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A California Toolkit to Transform Maternity Care

Improving Health Care Response to Preeclampsia: A California Quality Improvement Toolkit

THIS COLLABORATIVE PROJECT WAS DEVELOPED BY:

THE PREECLAMPSIA TASK FORCE

CALIFORNIA MATERNAL QUALITY CARE COLLABORATIVE

MATERNAL, CHILD AND ADOLESCENT HEALTH DIVISION; CENTER FOR FAMILY HEALTH

CALIFORNIA DEPARTMENT OF PUBLIC HEALTH

Improving Health Care Response to Preeclampsia: A California Quality Improvement Toolkit

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The California Toolkit to Transform Maternity Care called “Improving Health Care Response to Preeclampsia” was reviewed by the California Department of Public Health; Maternal Child and Adolescent Health Division. This toolkit is considered a resource, but does not define the standard of care in California. Readers are advised to adapt the guidelines and resources based on their local facility’s level of care and patient populations served and are also advised to not rely solely on the guidelines presented here.

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EXECUTIVE SUMMARY

Between 1999 and 2008, the rate of maternal deaths in California nearly doubled from 8 to 14 per 100,000 live births. In African-American women the rate was approximately four times higher than in all other racial/ethnic groups.[1]

Hypertensive disorders of pregnancy are a leading cause of maternal mortality occurring in 12-22% of pregnancies.[1] These disorders are responsible for approximately 17% of maternal mortality in the United States.[2-4] The California Pregnancy Associated Mortality Review (CA-PAMR) from 2002-2004, found a similar incidence of maternal mortality related to preeclampsia and associated syndromes.[1] The overall mortality rate for preeclampsia among the CA-PAMR deaths is 1.6/100,000. In addition, these disorders are one of the leading contributors to premature birth leading to significant neonatal morbidity and mortality.[1] Tragically, all of these deaths were determined to have at least some chance to alter the outcome, and half of those were determined to have a strong-to-good chance to alter the outcome.

A major quality improvement theme that emerged in the analysis of CA-PAMR preeclampsia cases was that despite triggers that clearly indicated a serious deterioration in the patient's condition, health care providers failed to recognize and respond to these signs in a timely manner leading to delays in diagnosis and treatment. In addition, the Preeclampsia Task Force recognized the need to emphasize additional educational efforts on the importance of accurate blood pressure measurement and initiating antihypertensive medications early and aggressively to prevent progression of the disease.

In response to the alarming trends in maternal morbidity and mortality and inconsistent application of evidence based guidelines for managing hypertensive disorders, the California Maternal Quality Care Collaborative (CMQCC) and the Preeclampsia Task Force developed the toolkit, "Improving Health Care Response to Preeclampsia." The toolkit authors represent a multi-disciplinary team of experts from every corner of the state and from both large and low volume Obstetric (OB) units. The editorial process in developing the toolkit was extensive and included peer review and consensus among experts from around the state. One of the most important goals of this project was to provide tools and guidelines gleaned from the "lessons learned" from the CA-PAMR review to assist others in decreasing maternal morbidity and mortality in the future.

Many of the tools and best practices outlined in the toolkit have been developed and recommended by national and international organizations including: American Congress of Obstetricians and Gynecologists (ACOG), National Institute for Health and Clinical Excellence (NICE), United Kingdom, Society for Obstetricians and Gynaecologists of Canada (SOGC).

The toolkit provides a series of articles on best practices for hypertensive disorders that range in topic from diagnostic challenges to appropriate implementation of accepted medical therapy and recognition of institutional limitations in providing care for these complex maternal patients. Of particular interest, the toolkit addresses the management of severe preeclampsia < 34 weeks, the importance of recognition and treatment of delayed postpartum preeclampsia/eclampsia in the emergency department and early postpartum follow-up upon discharge. In addition, the toolkit provides care guideline summaries (in checklist, flowchart and table chart formats); it is organized into the following sections:

- Compendium of Best Practices: eighteen articles on multiple topics around hypertensive disorders
- Appendices: Collection of all Care Guidelines including tables, charts and forms that are highlighted in Article Sample forms for policy and procedure
- Slide set for Professional Education: slides that summarize the problem of and the best practices for preeclampsia to be used for local education and training

CMQCC and the California Department of Public Health (CDPH), Maternal, Child and Adolescent Health (MCAH) Division collaborated to develop and disseminate this toolkit using Title V MCH funds provided by CDPH-MCAH. The goal of this toolkit is to guide and support obstetrical providers, clinical staff, hospitals and healthcare organizations to develop methods within their facilities for timely recognition and organized, swift response to preeclampsia and to implement successful quality improvement programs for preeclampsia that will decrease short- and long-term preeclampsia-related morbidity in women who give birth in California.

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HOW TO USE THIS TOOLKIT

COMPENDIUM OF BEST PRACTICES

The Compendium of Best Practices consists of eighteen (18) articles authored by the CMQCC Preeclampsia Task Force. The articles highlight the current practices and recommendations for optimal care for hypertensive disorders that range in topic from diagnostic challenges to appropriate implementation of accepted medical therapy to recognition of institutional limitations in providing care for these complex maternal patients.

Most articles provide topic-specific tools for use at your facility. For example, the article titled, “Early Recognition” provides a tool to help clinicians recognize and respond to the evolving progression of preeclampsia. Each article also provides topic-specific recommendations for optimal care, evidence grading for the literature reviewed and full references.

PREECLAMPSIA CARE GUIDELINES

The Preeclampsia Care Guidelines provide summary information to assist with the identification and response to Preeclampsia/Eclampsia. One of the most important goals of this project was to provide tools and guidelines gleaned from the “lessons learned” from the CA-PAMR review to help others avoid similar maternal mortalities in the future.

SLIDE SET FOR PROFESSIONAL EDUCATION

A comprehensive slide set will be included in this toolkit for use by clinicians, educators and hospital administration. The slide set will include background information about the problem of hypertensive disorders and outline the key elements of the toolkit to provide support and guide providers, clinical staff, hospitals and healthcare organizations to develop strategies to improve early recognition and response to preeclampsia.

BACKGROUND, PREPARATION AND MANAGEMENT

The Best Practice articles that follow are topic-specific and include background information, current literature review and recommendations for clinicians who are preparing to respond to preeclampsia. In each article, a “grade” is provided for the level of evidence found in the literature to support the topic recommendations made by the Task Force. Many articles include specific tools—topic specific forms, tables or appendices—that are included at the end of each article.

The Compendium of Best Practices provides a broad range of background information for preeclampsia and provides the current literature and expertise from which the summary care guidelines were developed.

Table 1: Evidence Categories

Type of Study or Evidence	
I	Evidence obtained from at least one properly designed randomized controlled trial
II-1	Evidence obtained from well-designed controlled trials without randomization
II-2	Evidence obtained from well-designed cohort or case-control analytic studies, preferably from more than one center or research group
II-3	Evidence obtained from multiple time series with or without intervention. Well done QI studies with statistical process control analyses (or the like) fall into this category. Dramatic results in uncontrolled experiments also could be regarded as this type of evidence
III	Opinions of respected authorities, based on clinical experience, descriptive studies, or reports of expert committees

Level of Recommendations	
A	Recommendations based on high quality and consistent evidence
B	Recommendations based on limited or inconsistent evidence
C	Recommendations based primarily on consensus and expert opinion

Adapted from United States Preventive Services Task Force (USPST) and ACOG

INTRODUCTION AND HISTORICAL PERSPECTIVE

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Hypertensive disorders of pregnancy are one of the most common medical disorders of pregnancy, occurring in 12-22% of pregnancies.[1] These disorders are responsible for approximately 17% of maternal mortality in the United States.[2,3] The California Pregnancy-Associated Mortality Review (CA-PAMR)[3], found a similar incidence of maternal mortality related to preeclampsia and associated syndromes, such as severe preeclampsia, eclampsia and HELLP (**H**emolysis, **E**levated Liver enzymes, **L**ow **P**latelet Count) from 2002-2004. The California Pregnancy Associated Mortality Review (CA-PAMR)[1], found a similar incidence of maternal mortality related to preeclampsia and associated syndromes from 2002-2004. In addition, hypertensive disorders are one of the leading contributors to premature birth leading to significant neonatal morbidity and mortality. Delivery of the fetus and placenta is an essential and critical component of the management of this disease. Induced premature delivery, placing the preterm newborn at significant risk, is often necessary to preserve the pregnant patient's health and life. The cost of preserving maternal health is a potential increase in the incidence of preterm delivery.

The association between preeclampsia and maternal mortality has been noted in the medical literature for over 150 years. Physicians in Great Britain and France identified the presence of albumin in the urine of pregnant women and edema as factors in the development of eclampsia in the mid-1800s. With the development of the sphygmomanometer in 1888, physicians recognized that elevated blood pressure was associated with eclampsia, leading to the triad of proteinuria, edema and hypertension being universally recognized as precursors to eclampsia. The term preeclampsia was introduced as a means to recognize the time period where delivery could potentially be used to prevent the progression to eclampsia. Organizational efforts to introduce prenatal care as an intervention to prevent and treat conditions of pregnancy that contributed to high maternal mortality rates largely addressed the identification and treatment of preeclampsia and eclampsia. The current pattern of prenatal care visits closely reflects the recommendations published by the Children's Bureau in 1924.[4]

Major emphasis has been placed on the prevention of eclamptic seizures, which are associated with a significant increase in both maternal and neonatal morbidity and mortality. The use of magnesium sulfate to prevent and treat seizures has been well accepted throughout the world as the standard of care.[5,6-8] The current standard of practice is to administer magnesium sulfate for seizure prophylaxis in patients with severe preeclampsia. Seizure prophylaxis for treatment of preeclampsia without severe features (mild) remains controversial.

Historically, less emphasis has been placed on the control of blood pressure to prevent stroke, and this aspect of management has recently been identified as a major gap in knowledge and application of proven therapeutic interventions. Treatment of systolic blood pressure at levels of equal to or greater than 160, and/or diastolic blood pressure of equal to or greater than 105 has been emphasized by Martin et al.[9] However, the clinician may choose to institute therapy at lower levels of systolic and/or diastolic blood pressures. (Please refer to National Institute of Health and Clinical Excellence Guidelines).[2] The data from the CA-PAMR review from 2002-2004 confirmed the importance of this approach, as lack of timely therapeutic intervention at these levels of blood pressure was a consistent finding in patients dying of cerebrovascular accident (CVA) in the setting of preeclampsia/eclampsia.

There is little dispute that delivery of the fetus and placenta is the most important intervention in the treatment algorithm for preeclampsia/eclampsia. The aphorism that "delivery is the cure" is widely accepted in the obstetrical world, but it is clear that in many cases the multi-system pathology continues for a variable amount of time following delivery. There is greater recognition of the importance of continued evaluation in the postpartum period following delivery of the fetus and placenta, as serious clinical consequences persist for days and even weeks postpartum. These include severe levels of hypertension, onset of eclamptic seizures, and renal dysfunction. The onset of posterior reversible encephalopathy syndrome (PRES) is often diagnosed in the postpartum period. The initial two weeks postpartum seems to be a particularly vulnerable time for these complications, but reports of sequelae of preeclampsia have been reported up to six weeks postpartum.

The preeclampsia task force was charged with developing a toolkit to address the clinical spectrum of this serious disorder and develop systematic and evidence-based approaches to management of this disease. Maternal mortality is the unfortunate outcome of this disease in a considerable number of cases, but the morbidity and long-term effect on patients' lives are significant, underreported, and underappreciated.[10,11]

Data from the CA-PAMR and other state and international reports have emphasized the high rate of preventability of morbidity and mortality in 50-70% of cases of hypertensive disorders of pregnancy.[4,10,12,13] The CA-PAMR analysis of maternal deaths from 2002-2004 revealed that all of maternal deaths related to preeclampsia had at least 'some' chance of being altered by adherence to systematic, evidence-based and well-published algorithms for management of this disease. Almost half (48%) had a 'good to strong' chance to alter the outcome. The Quality Improvement Opportunities (QIOs) identified through CA-PAMR reinforced the international data suggesting increased preventability

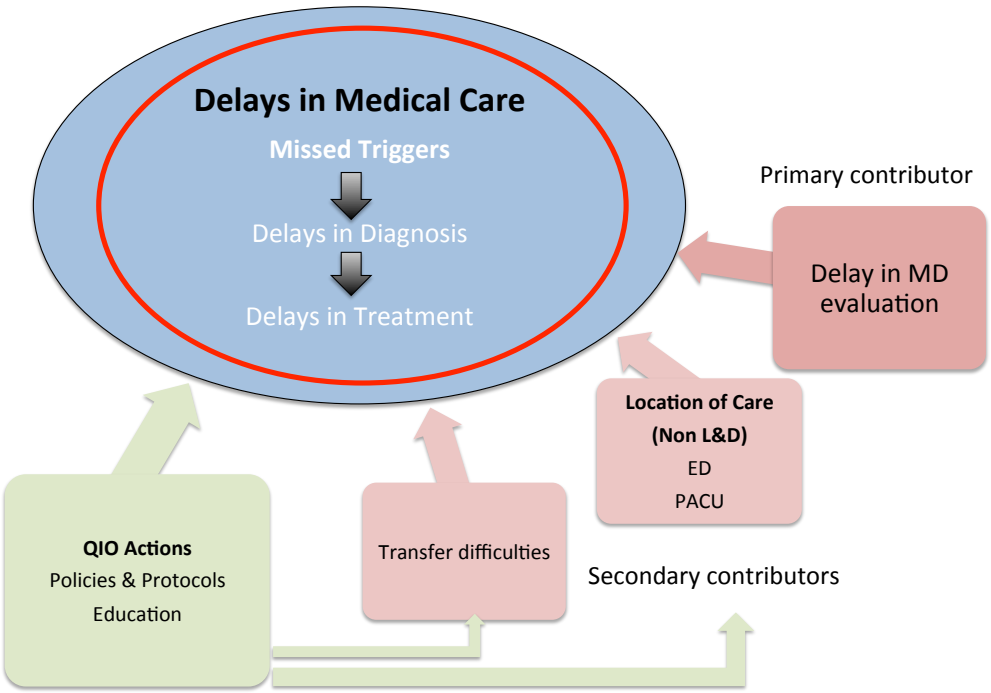

Figure 1: Major Themes in QIOs among Preeclampsia Deaths, CA-PAMR 2002-2004

of mortality by following straightforward management approaches. The 3-Delay (3D) Model was developed in under-resourced countries to address the significant incidence of maternal mortality in those countries and is validated by current data. The "3 Delays" are: 1) delay in deciding to seek care, 2) delay in reaching care in time, and 3) delay in receiving adequate treatment.[14] Unfortunately, these same delays are often present in our own state and country as reflected in Figure 1.

