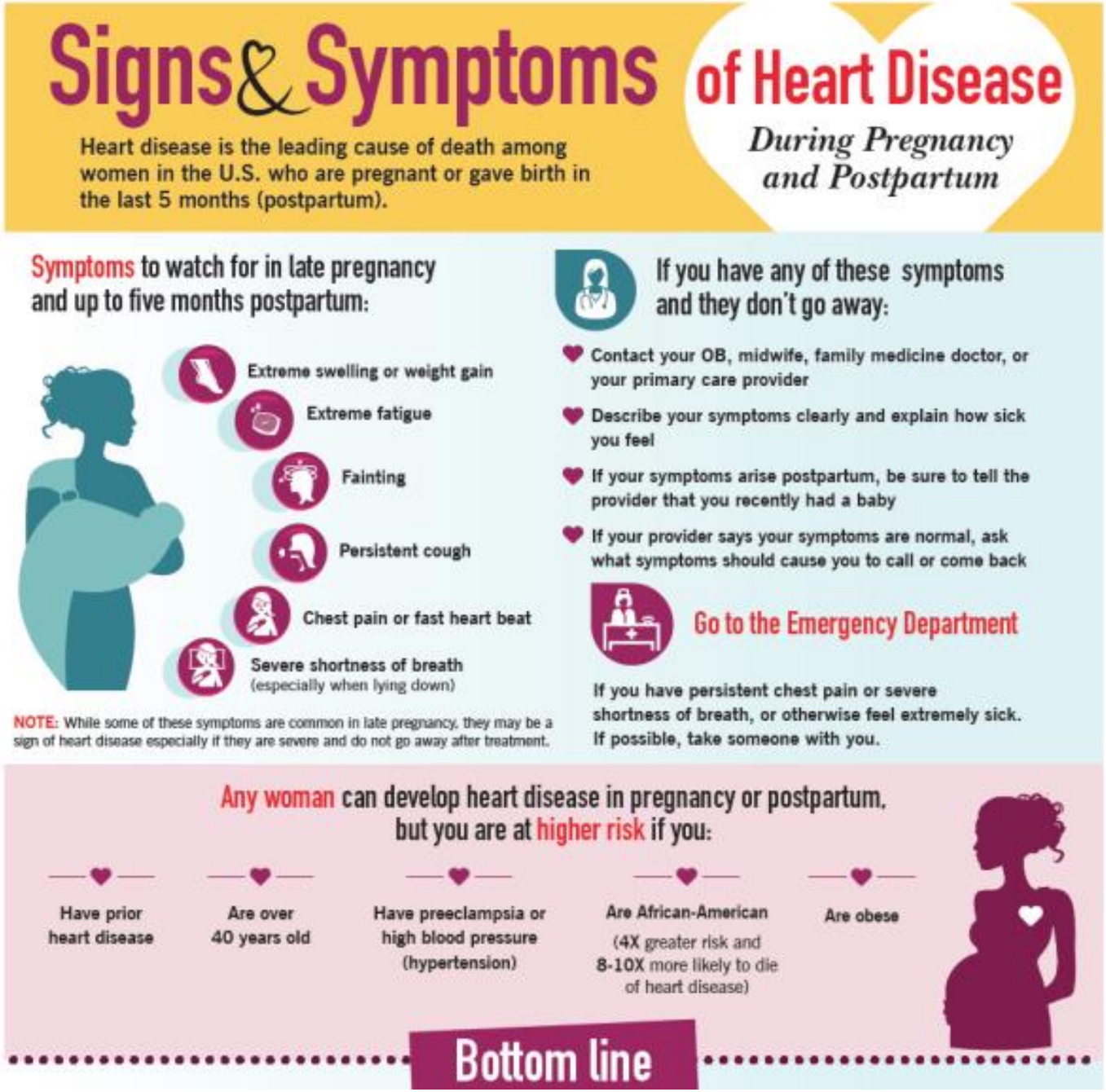
New onset asthma is rare in adults

Bilateral crackles on lung examination are most likely associated with Congestive Heart Failure (CHF)

Improvement of dyspnea with bronchodilators does not confirm the diagnosis of asthma, as CHF may also improve with bronchodilators. Likewise, a lack of response to bronchodilators should prompt the entertainment of a diagnosis other than asthma.

(CMQCC, 2017)