This toolkit has been developed to be applicable at all levels of hospitals that deliver care to pregnant women and newborn infants. The toolkit algorithms are straightforward and focus on critical action. They are flexible for use by a wide variety of practitioners who are likely to encounter women with hypertensive disorders of pregnancy including family practitioners, emergency department personnel, midwives, obstetricians, perinatologists, nursing staff, and labor and delivery staff. The focus of the toolkit is on the continuum of care from the prenatal period through delivery and postpartum.

CLINICAL PEARLS

Compiled by the Preeclampsia Task Force

ACUTE TREATMENT:

- Antihypertensive medications administered within 1 hour and ideally as soon as possible upon arrival at a healthcare facility for blood pressures of 160 systolic, and/or 105-110 diastolic or greater is a critical initial step in decreasing morbidity and mortality.

- Magnesium sulfate therapy for seizure prophylaxis should be administered to any patients with:
    - Severe preeclampsia with subjective neurological symptoms such as headache or blurry vision or right upper quadrant or epigastric abdominal pain AND
    - Should be considered in patients with preeclampsia without severe features (mild).

- Magnesium sulfate is the approved initial therapy for an eclamptic seizure.

- Algorithms for acute treatment of severe hypertension and eclampsia should be readily available or preferably posted in all labor and delivery units.

- Early post-discharge follow-up should be the norm for all patients diagnosed with preeclampsia/eclampsia. The Task Force recommends that follow-up occur within 3-7 days if blood pressure medication was used during the labor and delivery or postpartum and within 7-14 days if the diagnosis of preeclampsia was made but no medication was used. Current ACOG guidelines recommend for women in whom gestational hypertension, preeclampsia, or superimposed preeclampsia is diagnosed, that BP be monitored in the hospital or that equivalent outpatient surveillance be performed for at least 72 hours postpartum and again 7-10 days after delivery or earlier in women with symptoms.[15]

- Postpartum patients presenting with hypertension, preeclampsia or eclampsia to the Emergency Department should be either assessed by or admitted to an obstetrical service. If they are treated in the Emergency Department and discharged, adequate follow-up must be arranged with an obstetrical provider.

- All institutions should consider preparing a severe preeclampsia/eclampsia box of medications and supplies needed for the treatment of preeclampsia (see Appendix, S, pg. 124) that includes at a minimum the following: Magnesium sulfate (including tubing, syringes and needles), labetalol, hydralazine and calcium gluconate. Additional medications such as second-line antihypertensives should be institution specific.

- Treatment of hypertension in the patient with chronic cocaine/amphetamine abuse may cause an exaggerated decrease in blood pressure. Hypotension may be difficult to treat due to altered vasopressor response and depleted endogenous catecholamine stores. Unexpected, severe hypotension may also occur after regional anesthesia or general anesthesia.

PATIENT ASSESSMENT:

- A high index of suspicion for hypertensive disorders of pregnancy and the syndrome of preeclampsia/eclampsia is required when encountering pregnant women with evidence of NEW ONSET hypertension and/or proteinuria.

- Preeclampsia is typically a disease of the late third trimester; however, earlier onset of preeclampsia prior to 34 weeks is often more severe and may have an atypical presentation. This diagnosis should be considered in any patient with new onset symptoms and signs of hypertension and/or proteinuria.

- Patients presenting with vague symptoms such as headache, abdominal pain, shortness of breath, "I just don't feel right," or generalized swelling should be evaluated for atypical presentations of preeclampsia or "severe features."

- Forty percent of patients with new onset hypertension or new onset proteinuria will develop preeclampsia.[16]

- Patients presenting with preeclampsia, severe preeclampsia or eclampsia to centers with limited resources to care for either the infant or mother should be stabilized and transferred to a center that has the capacity to care for expected complications of either the mother or infant.

PROVIDER and PATIENT EDUCATION:

- Healthcare professionals often tend to minimize signs and symptoms and therefore, may miss an opportunity to alter outcome.

- Use of patient education strategies, targeted to the educational level of the patients will increase patient awareness of signs and symptoms of preeclampsia.

- The importance of adequate prenatal care and access to obstetrical services should be emphasized for all socio-economic groups.

- Use of preeclampsia specific checklists, team training and communication strategies, and implementation of a continuous process improvement strategy may reduce the morbidity associated with hypertensive disorders of pregnancy.

- The patient should be counseled that hypertensive disorders during pregnancy may predict future cardiovascular risk.

- There is no clinically validated screening strategy to predict the development of preeclampsia at this time.

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CLASSIFICATION AND DIAGNOSIS OF HYPERTENSIVE DISORDERS OF PREGNANCY

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The diagnosis and classification of hypertensive disorders of pregnancy was primarily based on ACOG Practice Bulletin No. 33, January 2002, reaffirmed 2012.[1] The current diagnosis and classification is based on Hypertension in Pregnancy: Report of the American College of Obstetricians and Gynecologists' Task Force on Hypertension in Pregnancy published November 2013.[2] The definition of hypertension in pregnancy is a blood pressure of ≥ 140 mm Hg systolic or ≥ 90 mm Hg diastolic. The criteria for the diagnosis of preeclampsia, which is a pregnancy specific syndrome usually occurring after 20 weeks of gestation, include new onset:

1. Blood pressure of 140 mm Hg systolic or higher or 90 mm Hg diastolic or higher that occurs after 20 weeks gestation in a women with previously normal blood pressure AND

2. Proteinuria, defined as urinary excretion of 0.3 grams protein or higher in a 24-hour urine specimen,[2] OR

3. In the absence of proteinuria, new-onset hypertension with the new onset of any of the following:

    a. Thrombocytopenia: platelet count less than 100,000/microliter
    b. Renal insufficiency: serum creatinine concentrations greater than 1.1 mg/dL or a doubling of the serum creatinine concentration in the absence of other renal disease
    c. Impaired liver function: elevated blood concentrations of liver transaminases to twice normal concentration
    d. Pulmonary edema
    e. Cerebral or visual symptoms[2]

4. Preexisting hypertension prior to 20 weeks gestation would be considered chronic hypertension. Preexisting proteinuria prior to 20 weeks gestation would be suggestive of chronic renal disease.

New onset hypertension without proteinuria but with signs and symptoms of major end organ involvement such as headache, upper abdominal pain, hepatic dysfunction, pulmonary edema, or severe renal dysfunction, would potentially be indicative of "atypical preeclampsia."[3] The updated ACOG Executive Summary has deleted the term 'atypical', and a diagnosis of "preeclampsia" is recommended in patients with this presentation.[2]

The term gestational hypertension is used to describe cases in which elevated blood pressure without proteinuria develops in a woman after 20 weeks gestation and blood pressure levels return to normal postpartum (National High Blood Pressure working

Group). As many as one quarter of women with gestational hypertension will develop proteinuria, i.e. preeclampsia.[4]

There is clearly potential for overlap of all these conditions, as a patient may present with gestational hypertension and progress to the preeclampsia/eclampsia syndrome very rapidly.

Table 1: Classification of hypertension in pregnancy

Chronic hypertension	• BP of ≥ 140 mm Hg systolic or 90 mm Hg diastolic predating conception • Identified prior to 20 weeks gestation • Persists > 12 weeks postpartum • Use of antihypertensive medications before pregnancy
Superimposed preeclampsia or eclampsia on chronic hypertension	• New onset in a woman with hypertension prior to 20 weeks • Sudden increase in proteinuria if already present in early gestation • Sudden increase in BP • Development of HELLP syndrome • Development of headache, scotomata, or epigastric pain
Gestational hypertension	• 140 mm Hg systolic or ≥ 90 mm Hg without proteinuria occurring after 20 weeks gestation • Transient diagnosis with normalization of BP by 12 weeks postpartum • May represent pre-proteinuric phase of preeclampsia or recurrence of chronic hypertension abated in mid-pregnancy • May evolve to preeclampsia • Retrospective diagnosis
Preeclampsia	• Occurring after 20 weeks of pregnancy • BP ≥ 140 mm Hg systolic or ≥ 90 mm Hg diastolic or higher • Proteinuria 0.3 grams protein or higher in a 24-hour urine specimen OR ≥+1 per dipstick OR P/C ratio > 0.3 mg/dL
Eclampsia	• Presence of new onset grand mal seizures in a pregnant woman with preeclampsia (rule out idiopathic seizure disorder or other central nervous system pathology such as intracranial hemorrhage, bleeding arteriovenous malformation, ruptured aneurysm) • New onset seizures 48-72 hours postpartum (other central nervous system pathology is the likely reason for the seizure after 7 days)
Severe preeclampsia	If one or more of the following criteria are present: 1. Blood pressure of 160 mm Hg systolic or higher or 110 mm Hg diastolic or higher on two occasions at least 6 hours apart while the patient is on bed rest 2. Oliguria of less than 500 ml in 24 hours 3. Cerebral or visual disturbances 4. Pulmonary edema or cyanosis 5. Epigastric or right upper-quadrant pain 6. Impaired liver function as indicated by abnormally elevated blood concentrations of liver enzymes (to twice normal concentration), severe persistent right upper quadrant or epigastric pain unresponsive to medication and not accounted for by alternative diagnoses, or both 7. Thrombocytopenia 8. Renal insufficiency
HELLP Syndrome (subset of severe preeclampsia)	**H**emolysis **E**levated **L**iver enzymes **L**ow **P**latelets

Adapted from ACOG Practice Bulletin #33, Reaffirmed 2013[1] and Hypertension in Pregnancy: Report of the American College of Obstetricians and Gynecologists' Task Force on Hypertension in Pregnancy, November 2013.[2]

Table 2: Hypertension in Pregnancy: Recommendations of the ACOG Task Force on Hypertension in Pregnancy: Executive Summary, published November 2013[2]

<table>
<tr><td>PRIOR Terminology (ACOG Bulletin #33, 2002, reaffirmed 2012)</td><td>Hypertension In Pregnancy: Report of the ACOG Task Force on Hypertension In Pregnancy, November 2013</td></tr>
<tr><td>Mild preeclampsia (BP > 140/90 mm Hg)</td><td>(The Term ‘mild preeclampsia’ is discouraged for clinical classification)
Diagnostic Criteria: Preeclampsia Without Severe Features*
<table><tr><td>Blood pressure</td><td>• Greater than or equal to 140 mm Hg systolic or greater than or equal to 90 mm Hg diastolic on two occasions at least 4 hours apart after 20 weeks of gestation in a woman with a previously normal blood pressure
• Greater than or equal to 160 mm Hg systolic or greater than or equal to 110 mm Hg diastolic, hypertension can be confirmed within a short interval (minutes) to facilitate timely antihypertensive therapy</td></tr><tr><td colspan="2">and</td></tr><tr><td>Proteinuria</td><td>• Greater than or equal to 300 mg per 24-hour urine collection (or this amount extrapolated from a timed collection)
or
• Protein/creatinine ratio greater than or equal to 0.3*
• Dipstick reading of 1+ (used only if other quantitative methods not available)</td></tr><tr><td colspan="2">Or in the absence of proteinuria, new-onset hypertension with the new onset of any of the following:</td></tr><tr><td>Thrombocytopenia</td><td>• Platelet count less than 100,000/microliter</td></tr><tr><td>Renal insufficiency</td><td>• Serum creatinine concentrations greater than 1.1 mg/dL or a doubling of the serum creatinine concentration in the absence of other renal disease</td></tr><tr><td>Impaired liver function</td><td>• Elevated blood concentrations of liver transaminases to twice normal concentration</td></tr><tr><td>Pulmonary edema</td><td></td></tr><tr><td>Cerebral or visual symptoms</td><td></td></tr></table>*Each measured as mg/dL.</td></tr>
<tr><td>Chronic hypertension
Gestational hypertension
Superimposed preeclampsia</td><td>No Change in Definition</td></tr>
<tr><td>Severe preeclampsia: If one or more of the following criteria are present:</td><td>Diagnostic Criteria: Severe Preeclampsia*
• Systolic blood pressure of 160 mm Hg or higher, or diastolic blood pressure of 110 mm Hg or higher on two occasions at least 4 hours apart while the patient is on bed rest (unless antihypertensive therapy is initiated before this time)
• Thrombocytopenia (platelet count less than 100,000/microliter)
• Impaired liver function as indicated by abnormally elevated blood concentrations of liver enzymes (to twice normal concentration), severe persistent right upper quadrant or epigastric pain unresponsive to medication and not accounted for by alternative diagnoses, or both
• Progressive renal insufficiency (serum creatinine concentration greater than 1.1 mg/dL or a doubling of the serum creatinine concentration in the absence of other renal disease)
• Pulmonary edema
• New-onset cerebral or visual disturbances</td></tr>
</table>

*Copyright permission received for use of tables inserted above.

Other common associations with Preeclampsia:

HELLP Syndrome (**H**emolysis, **E**levated **L**iver enzymes, **L**ow **P**latelets) is suggested when women with severe preeclampsia develop hepatic and hematologic manifestations as the predominant clinical picture, and is associated with an increased risk of adverse outcomes.[4-6]

Chronic Hypertension complicating pregnancy is diagnosed by high blood pressure, BP ≥140/90 or greater, known to predate conception. When preconception blood pressures are not known, elevated blood pressure detected before 20 weeks of gestation is often due to chronic hypertension. The most common etiology of chronic hypertension is most likely essential hypertension, although secondary hypertension as a result of renal disease, autoimmune disease, or vascular disease should be considered depending on the clinical presentation of the patient.

Superimposed Preeclampsia/Eclampsia chronic or gestational hypertension with superimposed preeclampsia is a common finding. Patients with underlying renal or vascular disease have a high risk of developing superimposed preeclampsia, as do those with essential hypertension.

There have been a number of recommendations to further divide preeclampsia according to the gestational age of presentation into the following categories:

Less than 34 weeks gestation – early preeclampsia

Greater than 34 weeks gestation – late preeclampsia

Preeclampsia is either mild or severe under the prior accepted definitions. However, the ACOG Executive Summary is recommending the elimination of the use of the term “mild.” The recommendation is to use the terms “preeclampsia without severe features” or “preeclampsia with severe features.” The prior rigid assignment of patients with this disease into a category of “mild preeclampsia” was often detrimental to the appropriate management of patients. This disease is often not stable or static, but may evolve from “mild“ preeclampsia to severe preeclampsia, HELLP Syndrome and/or eclampsia within a matter of hours. Rapid progression is typically seen in preeclampsia with onset prior to 34 weeks.[7]

EVIDENCE GRADING
Level of Evidence: II-2, II-3

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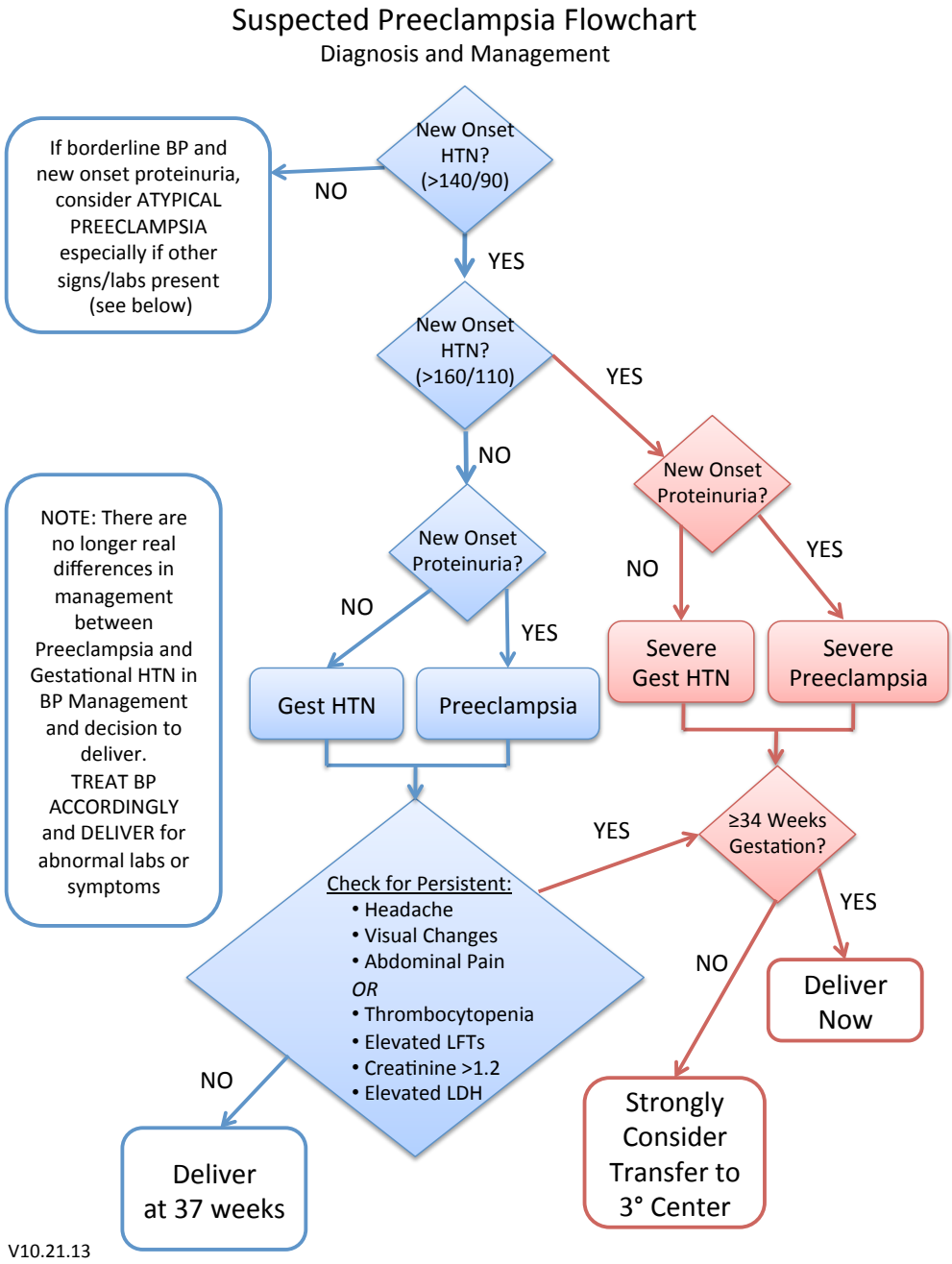
SUSPECTED PREECLAMPSIA ALGORITHM



PATIENT CARE AND TREATMENT RECOMMENDATIONS

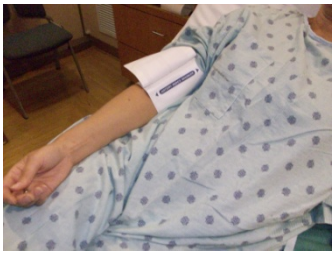
ACCURATE BLOOD PRESSURE MEASUREMENT

Kristi Gabel, RNC-OB, C-EFM, MSN, CNS, Sutter Roseville Medical Center

BACKGROUND

The current method used most often in the hospital setting for accurate measurement of blood pressure is the oscillatory method, or automated blood pressure machine, which tends to underestimate both systolic and diastolic readings by as much as 10 mm Hg[1,2] In the clinic setting and physician offices, blood pressure measurement is often used with the aneroid (mechanical type with a dial) sphygmomanometer. Refer to Table 1 for steps in obtaining accurate blood pressure measurement and Figure 1 for recommended cuff sizes.

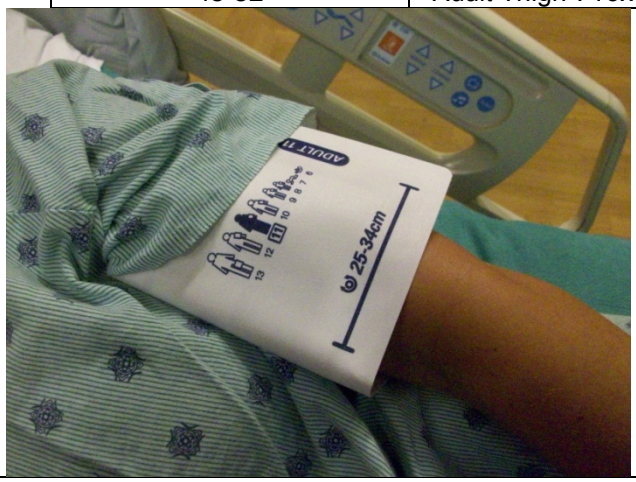
Table 1: Steps for Obtaining Accurate Blood Pressure Measurements[3]

Step 1: Prepare equipment	a. Mercury sphygmomanometer is gold standard, can use validated equivalent automated equipment b. Check cuff for any defaults c. Obtain correct size cuff: width of bladder 40% of circumference and encircle 80% of arm (See Figure 1)
Step 2: Prepare the patient: 	a. Use a sitting or semi-reclining position with back supported and arm at heart level b. Patient to sit quietly for 5 minutes prior to measurement c. Bare upper arm of any restrictive clothing d. Patients feet should be flat, not dangling from examination table or bed, and her legs uncrossed e. Assess any recent (within previous 30 minutes) consumption of caffeine or nicotine. If blood pressures are at the level that requires treatment, consumption of nicotine or caffeine should not lead to delays in instituting appropriate anti-hypertensive therapies
Step 3: Take measurement	a. Support patients arm at heart level, seated in semi-fowlers position b. For ausculatory measurement: use first audible sound (Kortokoff I) as systolic pressure and use disappearance of sound (Kortokoff V) as diastolic pressure c. Read to the nearest 2 mm Hg d. Instruct the patient not to talk e. At least one additional readings should be taken within 15 minutes f. Use the highest reading g. If greater than or equal to 140/90, repeat within 15 minutes and if still elevated, further evaluation for preeclampsia is warranted. **Do not reposition patient to either side to obtain a lower BP. This will give you a false reading.**
Step 4: Record Measurement	Document BP, patient position, and arm in which taken

Adapted from Peters RM (2008) High blood pressure in pregnancy. Nursing for Women's Health, Oct/Nov, pp. 410-422. Photo courtesy of and printed with permission by Kristi Gabel, RNC-OB, C-EFM, MSN, CNS, Sutter Roseville Medical Center 2013.

Figure 1: Recommended cuff sizes

Arm Circumference (cm)	Cuff Size
22-26	"Small Adult": 12x22cm
27-34	"Adult": 16x30cm
35-44	"Large Adult": 16x36cm
45-52	"Adult Thigh": 16x42cm



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Accurate blood pressure measurements in obese women can be quite challenging and it is extremely important to use an appropriate sized cuff. In women with an upper-arm circumference of more than 34cm, large adult cuffs or thigh cuffs can be used to improve blood pressure accuracy. For upper-arm measurements greater than 50cm, the American Heart Association recommends using a cuff on the forearm and feeling for the appearance of the radial pulse at the wrist to estimate systolic blood pressure. However, the accuracy of forearm measurement is not reliable.[4]

EVIDENCE GRADING
Level of Evidence: II and III

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EARLY RECOGNITION

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Laurence E. Shields, MD, Marian Regional Medical Center/Dignity Health
Christine H. Morton, PhD, California Maternal Quality Care Collaborative

BACKGROUND

Early recognition and treatment of worsening signs and symptoms of preeclampsia was identified as a critical factor in reducing maternal morbidity and mortality in the 2002-2004 data from the California Pregnancy-Associated Mortality Review.[1] Of the 24 deaths due to preeclampsia, 48% (n=12) had a good-to-strong chance to alter the outcome, and an additional 48% (n=12) had some chance to alter the outcome. A major theme that emerged from the quality improvement data analysis was that despite clear triggers indicating a serious deterioration in the patient's condition, health care providers failed to recognize and respond to these clinical signs in a timely manner. In fact, missed vital sign "triggers" occurred in 60% of the preeclampsia deaths. Many of these cases documented elevated blood pressures in the medical record that should have alerted the health care team to implement an immediate clinical action to treat the women with antihypertensive medication. In addition, there were other "triggers" such as: proteinuria, headache, epigastric pain, deteriorating fetal status and altered mental status that were not recognized as serious or, in some cases, were dismissed or misinterpreted. In addition, the presence of various co-morbidities (pulmonary edema, hypotension, liver hematoma) was not considered in the context of the overall clinical picture. These cases demonstrated an overall lack of critical thinking or "putting the pieces of the puzzle together" to form a diagnosis by the health care team.

Another factor that can cause delays in early recognition, diagnosis and management of preeclampsia are the physiological changes of pregnancy, such as vasodilatation as a result of increased progesterone, that leads to a period of relative hypotension in the second trimester. Symptoms, such as headache, abdominal discomfort and "swelling" secondary to edema are common in normal pregnancy. Patients presenting with these symptoms may be judged to have "normal' changes of pregnancy and the signs of deterioration may therefore be masked for several hours. This can result in missed opportunities for timely interventions that may decrease the risk of adverse outcomes and/or death. Similar findings noted in the critical care literature, found that as many as 80% of patients have physiological abnormalities outside of the normal range in the 24 hours preceding critical care admission and up to 75% of such patients have at least one potentially life-threatening factor in the 8 hours before intensive care admission.[2]

The National Health System of the United Kingdom has been using a "Modified Obstetric Early Warning System" (MEOWS) chart ever since the 2003-2005 Confidential Enquiry into Maternal and Child Health (CEMACH) Report recommended its use.[3] This MEOWS chart is designed to aid in the early recognition of severity of illness in order to allow prompt treatment of patients who are at risk for life-threatening complications.

In 2010, The Joint Commission also issued a Sentinel Alert, "Preventing Maternal Death," recommending that all centers have a process in place for recognition and response to a patient's deteriorating condition with written criteria describing early warning signs and indicating when to seek further assistance.[4]

RECOMMENDATIONS FOR QUALITY IMPROVEMENT:

1. All centers should develop:
    a. A process for both the recognition and appropriate response in the event of a patient's deteriorating condition.
    b. Written criteria describing early warning signs and intervention strategies. Whenever possible, these should be built into the electronic medical record system. [See example of a Preeclampsia Early Recognition Tool (PERT) attached.]
    c. Protocols and drills for recognizing, responding to and treating preeclampsia.