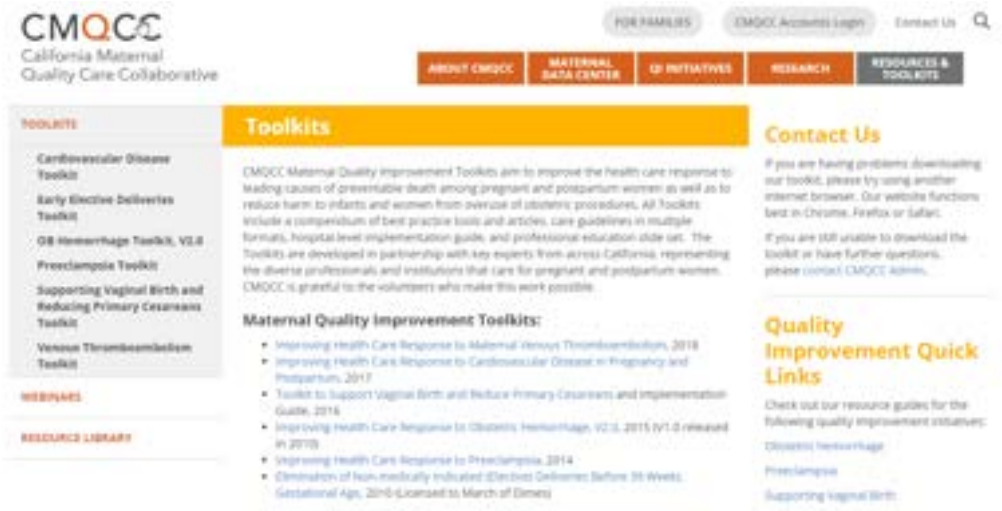
CVD & Future Risk Discharge Education



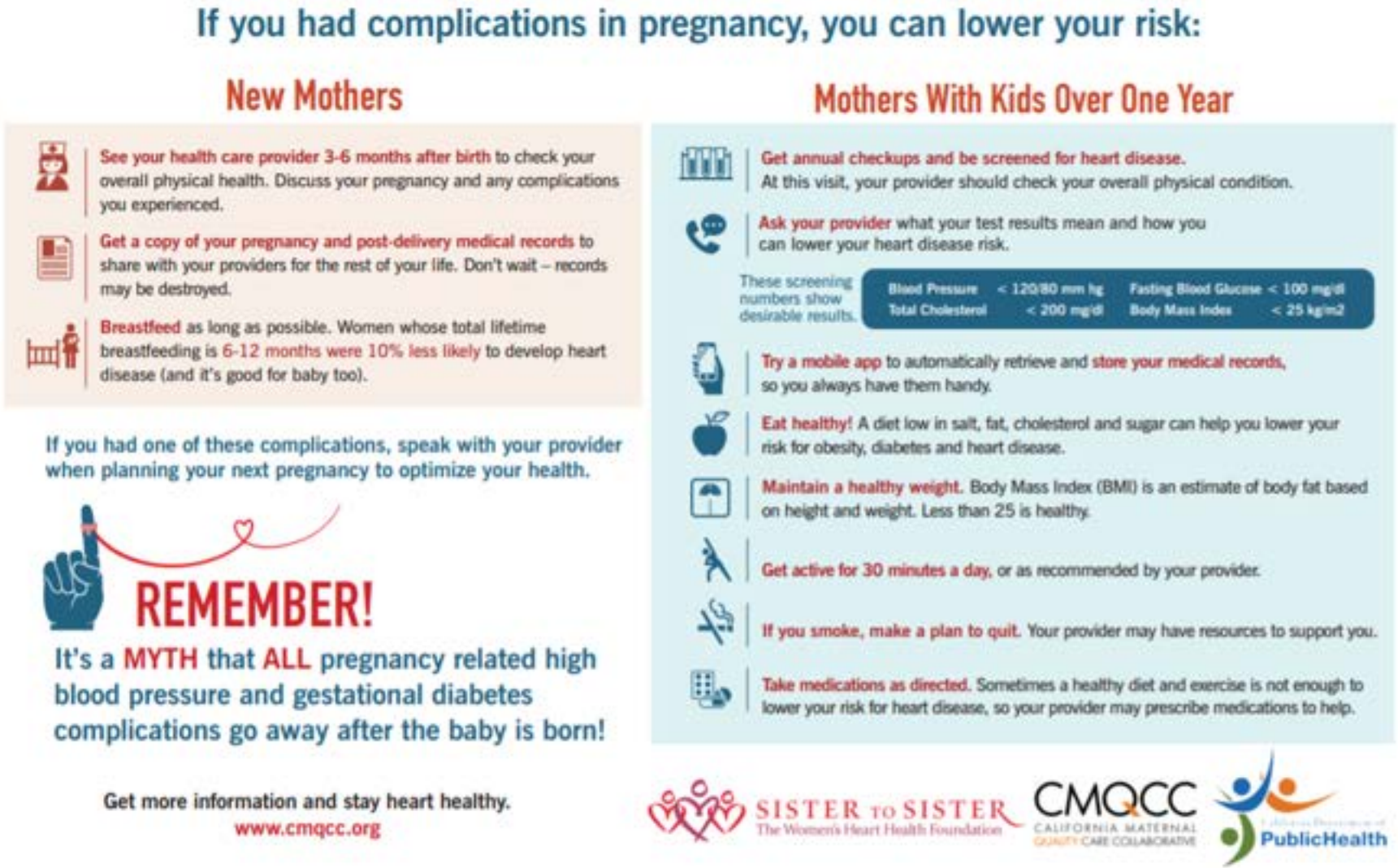
COUNCIL ON PATIENT SAFETY IN WOMEN'S HEALTH CARE

safe health care for every woman

Resources



LONG TERM CONSEQUENCES OF PREECLAMPSIA



(CMQCC, 2017)

SUGGESTED PATIENT EDUCATION TO BE POSTED IN THE EMERGENCY ROOM

Improving Health Care Response to Hypertensive Disorders of Pregnancy, a CMQCC Quality Improvement Toolkit, 2021.

CMQCC 2021 P. 199

Through Education, Recognition and Listening to Our Patients!

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