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PREECLAMPSIA EARLY RECOGNITION TOOL (PERT)

Preeclampsia Early Recognition Tool (PERT)

ASSESS	NORMAL (GREEN)	WORRISOME (YELLOW)	SEVERE (RED)
Awareness	Alert/oriented	•Agitated/confused •Drowsy •Difficulty speaking	•Unresponsive
Headache	None	•Mild headache •Nausea, vomiting	•Unrelieved headache
Vision	None	•Blurred or impaired	•Temporary blindness
Systolic BP (mm HG)	100-139	140-159	≥160
Diastolic BP (mm HG)	50-89	90-105	≥105
HR	61-110	111-129	≥130
Respiration	11-24	25-30	<10 or >30
SOB	Absent	Present	Present
O2 Sat (%)	≥95	91-94	≤90
Pain: Abdomen or Chest	None	•Nausea, vomiting •Chest pain •Abdominal pain	•Nausea, vomiting •Chest pain •Abdominal pain
Fetal Signs	•Category I •Reactive NST	•Category II •IUGR •Non-reactive NST	•Category III
Urine Output (ml/hr)	≥50	30-49	≤30 (in 2 hrs)
Proteinuria (Level of proteinuria is not an accurate predictor of pregnancy outcome)	Trace	•≥ +1** •≥300mg/24 hours	
Platelets	>100	50-100	<50
AST/ALT	<70	>70	>70
Creatinine	≤0.8	0.9-1.1	≥1.2
Magnesium Sulfate Toxicity	•DTR +1 •Respiration 16-20	•Depression of patellar reflexes	•Respiration <12

GREEN = NORMAL
Proceed with protocol

YELLOW = WORRISOME
Increase assessment frequency

# Triggers	TO DO
1	•Notify provider
≥2	•Notify charge RN •In-person evaluation •Order labs/tests •Anesthesia consult •Consider magnesium sulfate •Supplemental oxygen

**Physician should be made aware of worsening or new-onset proteinuria

RED = SEVERE

Trigger: 1 of any type listed below	TO DO
1 of any type	• Immediate evaluation • Transfer to higher acuity level • 1:1 staff ratio
Awareness Headache Visual	• Consider Neurology consult • CT Scan • R/O SAH/intracranial hemorrhage
BP	• Labetalol/hydralazine in 30 min • In-person evaluation • Magnesium sulfate loading or maintenance infusion
Chest Pain	• Consider CT angiogram
Respiration SOB O2 SAT	• O2 at 10 L per rebreather mask • R/O pulmonary edema • Chest x-ray

11.8.13.v1

Adapted from the Modified Obstetric Early Warning System (MEOWS) in "Saving Mothers Lives: Reviewing maternal deaths to make motherhood safer (2003-2005). The Seventh Report of the Confidential Enquiries into Maternal Deaths in the United Kingdom 2007

PROTEINURIA

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BACKGROUND

Proteinuria may be identified and quantified by chemstick "dip", timed urine collection or protein/creatinine ratio. A 24-hour urine collection is considered the gold standard for quantification of urine protein.[1,2] Past studies identified inconsistent results from one-time urine chemstick tests.[3,4] However, recent articles confirmed the accuracy and value of urine dipstick tests as a method to assess proteinuria.[5,6] Timed urine collections of 2-hours (h), 4-h, and 12-h have shown to correlate well with 24-h urine results and may be an acceptable alternative when there is not enough time to collect a 24-h urine.[7-9] Chemstick testing of urine, while approved as a FDA Clinical Laboratory Improvement Amendments (CLIA) waived test, nevertheless requires considerable resources to meet the College of American Pathologists (CAP) accreditation standards.[10] Some facilities routinely screen all patients who arrive for evaluation in triage with a chemstick dip while others send a sample for urinalysis to the laboratory for evaluation. Either method of assessment appears to be adequate for initial patient assessment.

The urine protein/creatinine ratio is a measurement designed to compensate for the variation in protein concentration in urine by comparing the amount of protein to the concentration of creatinine present (Figures 1, 2). Recent recommendations do not prove one method of urine testing for proteinuria superior to another and each is acceptable to use. Clinicians need to be aware of what testing methods are used by the laboratories in their practice setting(s).

Similar to gestational hypertension, isolated new onset proteinuria, in the absence of urinary tract infection (UTI), is associated with a significantly increased risk for development of preeclampsia/atypical preeclampsia.[11]

Table 1. Proteinuria Values in Preeclampsia

Preeclampsia	**Dipstick**	**24-hour urine (UNIT)**	**Protein: Creatinine ratio** (See Figures 2,3 for how to calculate)
Preeclampsia	1+	≥ 300 mg/24 hours	≥ 0.3 mg/dL

For diagnosis: Urine dipstick samples should be obtained twice, four hours apart and in absence of infection.[1,2]

RECOMMENDATIONS FOR QUALITY IMPROVEMENT:

1. Urine dipstick is an acceptable initial screen. If positive (1+ or more) further evaluation is warranted. The 24-hour urine collection is the gold standard and should be used to confirm significant proteinuria if time allows.

2. Alternative testing may include 2, 4, 12-hour urine collection or protein/creatinine ratio, if these methods are available for use at the institution.

3. The amount of proteinuria should not be used to classify preeclampsia as preeclampsia without severe features (mild) or severe, and should not be otherwise used to predict severity of disease or guide patient management.[12-14] Refer to Special Circumstances: Severe Preeclampsia at < 34 weeks for additional considerations for < 34 week gestation).

4. The level of proteinuria should not be used as a criterion for management decisions.

5. Do not delay care in order to obtain 24-hour urine results; proceed with treatment/management if other criteria for severe preeclampsia are present.

6. Obtain baseline 24-hour urine protein or validated equivalent from those patients with proteinuria present in early or pre-pregnancy. Use heightened surveillance, carefully evaluate for symptoms of severe preeclampsia, and monitor for an increase in excreted protein in this population.

7. Preeclampsia, eclampsia, severe gestational hypertension, and/or HELLP syndrome, may occur without proteinuria.[10-13,15,16] Close monitoring remains necessary for non-proteinuric pregnant patients with blood pressures ≥ 140 systolic and/or ≥ 90 diastolic.

8. The presence of new onset proteinuria in the absence of elevated blood pressure requires careful and more frequent patient surveillance (weekly to twice weekly) for the possible development of preeclampsia.[11,17,18]

Figure 1: Calculation of creatinine ratio

Calculation of urine protein: creatinine ratio
(*Urine protein* x 0.088) ÷ (*urine* creatinine)

Figure 2: Online calculator for creatinine ratio

Online Calculator for urine protein: creatinine ratio
http://www.easycalculation.com/medical/urinaryprotein.php

EVIDENCE GRADING
Level of Evidence: III-C

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ANTE, INTRA, POSTPARTUM NURSING MANAGEMENT AND ASSESSMENT OF PREECLAMPSIA: MATERNAL/FETAL ASSESSMENT AND MONITORING RECOMMENDATIONS

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BACKGROUND

Antepartum management as an outpatient can be considered for select women who have preeclampsia without severe features (mild), who have access to follow-up appointments and can adhere to the treatment plan.[1] Management of preeclampsia without severe features (mild) preeclampsia at term, severe preeclampsia, or those whose conditions have worsened will require frequent monitoring of blood pressure, urinary output, cardiac and respiratory status, and central nervous system status. Because early recognition of changes in maternal-fetal status is imperative, women with preeclampsia should be cared for by a nurse who is experienced in caring for high-risk patients and has the experience to recognize worsening signs of preeclampsia. Specific preventable errors contributing to maternal deaths include failure to control blood pressure for hypertensive women, and failure to adequately diagnose and treat pulmonary edema in preeclampsia.[2-4]

Maintaining a quiet, calm atmosphere and controlling environmental stressors are important for the patient and the family. Frequent updates for the family on the condition of the mother help them to maintain a focus on the mother and infant rather than on the illness.[5] Postpartum preeclampsia/eclampsia can develop four to six (4-6) weeks after birth among women who had no evidence of preeclampsia during their pregnancy or at the time of delivery.[6] Women and their family members should be given specific instructions prior to discharge on signs and symptoms that warrant immediate follow up.

KEY LEARNING POINTS

1. Assess for signs and symptoms of worsening or severe preeclampsia and notify provider if any of these are present:
   - Increasing blood pressure
   - Headache
   - Altered level of consciousness – agitation, restless, lethargy, hallucinations, confusion
   - Visual disturbances – blurred vision, floaters, spots, blind spot
   - Upper abdominal pain
   - Urine output <30 ml/hr
   - Shortness of breath
   - Complaints of chest pain
   - SaO2 < 95%
   - Cough

- Tachypnea > 26 breaths per minute
- Tachycardia > 100 bpm
- Adventitious breath sounds
- Eclamptic seizure
- Magnesium toxicity

2. Patient care assignments should take into account the level and expertise of the clinician or nurse assigned to care. Patients diagnosed with severe preeclampsia should be staffed with a 1:1 nurse to patient ratio, with the most experienced nurse available.

5. Women with severe preeclampsia should receive care by a multi-disciplinary team. The team should consist of an obstetric provider credentialed to perform cesarean sections, nursing, anesthesia, NICU, laboratory, blood bank, social work, and other sub-specialties as needed.

6. Utilize the following as parameters (Table 1) as recommended guidelines for the frequency of nursing assessment. The recommended assessment frequencies listed in Table 1 are guidelines and additional or more frequent assessments can be done as needed based on patient condition.[7]

Table 1. Nursing Assessment Frequency

A. Preeclampsia Without Severe Features (Mild)

	Preeclampsia without Severe Features (mild)		
	Antepartum*	Intrapartum*	Postpartum*
BP, Pulse, Respiration, SaO2	Every 4 hours	Every 60 min	Every 4 hours
Lung sounds	Every 4 hours	Every 4 hours	Every 4 hours
Deep consciousness Edema Assessment for headache, visual disturbances, epigastric pain	Every 8 hours	Every 8 hours	Every 8 hours
Fetal status and uterine activity	Every shift	Continuous	N/A
Temperature	Per facility protocol		
Intake and output	Every 1 hour with totals every 8 and 24 hours		

*This is the minimum frequency recommended for the patient NOT on magnesium sulfate.

B. Severe Preeclampsia Nursing Assessment Frequency

	Severe Preeclampsia Intrapartum and Postpartum for women on Magnesium Sulfate

BP, Pulse, Respiration, SaO2	• Every 5 mins during loading dose and q30 mins during maintenance of magnesium sulfate infusion
	• Can change to every 60 mins if any one or more of the following criteria are met:
	  ○ Preeclampsia without severe features (mild)
	  ○ BP stable without increases for a minimum of 2 hours
	  ○ No antihypertensives within last 6 hours
	  ○ Antepartum patient
	  ○ Latent phase of labor
	• Continuous SaO2 during magnesium infusion for intrapartum. For postpartum patient, check with vital signs

Lung sounds	Every 2 hours
Deep tendon reflexes & clonus, Level of consciousness Edema Assessment for headache, visual disturbances, epigastric pain	Every 4 hours
Temperature	Per facility protocol
Intake and output	Intake: • IV solutions and medication drips should all be on a pump • Total hourly intake should be ≤ 125 ml/hr • NPO with ice chips or as permitted by practitioner Output: • Insert foley with urometer Calculate hourly, end of shift, and 24-hour totals
Fetal status and uterine activity	Continuous fetal monitoring

C. Post Eclamptic Seizure and Magnesium Sulfate Toxicity

Post Eclamptic Seizure and Magnesium Sulfate Toxicity for Ante, Intra and Postpartum	
BP, Pulse, Respiration	Every 5 min until stable
O2 Sat & LOC	Every 15 min for a minimum of 1 hour
Fetal Assessment and Uterine Activity	Continuous

D. Acute BP Treatment with IV Medication

Acute BP Treatment with IV Medication: Ante, Intra and Postpartum	
BP, Pulse, Respiration	Every 5-15 min until stable
SAO2 and LOC	Every 5-15 min for a minimum of 1 hour
Fetal assessment and uterine activity	Continuous

EVIDENCE GRADING
Level of Evidence: III-C

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OUTPATIENT MANAGEMENT OF PREECLAMPSIA

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BACKGROUND

Once a diagnosis of preeclampsia has been made based on new onset systolic blood pressure ≥ 140 mm Hg and or diastolic blood pressure ≥ 90 mm Hg, and new onset significant proteinuria, or signs and symptoms of preeclampsia as seen in the Chapter: Classification and Diagnosis or Hypertensive Disorders of Pregnancy, (Table 1, pg. 20), the provider must decide if the woman has preeclampsia without severe features (mild) or severe preeclampsia. Outpatient treatment should only be considered for women with preeclampsia without severe features (mild) at less than 37 weeks and only after confirming fetal wellbeing and maternal stability.[1] It is imperative in the initial evaluation to document the severity of preeclampsia and the following evaluation is recommended: blood pressure, proteinuria assessment, CBC (complete blood count) with platelet count, AST (Aspartate Aminotransferase), ALT (Alanine Aminotransferase), Cr (Creatinine), bilirubin, and LDH (Lactate dehydrogenase).[2] The symptoms that should be assessed and documented as present or absent include headache, abdominal pain, and significant visual disturbances.

Fetal assessment should include NST (Non-stress Test) or BPP (Biophysical Profile), which includes NST plus fetal movement, tone, breathing, and heart rate and amniotic fluid volume, and ultrasound assessment of fetal growth. The goal of outpatient management in women with preeclampsia without severe features (mild) is early identification of the development of severe preeclampsia so that the woman is hospitalized and delivered if necessary, before significant maternal or fetal morbidity ensues.

If any abnormalities in either maternal or fetal assessments are consistent with severe preeclampsia, further management should occur in the hospital (see Chapter: Special Circumstances: Severe Preeclampsia At < 34 weeks, pg. 76). If preeclampsia without severe features (mild) is documented and outpatient management is considered then there should be a clear documented follow-up plan that is understood by the patient. Heightened surveillance is recommended to diagnose signs of worsening disease, which would prompt hospitalization and/or delivery. This generally includes twice-weekly maternal and fetal assessment. Maternal blood pressure, urine protein assessment and a verbal review of signs and symptoms should be performed twice per week. The fetus should have an NST and AFI (Amniotic Fluid Index) or BPP twice per week during outpatient observation. Additional maternal laboratory tests should be done as indicated if there is a suspicion of worsening disease. Once the patient develops any sign of severe preeclampsia *she should be admitted to the hospital and* her plan should change accordingly. If the patient continues to have only preeclampsia without severe features (mild) but reaches 37 weeks, the plan of treatment should include delivery. If the patient is diagnosed with severe preeclampsia, she should be admitted to the hospital and—if

gestational age is 34 weeks or greater—delivered.[3] If she is less than 34 weeks with severe preeclampsia, she should be admitted and managed at a tertiary care facility with close observation for worsening disease or complications that necessitate delivery.

EVIDENCE GRADING
Level of Evidence: C

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CHRONIC HYPERTENSION IN PREGNANCY

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BACKGROUND:

The prevalence of chronic hypertension in the child-bearing age population has been reported to vary from 0.6% to greater than 22% depending on the age, BMI, and ethnicity of the patient, with about 1-5% of pregnant women having chronic hypertension.[1,2] The rate of chronic hypertension in the pregnant population has increased significantly since 1999.[2] This increased incidence of chronic hypertension has been attributed to increasing maternal age, along with increased rates of obesity and diabetes. Pregnancies complicated by chronic hypertension are at increased risk for a variety of maternal complications[3] including superimposed preeclampsia[4,5], pulmonary edema, placental abruption, acute renal failure, cerebral vascular accidents, stroke, and maternal death.[2,6] The rate of many complications associated with superimposed preeclampsia appear to be similar to those noted with severe preeclampsia.[7]

Among women who died from a pregnancy-related cause in California between 2002-2004, 17% (N=25/145) died from preeclampsia. Among this cohort of pregnancy-related deaths, the true burden of hypertension was significantly higher.[8] Fifty-seven of 145, or 39% of the women who died during pregnancy were noted to have hypertension during the prenatal period, at labor and delivery, or postpartum. This is five-to-six times higher than in the general obstetrical population in California, suggesting hypertension is a significant comorbidity for pregnancy-related deaths. Patients with a history of chronic hypertension also represented a significant percentage of those patients whom died from cardiomyopathy.

Chronic hypertension during pregnancy is defined as blood pressure (mm Hg) ≥ 140 systolic or ≥ 90 diastolic, prior to the 20th week of pregnancy (Table 1).[9,10] It is preferable to identify chronic hypertension prior to 12 weeks gestation, in part because the normal nadir of maternal blood pressure during pregnancy occurs at approximately 16-18 weeks. As a result, it is possible that a patient presenting with second trimester blood pressures slightly below the 140/90 cut-off for the diagnosis of chronic hypertension may in fact have mild to moderate chronic hypertension. Most national committees divide the severity of hypertension into mild or severe categories. The majority (90%) of patients diagnosed with chronic hypertension will have essential hypertension. (See Table 1, pg. 41) The remaining 10% will have a secondary cause of the hypertension and patients presenting with severe hypertension first diagnosed in early pregnancy should be evaluated for secondary causes (pheochromocytoma, primary aldosteronism, Cushing Syndrome, sleep apnea, methamphetamine use, renal artery stenosis).[1,11] As a result, it is possible that a patient's chronic hypertension increases with the risk for the development of superimposed preeclampsia and the presence of proteinuria at initial evaluation also increases the risk of adverse pregnancy outcomes.[4] The most severe adverse outcomes

of pregnancy related to hypertension (i.e., stroke and cerebral vascular accidents) are most closely associated with systolic hypertension above 155-160 mm Hg.[12]

The most effective therapeutic approach to women with chronic hypertension during pregnancy is controversial. Treatment trials have been limited in size and yielded mixed results. Many experts argue that treatment of hypertension outside of pregnancy is directed towards reducing the longer-term risk of cerebral vascular and cardiac events, and the duration of pregnancy is unlikely to influence these outcomes in patients with mild chronic hypertension. Well-controlled randomized trials are limited in assisting clinicians in appropriate choices of medical therapy. Two Cochrane reviews are available detailing the results of treatment of mild and moderate chronic hypertension during pregnancy.[7,13] In these reports, the use of beta-blockers and methyldopa were both associated with reductions in progression to severe hypertension, and beta-blockers were also associated with reductions in proteinuric preeclampsia, eclampsia, and neonatal Respiratory Distress Syndrome (RDS). Other widely accepted anti-hypertensive agents in pregnancy include labetalol, hydralazine, and nifedipine; however, there are some concerns that nifedipine may be associated with a modest increased risk for the development of superimposed preeclampsia.[1,7] Neither of these reviews addresses the issue of the level of blood pressure control, and concerns have been raised that aggressive treatment may decrease placental perfusion and negatively impact fetal growth.[13]

Recommendations related to treatment have been primarily in the form of expert opinion and consensus recommendations from groups like American Congress of Obstetrics and Gynecology (ACOG), Society of Obstetricians and Gynaecologists of Canada (SOGC), and the National Institute for Health and Clinical Excellence (NICE) (Table 2). Women with chronic hypertension who are treated with medication should be closely supervised for both maternal and fetal status by a physician experienced in treating and monitoring hypertension in pregnancy.

Table 1. Diagnostic Criteria for Patients with Chronic Hypertension in Pregnancy among U.S. and Canada Organizations

Organization		Mild (mm Hg)		Severe (mm Hg)
ACOG*	Systolic Diastolic	140-159 90-109		≥ 160 ≥ 110
SOGC**	Systolic Diastolic	≥ 140 ≥ 90		≥ 160 ≥ 110
		Mild	Moderate	Severe
NICE***	Systolic Diastolic	140-149 90-99	150-159 100-109	≥ 160 ≥ 110

*American College of Obstetrics and Gynecology
**Society of Obstetricians and Gynaecologists of Canada
***National Institute for Health and Clinical Excellence (NICE)

Table 2. Treatment Recommendations for Blood Pressure (Systolic/Diastolic mm Hg) Patients with Chronic Hypertension among U.S. and Canada Organizations

Organization	Recommendation	Goal	Co-Morbidities****
ACOG*	160/105	120 -160/80-105	Not applicable
SOGC**	140-159/90-109	130-155/90-109	130-139/80-90 mm Hg
NICE***	150/100	< 150/100	< 140/90

* American College of Obstetrics and Gynecology[14]
** Society of Obstetricians and Gynaecologists of Canada
*** National Institute for Health and Clinical Excellence
****Comorbid conditions (i.e., Special circumstances) are defined as the presence of impaired renal function, pre-gestational diabetes, cardiovascular disease, SOCG 2008;30 (3) S29

KEY LEARNING POINTS

Women with chronic hypertension should receive more frequent prenatal assessments during the late second and early third trimester due to the increased rate of maternal and fetal complications. The frequency of assessment should be weekly for those with stable blood pressure control, and every 3-4 days for those that are requiring increasing dosages of blood pressure medication.

1. Women with chronic hypertension should receive antihypertensive treatment if their blood pressure is in the severe range; they should be considered for therapy if their blood pressure elevation is mild to moderate, particularly if comorbid conditions such as diabetes, collagen vascular disease, or chronic renal disease are present.

2. Women presenting for their first prenatal visit in the mid-second trimester with blood pressures that are not quite high enough for a diagnosis of chronic hypertension (e.g., 130-139/80-89 mm Hg) may in fact have chronic hypertension and should be observed more frequently for blood pressure exacerbation.

3. Cardiomyopathy should be part of the differential diagnosis and assessment for women presenting with symptoms of shortness of breath and chronic hypertension, particular if they are in a high-risk category (preexisting diabetes, collagen vascular disease, obesity, advanced maternal age, African American ethnicity, or long standing chronic hypertension).

4. Evaluation of cardiac function using echocardiography and laboratory assessment Brain Natriuretic Peptides (BNP), a test for cardiovascular disease, should be considered in these patients.

EVIDENCE GRADING
Level of Evidence: I-A, III-C

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ANTIHYPERTENSIVE AGENTS IN PREECLAMPSIA

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BACKGROUND

Early treatment of hypertension has consistently been found to reduce the incidence of hypertensive crisis, and data from multiple case studies revealed increased rates of heart failure, pulmonary edema, stroke and death when antihypertensive medications were not used in women with severe gestational hypertension or severe preeclampsia.[1] According to ACOG, a hypertensive emergency is an acute-onset, severe hypertension that is persistent for 15 minutes or more.[2]

Treatment should be initiated for blood pressures that are ≥160 mm Hg systolic or 105-110 mm Hg diastolic.[3] It should be noted that others have suggested that treatment should be initiated at a lower threshold of 155/105 if the primary goal is to reduce maternal intracranial hemorrhage, which remains the leading cause of death from preeclampsia.[4]

The goal of blood pressure control is not to return it to "normal" but rather to lower it to a range of 140-160/90-100 mm Hg, a level at which the risk of intracranial hemorrhage is reduced. Lowering the blood pressure below this range may reduce placental perfusion and harm the fetus.[4,5]

NOTE: Treatment of hypertension in the patient with chronic cocaine/amphetamine abuse may cause an exaggerated decrease in blood pressure. Hypotension may be difficult to treat due to altered vasopressor response and depleted endogenous catecholamine stores. Unexpected, severe hypotension may also occur after regional anesthesia or general anesthesia. (See Appendix T, pg.127.)

KEY LEARNING POINTS

1. Antihypertensive therapy is reserved for women with systolic blood pressure greater than 160 mm Hg or diastolic blood pressure greater than 105-110 mm Hg. Increasingly, risk of stroke is felt to be correlated with maximum systolic blood pressure.[3,6,7]

2. Hydralazine and labetalol are the two "first line" agents used for hypertension in preeclampsia. Hydralazine is an arteriolar dilator that reduces blood pressure but may cause tachycardia. Possible side effects are headache, risk of delayed maternal hypotension, which can be associated with fetal bradycardia, and rarely, upper abdominal (e.g., "epigastric") pain, which may be confused with worsening

preeclampsia. Labetalol is a combined alpha and beta-blocking agent, which reduces blood pressure by dilating arterioles and decreasing heart rate. Labetalol should be administered intravenously for acute hypertensive emergencies.[2] Asthma, cocaine and amphetamine use (including methamphetamine) is a contra-indication for labetalol use. (See Appendix T, pg. 127.)

3. Oral nifedipine (calcium channel blocker), IV esmolol (beta blocker) and IV nicardipine (calcium channel blocker) are second line drugs. Esmolol, is a very short-acting agent, and can cause the baseline fetal heart rate to decrease, but often resolves rapidly when esmolol is stopped.

4. First line therapy recommendations for acute treatment of critically elevated BP in pregnant women (160/105-110 mm Hg) are either with IV labetalol or hydralazine (see algorithms in Medication section, pg. 50)[2,3] In the event that acute treatment is needed in a patient without IV access oral nifedipine may be used (10 mg) and may be repeated in 30 minutes.[8] PO nifedipine appears equally as efficacious as IV labetalol in correcting severe BP elevations.[9] Oral labetalol would be expected to be less effective in acutely lowering the BP due to the slower onset to peak and thus should be used only if nifedipine is not available in a patient without IV access.[9]

Hypertensive Medication Administration Oral versus IV	
IV Labetalol • Onset: 2-5 min • Peak: 5 min	IV Hydralazine • Onset: 5-20 min • Peak: 15-30 min
PO Labetalol: • Onset: 20 min-2 hrs • Peak: 1-4 hrs	PO Nifedipine • Onset: 5-20 min* • Peak: 30-60 min

*PO, not sublingual nifedipine onset of action is 15-30 minutes depending upon the source.[8,10,11]

5. Sodium nitroprusside is a very potent vasodilator that acts immediately and is rarely used. It must be used by experienced providers accompanied by invasive (e.g., an arterial line) blood pressure monitoring.

6. Consideration for consultation with anesthesiologists who are accustomed to the titration of vasoactive medications should be considered early for patients with uncontrolled blood pressure.

7. Placement of an arterial line may be helpful in women whose blood pressure is particularly difficult to control. There may also be cases where repeated blood studies will be necessary, e.g., magnesium levels, platelet counts, etc., and where repeated venipunctures may be difficult.

8. Women with severe hypertension requiring antihypertensive medications need to be observed carefully for signs of pulmonary congestion such as agitation, low oxygen saturation, cough, or rales on lung exam suggesting pulmonary edema or heart failure. Careful monitoring should be implemented.

9. Proper lateral positioning should be employed for these patients, since aortocaval compression can exacerbate uteroplacental insufficiency due to preeclampsia itself.

10. One of the most common and severe complications is hypertensive encephalopathy or Posterior Reversible Encephalopathy Syndrome (PRES).

RECOMMENDATIONS FOR QUALITY IMPROVEMENT:

1. Timely initiation of medication for treating elevated blood pressure is critical. Initiation of therapy within 60 minutes is recommended. However, every attempt should be made to initiate therapy within 30 minutes after confirmation of severe range blood pressures if possible. Initial therapy should consist of labetalol 20 mg or hydralazine 5-10 mg IV over 2 minutes. Hydralazine begins to have an effect within 5-20 minutes with its maximum effect occurring at 15-30 minutes. Labetalol onset is within 2-5 minutes and has its maximum effect after 5 minutes. (See Appendix X, pg. 137).

2. Implementation of a “Preeclampsia Box” (see Appendix S, pg. 126) will assist in the initiation of rapid delivery of medication.

3. Maximum cumulative IV administered doses should not exceed the following: hydralazine 25 mg; labetalol 220 mg in 24 hours.[3]

4. The goal for blood pressure control is 140-160/90-100. Do not try to lower the blood pressure to “normal.”

5. The anesthesiologist should be seen as a resource for invasive blood pressure monitoring (if required) and medication titration.

6. An arterial line can be useful for acquiring multiple blood samples as well as for arterial pressure measurement.

SAMPLE PREECLAMPSIA/ECLAMPSIA MEDICATION BOX

Each institution should prepare its own medication box specific to its protocols.

L&D Severe Preeclampsia & Eclampsia Box – Content and Dose Guideline	
Magnesium 20 grams/500 ml bag	**IV (Use Magnesium Sulfate Continuous Infusion under L&D protocol in Alaris Pump Library):** *Initial (Loading Dose):* 4-6 g (100 ml – 150 ml) over 20 minutes *Maintenance Dose:* 1-2 g/hour (25 ml/hr – 50 ml/hr) continuous infusion
Labetalol 100 mg/20 ml vial	***Initial: Draw 4 ml from the vial.*** **20 mg (4 ml)** IV bolus followed by **40 mg (8 ml)** if not effective within 10 minutes; then **80 mg (16 ml)** every 10 minutes (maximum total dose of 300 mg/60 ml)
Hydralazine 20 mg/ml vial	***Initial: Draw 0.25 ml from the vial.*** **5-10 mg (0.25-0.5 ml)** doses IV every 15-20 minutes
Esmolol 100 mg/10 ml vial **(By Anesthesiologists ONLY)**	**1-2 mg/kg (0.1-0.2 ml/kg)** IV over 1 minute
Propofol 10 mg/ml, 20 ml vial **(By Anesthesiologists ONLY)**	**30-40 mg (3-4 ml)** IV bolus
Calcium gluconate 1000 mg/10 ml vial	1000 mg/10 ml IV over 2-5 minutes
Labetalol 200 mg tablets	200 mg PO and repeated in 30 minutes if needed
Nifedipine 10 mg PO	10 mg PO in 30 minutes if needed
Supply contents	3 ml, 10 ml, and 20 ml syringes, appropriate needles and appropriate tubing sets

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EVIDENCE GRADING
Level of Evidence: III-C

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MAGNESIUM SULFATE

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BACKGROUND

Magnesium sulfate is the primary medication used in the prevention and management of eclamptic seizures and exerts its effect by depressing the central nervous system.[1]

In the setting of severe preeclampsia, magnesium sulfate has been shown to significantly reduce the rate of eclampsia compared to placebo, phenytoin, nimodipine, or diazepam. In the setting of eclampsia, magnesium sulfate has been demonstrated to be superior to diazepam, phenytoin, or lytic cocktails in reducing the risk of recurrent seizures as well as reducing the risk of maternal death.[2-7] However, controversy surrounds the use of magnesium in the setting of preeclampsia without severe features (mild) with some studies finding no difference and others alluding to a potential benefit.[8,9] The Magpie Trial demonstrated the numbers of women who needed to be treated in order to prevent one seizure was 63 in subjects with severe preeclampsia and 109 in those with preeclampsia without severe features (mild).[2] A similar rate of eclampsia (1.1%) was observed when magnesium sulfate was not used in women with less severe disease.[10]

The current ACOG Hypertension in Pregnancy publication has the following statement regarding magnesium sulfate therapy for preeclampsia without severe features:[11]

> "For women with preeclampsia with systolic BP of less than 160 mm HG and a diastolic BP less than 110 mm HG and no maternal symptoms, it is suggested that magnesium sulfate not be administered universally for the prevention of eclampsia." (Quality of Evidence: Low; Strength of recommendation: Qualified)
>
> "When the task force has made a 'qualified' recommendation the health care provider and patient are encouraged to work together to arrive at a decision based on the values and judgment and underling health condition of a particular patient in a particular situation."

Currently, the use of magnesium sulfate in severe preeclampsia and eclampsia is supported by The American Congress of Obstetricians and Gynecologists (ACOG),[12] World Health Organization (WHO),[13] Society of Obstetricians and Gynaecologists of Canada (SOGC),[14] and the National Institute for Health and Clinical Excellence (NICE).[15] Of these, the SOGC and WHO provide statements that support the use of magnesium sulfate in the setting of preeclampsia without severe features (mild).[13,14]

Magnesium sulfate is listed by the Institute of Safe Medication Practices (ISMP) as a high-alert medication.[16] In 2004, published data about Medication Errors in Labor,

Delivery, Recovery, and Postpartum (LDRP's), magnesium sulfate was identified as the second most common product to be mismanaged in the Labor, Delivery and Recovery (LDR) area.[16]

The Association of Women's Health Obstetric and Neonatal Nurses (AWHONN) updated their nurse staffing guidelines in 2010.[17] Specific guidelines are identified for magnesium sulfate throughout the inpatient stay as follows:

- High-Risk Antepartum Care: A woman who is receiving IV magnesium sulfate should have one (1) nurse in continuous bedside attendance for the first hour of administration. Women receiving IV magnesium sulfate who are not in labor require a minimum of one (1) nurse to two (2) women.

- During labor of women with medical or obstetric complications: Women in labor who are receiving magnesium sulfate should have one (1) nurse in continuous bedside assistance for the first hour of administration and one (1) nurse to one (1) woman thereafter.

- Mother-Baby Care: Nurses caring for women receiving magnesium sulfate during the postpartum period should not have more than one (1) other mother-baby couplet.

RECOMMENDATIONS FOR QUALITY IMPROVEMENT:

1. Mark magnesium sulfate as a high-alert medication.

2. Administer loading dose from an admixture bag and not from the maintenance solution.

3. Clearly label IV solutions, tubings and connections.

4. Use luer-lock connectors at all points.

5. Require independent verification by two nurses of magnesium sulfate IV pump infusion settings.

6. Standardize the ordering, storage, preparation, and administration of magnesium sulfate.

7. Improve access to information concerning indications, risks and benefits, and treatment of toxicity.

In 2011 the Joint Commission recommended that magnesium sulfate be written out and not abbreviated as MgSO4, as this designation can be misinterpreted as MS or MSO4, which are abbreviations for morphine sulfate.[18]

Table 1: Steps for Preparation, Storage, Ordering and Administration of Magnesium Sulfate

Step 1: Preparation	a. Purchase commercially prepared standard concentrations of magnesium sulfate. b. Use standard premixed magnesium sulfate infusions in a volume different than Oxytocin to prevent accidental loading dose. c. Pharmacy should prepare any non-commercially prepared solutions. d. Use a piggy-back bag for magnesium sulfate loading doses, do not use the main infusion bag
Step 2: Storage	a. Label bags with a High Alert Sticker or distinctive colored label. b. Loading dose bags should be stored in a separate pharmacy area to prevent mix-ups.
Step 3: Order/ Transcribe	a. Use preprinted orders and order sets with the entire medication spelled out when prescribing magnesium sulfate. b. Utilize a High Alert warning on the automated dispensing machine (ADM) when magnesium sulfate is withdrawn.
Step 4: Administration	a. Label tubing used for infusing magnesium sulfate appropriately. b. An infusion pump should always be used. A 'smart' infusion pump with patient safety software activated should be used when available. **NOTE: An independent double check should be performed by two nurses when magnesium sulfate is initiated, dose is changed and at change of shift.**
Step 5: Discontinuation	a. Disconnect tubing from main line immediately when magnesium sulfate is discontinued.

Table 2: Protocol for Administration of Magnesium Sulfate

A. Magnesium Sulfate Loading and Maintenance Dosage

	Loading (gm)	Infusion Rate (min)	Maintenance
Preeclampsia and Eclampsia	4-6	15-20	Infuse at 1-2 grams per hour via infusion pump
Recurrent Eclampsia	2	5	

B. Side Effects and Toxicity and Nursing Intervention

Side Effect/Toxicity	Nursing Intervention
Cutaneous flushing, sweating, malaise, weakness, drowsiness	Keep room and patient cool (provide fan), educate patient about potential side effects; monitor patient movement and assist with getting out of bed
Transient decreased amplitude and frequency of contractions at the time of loading dose	Continuous external fetal and uterine monitoring
Soreness at IV site	Warm soaks or ice to site PRN
Decreased rate and depth of respiration, shortness of breath (SOB)	Discontinue treatment if SOB not relieved with oxygen
Diuresis	Strict Input & Output; document output per orders; magnesium sulfate is excreted exclusively in urine and an output of < 30 ml/hr may lead to magnesium toxicity
Disappearance of deep tendon reflexes	Notify physician if absent or significant change in baseline assessment
Heart block (decreased PR interval, increased QRS), chest pain	Avoid use in patients with cardiac conduction abnormalities
Pulmonary edema	Strict input and output, fluid restrict as ordered (usually 60-100 ml/hour)

Nursing care and assessment: (refer to Ante, Intra, Postpartum Nursing Management and Assessment of Preeclampsia: Maternal/Fetal Assessment and Monitoring Recommendations chapter, pg. 35)

Increase frequency of assessments as indicated by patient condition.

If magnesium sulfate is unavailable, alternative anti-seizure medications such as a benzodiazepine (e.g., midazolam, lorazepam, or diazepam) or phenytoin should be used in the setting of eclampsia. Consultation with neurology is suggested to discuss continued medical prophylaxis for seizures if magnesium sulfate is unavailable. If a patient has preeclampsia without severe features (mild) and there is no magnesium sulfate available, we suggest observation alone.

KEY LEARNING POINTS

1. Magnesium sulfate dosage: Loading dose of 4-6 gm over 15-20 minutes. Maintenance dose of 1-2 g/hr.

2. Signs of magnesium toxicity: discontinue magnesium sulfate infusion and obtain a stat serum magnesium level in the following situations: hypotension, new-onset loss of DTRs, respiratory depression respiratory arrest, oliguria, shortness of breath, chest pains, electrocardiographic changes[1,19]

3. Magnesium levels: A specific therapeutic level is not known; however, serum magnesium levels may need to be monitored in certain circumstances (e.g., renal insufficiency, absent deep tendon reflexes). In such cases, magnesium levels between 4.8-8.4 mg/dL (4-7 mEq/L) is recommended. Symptoms of magnesium sulfate toxicity are seen with the following maternal serum concentrations: loss of deep tendon reflexes (9.6-12 mg/dL) (> 7 mEq/L), respiratory depression (12-18 mg/dL) (> 10 mEq/L), and cardiac arrest (24-30mg/dL) (> 25mEq/L).

4. Calcium gluconate: the antidote for magnesium toxicity is calcium gluconate 1 g IV over 3 minutes. Repeat doses may be necessary. Calcium chloride can also be used in lieu of calcium gluconate. The suggested dose for calcium chloride for magnesium toxicity is 500 mg of 10% calcium chloride IV given over 5-10 minutes.

5. In the setting of severe preeclampsia, magnesium sulfate should be administered upon diagnosis, continued intraoperatively and until 24 hours after birth.[11]
    a. However, if the patient shows no improvement in her symptoms of preeclampsia, clinical judgment is advised and magnesium sulfate administration may need to be provided for an extended period of time.
    b. If the patient is stabilized and remote from term and being expectantly managed, we advise continuing magnesium sulfate during the course of administering corticosteroids for fetal lung maturity. Upon completion of administration of the corticosteriods, magnesium sulfate can be stopped. Magnesium sulfate should be resumed if there are escalating signs of worsening preeclampsia, eclampsia, or plans are made to proceed with delivery.

6. In the setting of preeclampsia without severe features (mild) the use of magnesium sulfate for seizure prophylaxis can be considered. Recent ACOG Executive Summary suggests that magnesium sulfate not be administered universally for the prevention of eclampsia.[11] However, not all health care organizations are in agreement with this recommendation.[14,20]

7. If an eclamptic seizure occurs postpartum and the patient is not being treated with magnesium sulfate, it should be re-administered for at least 24 hours after the last seizure.

8. If a patient has recurrent seizures despite already being on magnesium sulfate the first therapy we recommend is an additional loading dose of magnesium sulfate 2g IV over 5 minutes. If the patient continues to have seizures despite a repeat loading dose of magnesium sulfate, alternative anti-convulsants should be considered:
    a. Lorazepam (Ativan) 4 mg IV over 2-5 minutes (can repeat in 5-15 minutes) to maximum of 8 mg in 12 hours
    b. Diazepam (Valium) 5-10 mg IV slowly (can repeat every 15 minutes up to 30 mg)
    c. Midazolam (Versed) 1-2 mg IV (can repeat in 5 -10 minutes)
    d. Phenytoin (Dilantin) 1000 mg IV over 20 minutes
    e. Use of other agents such as Propofol will be institution specific

9. Consideration of severe central nervous system events must be entertained for recurrent or persistent seizures.

10. Renal insufficiency: magnesium sulfate should be used with caution in women with renal insufficiency/failure (i.e. serum creatinine greater than 1.2 mg/dL). In these patients, if they are naive to magnesium therapy, a loading dose can be administered. A lower maintenance dose can be considered with serial serum magnesium levels to guide therapy (e.g. 1 g per hour).

11. Myasthenia Gravis: magnesium sulfate is contraindicated in patients with myasthenia gravis.

EVIDENCE GRADING
Level of Evidence: I-A, I-B, II-B, III, IV

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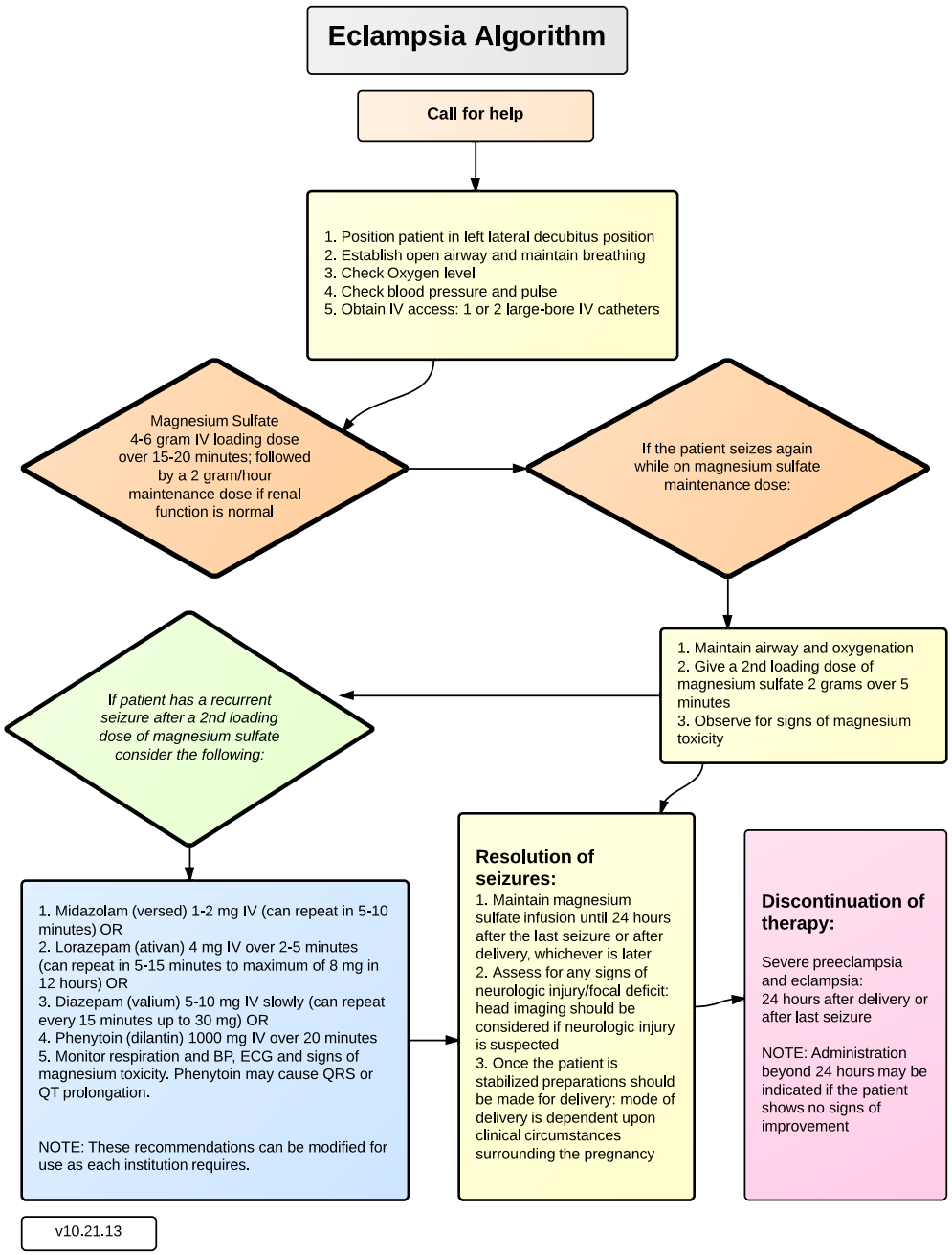
ECLAMPSIA ALGORITHM



SAMPLE PREECLAMPSIA/ECLAMPSIA MEDICATION BOX

Each institution should prepare its own medication box specific to its protocols.

L&D Severe Preeclampsia & Eclampsia Box – Content and Dose Guideline	
Magnesium 20 grams/500 ml bag	**IV (Use Magnesium Sulfate Continuous Infusion under L&D protocol in Alaris Pump Library):** *Initial (Loading Dose):* 4-6 g (100 ml – 150 ml) over 20 minutes *Maintenance Dose:* 1-2 g/hour (25 ml/hr – 50 ml/hr) continuous infusion
Labetalol 100 mg/20 ml vial	***Initial: Draw 4 ml from the vial.*** **20 mg (4 ml)** IV bolus followed by **40 mg (8 ml)** if not effective within 10 minutes; then **80 mg (16 ml)** every 10 minutes (maximum total dose of 300 mg/60 ml)
Hydralazine 20mg/ml vial	***Initial: Draw 0.25 ml from the vial.*** **5-10 mg (0.25-0.5 ml)** doses IV every 15-20 minutes
Esmolol 100 mg/10 ml vial **(By Anesthesiologists ONLY)**	**1-2 mg/kg (0.1-0.2 ml/kg)** IV over 1 minute
Propofol 10 mg/ml, 20 ml vial **(By Anesthesiologists ONLY)**	**30-40 mg (3-4 ml)** IV bolus
Calcium gluconate 1000 mg/10 ml vial	1000 mg/10ml IV over 2-5 minutes
Labetalol 200 mg tablets	200 mg PO and repeated in 30 minutes if needed
Nifedipine 10 mg PO	10 mg PO and repeated in 30 minutes if needed
Supply contents	3 ml, 10 ml, and 20 ml syringes, appropriate needles and appropriate tubing sets

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TEAMWORK AND COMMUNICATION

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Effective communication and teamwork are essential components of obstetric safety and quality.[1] Communication breakdowns and failures of organizational culture and teamwork have consistently ranked among the top three leading contributors to reported maternal and newborn sentinel events.[2,3] While it is difficult to link specific, discreet communication strategies to changes in patient outcomes, there is evidence that sustained attention to communication, teamwork, and safety can indeed improve perinatal outcomes.[4-6] Furthermore, empowerment of staff to speak up when they see problems or lack of protocol compliance has been a central component of initiatives to reduce or eliminate complications such as central line infections that were previously deemed unpreventable, and teamwork training substantially reduced surgical mortality.[7-10] However, multiple studies suggest that clinicians frequently may remain silent about their clinical concerns even when they know or believe that harm could potentially result from continuing with planned care.[11-15] Patients can also identify clinical deterioration and lack of protocol compliance, but often feel ignored if and when they raise concerns.[16-18] The seven U.S. professional organizations for clinicians who care for childbearing women assert that shared decision making, effective communication, and effective teamwork are fundamental tenets of quality patient care.[1] These principles are especially important in the setting of complications such as preeclampsia/eclampsia, where the potential for catastrophic problems is elevated and early identification and communication of disease progression is essential for effective management.[17]

Preeclampsia/eclampsia was the second leading cause of maternal deaths in the 2002-2003 California Pregnancy-Associated Mortality Review.[19] For women whose deaths were reviewed, clinician factors were identified as contributory to the death in 78% of cases, and facility or system level factors were identified as contributory to the deaths in 57% of cases. Overall, 48% of preeclampsia/eclampsia deaths were determined to have a strong or good chance to alter outcomes. Delays or failures in treatment, misdiagnosis, and denial of the severity of women's illness were key factors contributing to fatal outcomes.[19] Failures in communication, including silence in the face of clinical concern and lack of listening skills or responsiveness to concern, are likely to have contributed to delays, misdiagnosis, and treatment failures. Therefore, creating an environment where all staff—regardless of formal or informal status within the medical and organizational hierarchy—can and will speak up about their clinical concerns is critical to implementing clinical practice changes to improve preeclampsia outcomes and clinical safety.

Effective, highly reliable teams are preoccupied with the potential for failure and therefore collectively monitor and crosscheck each other and clinical processes to proactively identify potential problems. It is essential that perinatal units create an environment where

all staff are empowered to "stop the line," or formally interrupt planned care and procedures to check safety when they observe there is potential for harm.[20,21] Key skills include the ability of all staff, patients, and family members to speak up about concerns with persistence until a mutually agreeable resolution is established, and the ability to listen to each other and respond in a supportive manner regardless of whether or not they agree with their peers.[1,22] Established strategies for improving communication and teamwork are well delineated nationally and internationally, and are outlined in Table 1.[17,23]

Perspectives on the best course of action for a woman with preeclampsia in specific clinical situations may vary between physicians, midwives, nurses, the woman, and the woman's family members (see Table 2). Managing conflict traditionally has been difficult for clinicians. Key skills for handling conflict effectively include: a) addressing it rather than letting concerns fester; b) taking the time to listen carefully to the concerns of others; c) setting aside assumptions, especially regarding what motivates others' behavior; d) being willing to own part of the problem. When clinical disagreements are approached with a spirit of inquiry, good will, active listening, and dedication to shared decision-making, they can often be resolved quickly and in a manner that builds continued trust between team members.[22] In the event that concerns cannot be resolved using these or other communication strategies, all clinicians, including registered nurses, have an affirmative duty to pursue their concerns through the institutional chain of authority (Figure 1, pg. 58).[24]

Culture shifts including communication and behavior change require commitment from all staff across all disciplines. Numerous training models are available to assist in assessment, development, implementation and evaluation of communication and collaboration in complex settings. Findings of interdisciplinary team training have suggested that focused training contributes to optimizing human performance and reducing human error.[17]

RECOMMENDATIONS FOR QUALITY IMPROVEMENT

Recommendation Strength B-C

1) All units should adopt the principles outlined in "Quality Patient Care in Labor and Delivery: A Call to Action."[1]
2) Adoption of standardized protocols supports effective teamwork. Units should standardize protocols for risk assessment, medication selection and administration, and parameters for patient monitoring and primary provider notification.
3) Policy, procedure, and unit culture should outline clear lines of communication and clear avenues for escalation when appropriate.
4) Administrators must support clinicians and patient who raise concerns.
5) Conduct routine briefings and debriefings for patients with preeclampsia.

Table 1. Communication Strategies to Foster Mutual Respect and Shared Decision-making (30)

Briefings	• Set tone for team interaction • Can be a routine part of board rounds, huddles, handouts and bedside rounds
Debriefings	• Used to identify what happened, what was learned, and what can be done better next time • Can be team-building in real patient situations as well as simulation learning
Assertive Language	• Effective assertion is persistent, polite, timely, clear and solution focused • Using "CUS" as a guideline: "I'm **C**oncerned," "I'm **U**ncomfortable," "this is a **S**afety Issue"
Critical Language	• Ensures that specific, relevant, critical information is communicated; example: SBAR (Situation, Background, Assessment, Recommendation)
Closed Communication Loop	• Receiver of information restates what was said to the sender to ensure correct understanding. • Reinforces the importance of effective listening
Call Outs	• Used to confirm the phase of a process

Adapted from: Teamwork and Communication Working Group. Improving patient safety with effective teamwork and communication: Literature review needs assessment, evaluation of training tools and expert consultations, 2011. Edmonton (AB): Canadian Patient Safety Institute; TeamSTEPPS®: Strategies and Tools to Enhance Performance and Patient Safety, Agency for Healthcare Research and Quality, and Quality Patient Care in Labor and Delivery: A Call to Action. *J Midwifery Women's Health*. 2012; 57(2):112-113 and *J Obstet, Gynecol Neonatal Nurs*. 2012;41(1):151-3.

Example dialogue—Closed Communication Loop

Nurse: Hi CNM Jones, this is Nurse Smith, calling about Ms. Green in room 27 at XYZ birth center. She is 39-3/7 weeks G1P0 admitted for nausea and vomiting this morning. Her blood pressure is 150/92, no proteinuria on dip UA, but she has a sudden severe headache. I am concerned and would like you to come over now to evaluate her.

CNM: Thanks Nurse Smith, I'm going to be over later to rupture her membranes and get this labor going. She must be miserable from all that vomiting and probably has the flu.

Nurse: Hmm. I understand the vomiting could be a GI bug. But I'm concerned that the signs and symptoms Ms. Green is demonstrating could also be atypical preeclampsia, and if so, the headache would make it severe preeclampsia. I really think she needs a workup now and you should come over to evaluate her. When can I expect to see you?

CNM: Oh, I see. Please draw xyz labs right away. I'll be right over, and I'm calling the OB back-up now. Thanks for clarifying your concerns.

Nurse: Ok great. I'll draw x, y, and z labs right away. I'll let Ms. Green know you'll be in to see her in about 15 minutes.

CNM: Agreed, thank you.

Table 2. Approaches for improving communication and resolving clinical disagreements

Sources of Potential Conflict	Approach – May Need to have:
Differing expectations for information needs, communication content and style	• Team Training • Structured communication tools (e.g., SBAR-R-R structured handoffs) [a]; • Board rounds • Huddles • Attentive listening
Failure to communicate rationale Inattention to concern Concerns remain unresolved	• Routinely ask for plan and reasoning • Persistently restate concerns until resolved • Develop clear lines for problem resolution that can be activated quickly with high risk patients: e.g. laborist in house; MFM consultation available 24 hours a day; back-up list for who to call including anesthesiologists, MFM, intensivists, and administrators • Ratify plan before concluding conversation
Differing "world views," e.g., use of magnesium in women with preeclampsia without severe features (mild); meaning of signs and symptoms such as nausea, lethargy, or headache; interpretation, and management of complex tracings	• Standardize protocol for magnesium sulfate, including criteria for administration • Standardize ongoing clinical assessments and notification parameters for signs of potential disease progression or magnesium toxicity • Standardize fetal monitoring language and application • Provide regular interprofessional case reviews to discuss management; role model expression of concern and positive resolution of differences • Standardize expectations for notification of complications • Articulate and plan for potential problems early in care • Individuals take responsibility for collaboratively discussing differing views • Avoid professional stereotyping as an explanation for behavior
Disruptive behavior	• "Good Citizen" policy consistently enforced • Individuals and peers stand up to unprofessional behaviors • Administrative commitment to addressing any chronic issues • Availability of anonymous incident reporting system

Adapted from Lyndon, Zlatnik & Wachter Effective physician-nurse communication: a patient safety essential for labor and delivery. *Am J Obstet Gynecol.* 2011; Aug;205(2):91-6.
[a]SBAR-R-R = Situation, Background, Assessment, Recommendation, Reasoning, Ratification

SBAR-R-R Communication Technique

A specific strategy for structured communication that many health care providers are familiar with is "SBAR." This format, developed by Kaiser Permanente, was adapted from military and aviation crew resource management practices. It is recommended and taught in most healthcare teamwork improvement programs. The SBAR format, which stands for Situation-Background-Assessment-Recommendation, provides a brief, organized, predictable flow of information that facilitates critical thinking and communication skills between healthcare providers, and may be especially helpful in leveling communication styles between disciplines. However SBAR alone does not explicitly incorporate essential teamwork principles of assertive communication of concern and closed loop communication. These two principles can be built into SBAR with a simple expansion to SBAR-R-R (Table 3), which includes the steps "Reasoning," to ensure team members understand each other's interpretation of the present situation if immediate agreement is not reached, and "Ratification," to ensure the team members have an agreed upon plan for moving forward.

Table 3: SBAR-R-R Communication Technique Applied to Preeclampsia

Prepare for an SBAR-R-R by:

1. Assessing the patient
2. Reviewing recent notes and laboratory results
3. Having the medical record available during the conversation

Situation: Always identify yourself, where you are calling from, the name of the woman you are calling about, quickly state the main reason and the level of urgency for the call.

Background: Give brief pertinent background information – medical history, complaints, vital signs, and interventions that have already occurred

Assessment: Say what you think is going on

Recommendation: Say what you think should happen or ask for specific orders

Reasoning: If the response is not what you expect and requested, state *why* what you think should happen is important. What could happen if we don't do this?

Ratification: Close the loop by confirming actions to be taken. Assure mutual agreement on the plan.

Table 4: Sample SBAR-R-R Scenarios

	Ambulatory Care or Emergency Department	Inpatient Antepartum or Intrapartum	Postpartum
Situation	I am calling about Ms. ___, who □ is pregnant □ recently had a baby and is here in the ED with stomach pain. I am concerned about • High blood pressure • Headache • Visual disturbances • Decreased fetal movement • Nausea and vomiting	I am calling about Ms. ___, who is an antepartum patient being monitored for preeclampsia. I am concerned about: • New onset headache • Increasing blood pressures • Headache that has not resolved • Visual disturbances • Stomach pain • Abnormal or indeterminate fetal status • Altered/worsening lab values	I'm calling about Ms. ___ who had her second baby yesterday at 3 pm. I am concerned about: • New onset headache • Increasing blood pressures • Headache that has not resolved • Visual disturbances • Stomach pain • Altered/worsening lab values
Background	• GPTAL @__weeks or G_P_ #days post birth • Significant OB and medical history • Current problems • Patient complaints • Vital Signs • Interventions and response	• GPTAL @__weeks • Significant OB and medical history • Current problems • Patient complaints • Vital Signs • FHR tracing baseline, variability, accelerations, decelerations • Uterine activity • Interventions already completed	• G__P__ • Mode of birth (vaginal/cesarean) • Significant OB and medical history • Current problems • Patient complaints • Vital Signs • Interventions already completed
Assessment	• I'm thinking she may have preeclampsia and need an OB evaluation before we can clear her. • I'm concerned she may have severe preeclampsia and needs medication to control her blood	• Her preeclampsia seems to be progressing and her blood pressures indicate severe hypertension and severe preeclampsia. • The FHR tracing is indeterminate and the	• I'm thinking that her increasing BPs and new onset headache may represent preeclampsia and that she would benefit from an initial preeclampsia workup.

	pressure now.	decelerations do not resolve with position change.	
Recommendation	• Could you please come and evaluate her within___? ○ Now ○ Within 30 min ○ Before___, etc. • Could I have orders for:___ ○ CBC, liver function, kidney function ○ Antihypertensive • Magnesium sulfate	• I need you to come and evaluate her now. • May I please have an order for antihypertensive medication? • Are there any labs we need to repeat? • When can I expect you?	• May I have an order for a preeclampsia lab panel? • When can I expect you in to evaluate Ms. ___?
Reasoning	• I don't think it is safe to send her home without evaluating the possibility of preeclampsia • If we don't lower her blood pressure to a safer range she could have a stroke	• It is really important to control her blood pressure while we make preparations to proceed to birth. • If we don't lower her blood pressure to a safer range she could have a stroke.	• It's important for us to get baseline data before considering discharge in the morning.
Ratification	• Ok, I'll do___, and You'll evaluate her in ___ or call ___ for ___.	• Ok, I'll do___, and you'll be here to evaluate her in ___.	• OK, I'll do ___ and you'll be in to evaluate her in ___.

Adapted from Kaiser Permanente SBAR Guidelines and SBAR Report to Physician about a Critical Situation, and Ascension Health Perinatal SBAR Report Template.

Example Strategy for Building Collaborative Culture and Problem Solving Skills

Nurse-Led Multidisciplinary Obstetric Patient Summaries (MOPS)

Every patient is discussed by the multidisciplinary team each shift. This might occur at board rounds with the entire L&D team, or might be a two-person process involving the attending physician or midwife and bedside RN, with additional consultation from anesthesia, MFM, charge nurse, or others as needed for patient complexity. The exact make-up and logistics for each team are dependent on local conditions.
All care providers are encouraged to consider elements of concern or potential risks by pondering questions such as:

- What potential risks exist for this patient? (Is there risk of stroke, eclampsia, hemorrhage, fetal injury?)
- Are there trends that indicate concern? (e.g., vital signs, fetal trends, lab trends, headache, malaise, nausea, abdominal pain, scotomata)
- Is there any information or task that I don't understand or know how to perform?
- What is the plan of care based on the given information?
- Do I feel uncomfortable or I am concerned about the plan of care?
- Do I feel qualified or do I feel inexperienced in caring for a patient like this?
- Are there concerns I would like to have addressed?

EVIDENCE GRADING:
Level of Evidence: II-3, III

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Note: #17: Canadian Framework for Teamwork link may need to be copied and pasted into a web browser in order to work properly.

Example of resources for collaborative management of clinical disagreement and escalation cycle for conflict resolution

THE ROLE OF MEDICAL SIMULATION

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BACKGROUND

The use and recognition of the value of medical simulation continues to grow. There is a growing body of literature that demonstrates the efficacy of medical simulation, but a review of this data is beyond the scope of this discussion.

It is important to recognize that medical simulation represents a spectrum of tools that spans from low fidelity drills to high fidelity, inter-professional, interdisciplinary team simulations. Effective simulation programs must be designed with clear learning objectives and tailored to available resources and instructor expertise. They do not require extensive resources to be effective.

While simulation can be used to address knowledge gaps in the identification and treatment of preeclampsia, its greatest value lies in its potential to help teams "put it all together." Whether conducted in a dedicated simulation lab or in real patient care areas (in-situ simulation), inter-professional team training allows for:

- Testing of new policies and procedures
- Demonstration of skills in a more realistic environment
- Identification of systems issues and the ability to test new systems
- Instruction in techniques to improve communication and coordination of treatment teams, e.g., human factors, etc.

EDUCATIONAL MATERIALS

When constructing simulations for preeclampsia and eclampsia there are several variables to consider:

1. Different locations:
   - Location of the patient – LDR (labor, delivery and recovery), Postpartum, L&D triage, Emergency Department
2. Different diagnoses:
   - Diagnosis: preeclampsia without severe features vs. severe preeclampsia, eclampsia,
   - Requirements for successful treatment – e.g., will one (1) dose of anti-hypertensive medication be sufficient, or will the team be required to proceed with multiple doses/drugs to be successful?
   - Simulation expertise and resources of the participating medical center.

It is not possible to create a scenario that addresses all these variables. For the purposes of this program, two sample scenarios are provided that require the management of severe preeclampsia and eclamptic seizures that are refractory to magnesium. Both scenarios provide detailed information essential for an effective simulation experience, including debriefing guides specific to the scenario and a more generic debriefing guide

for teamwork/communication skills.

Scenarios provided include:

1. A version that covers both low fidelity and high fidelity simulations.
2. A detailed version created for teams that have high fidelity capabilities. This particular version includes programming and details for teams using SimMan3G.

There is no expectation that these scenarios alone will be adequate. Rather, these are simply examples that can be modified to include different clinical environments, differing levels of clinical complexity, and differing levels of simulation expertise/resources.

The scenarios are listed below and can be found in the appendices G through N.

- Severe Preeclampsia and Eclampsia in LDR v2.0 SimMan3G
    - Scenario Part 1: General Information
    - Scenario Part 2: Learning Objectives
    - Scenario Part 3: Patient Background Information
    - Scenario Part 4: Equipment/Materials List
    - Scenario Part 5: Program Algorithm & GUI (Graphic User Interface) Notes
    - Scenario Part 6: Debriefing Objectives
    - Scenario Part 7: Debriefing Guide/Evaluation

Simulations can be done with or without SimMan3 equipment.

FLUID MANAGEMENT IN PREECLAMPSIA

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BACKGROUND

Fluid management in preeclampsia is often difficult because of a leakage of water, electrolytes, and plasma from the intravascular space, due to underlying endolethial damage. This leakage can produce significant fluid shifts into the interstitial space resulting in peripheral and/or central (pulmonary and central nervous system, CNS) edema. As fluid shifts out of the intravascular space, there is also the potential for hypovolemia. Therefore, fluid administration must be assessed in the context of preserving organ perfusion, while limiting or preventing pulmonary edema. Renal endothelial damage appears to be particularly sensitive to these fluid changes resulting in proteinuria and oliguria. Assessment of renal function (serum creatinine) should be assessed to determine the degree of renal dysfunction. One hallmark of intravascular depletion is hemoconcentration.[1-4] Since pulmonary edema is more common and permanent renal damage due to preeclampsia is rare, fluids are normally restricted (see section related to Magnesium administration, pg. 50).[5]

If oliguria occurs, a trial of intravenous (IV) fluid bolus of 250-500 ml isotonic fluid (normal saline or Lactated Ringer's) can be given. If after a total infusion of 1000 ml of crystalloid IV fluids oliguria is not resolved, consideration is usually given to other modalities for enhancing urine output. If hypovolemia is still suspected then a trial of colloid IV fluid administration or blood may be used. Oxygen saturation monitoring is essential in these clinical settings due to the risk of pulmonary edema with excessive fluid administration in preeclamptic patients. If the patient is determined to be adequately hydrated, a trial pharmacological diuresis (furosemide, 5-10 mg IV) may be attempted. Oliguria, particularly when combined with excessive IV fluid administration, significantly increases the risk for pulmonary edema. Oliguria will also reduce the renal clearance of magnesium and the maintenance dose of magnesium will need to be adjusted to reduce the risk of magnesium toxicity. In the setting of oliguria and reduced O2 saturation (i.e. below 95%) diuresis is indicated. In rare instances, placement of a pulmonary artery catheter and measurement of pulmonary capillary wedge pressure may be needed. If these steps become necessary, the patient should be transferred to the intensive care unit for hemodynamic monitoring

KEY LEARNING POINTS

1. Patients with severe preeclampsia should have strict fluid intake and output monitoring assessments.

2. Total fluid intake (oral and intravenous) should be limited in both preeclampsia without severe features (mild) and severe preeclampsia. Many recommend that the sum of oral and all IV fluid should be ≤ 125 ml/hr (range 60 to ≤ 125 ml/hr) unless there are other clinical circumstances that dictate a different management plan.

3. Serum creatinine should be assessed in all patients with gestational hypertension, preeclampsia, or chronic hypertension with superimposed preeclampsia.

4. A Foley catheter with urometer is useful for monitoring urine output and is essential in the setting of oliguria or pulmonary edema.

5. An oliguric patient (less than 30 ml per hour for two hours, or less than 500 ml in 24 hours), should be given a limited trial of IV fluid boluses (normal saline or Lactated Ringer's), usually starting with 250-500 ml.

6. After a total of 1000 ml of crystalloid IV fluid is administered without resolution of the oliguria, and hypovolemia is still suspected, consideration may be given to the administration of colloid (e.g., albumin) or blood to enhance renal perfusion and urine output.

7. After adequate hydration, consideration should be given to the use of pharmacological diuresis (furosemide).

8. In the setting of oliguria and reduced O2 saturation (i.e., below 95%), pulmonary edema should be strongly suspected and diuresis is indicated.

9. Anesthesiologists should consider omitting or reducing the fluid bolus prior to epidural analgesia and ensure proper lateral positioning to avoid hypotension. Early treatment of hypertension has consistently been found to reduce the incidence of hypertensive crisis and will decrease the risk or prevent intracranial hemorrhage.[2-4,6]

10. Cardiac dysfunction should be strongly considered in the presence of persistently low O2 saturations, the development of respiratory distress, persistent pulmonary edema, or unanticipated low BP's. In this setting, measurement of maternal Brain Natriuretic Peptide (BNP) and/or maternal echocardiography is strongly recommended to evaluate cardiac function and detect dilated cardiomyopathy.

EVIDENCE GRADING
Level of Evidence: IIIC

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AIRWAY MANAGEMENT IN PREGNANT OR POSTPARTUM WOMEN HAVING SEIZURES

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BACKGROUND

A seizure is a frightening and uncommon occurrence in Labor and Delivery and the visceral response of many providers is to immediately administer magnesium sulfate to stop the abnormal movement associated with the seizure. However, even more important than stopping the seizure, which usually stops on its own after 1-2 minutes, is maintaining and protecting the airway. Seizures do not directly cause death, but intracranial hemorrhage and hypertensive encephalopathy do.[1,2] Therefore, the airway is the first priority in seizure management, even before administration of magnesium sulfate.

Basic airway maintenance skills need to be re-taught and actively maintained by nurses and physicians who work in Labor and Delivery, since this “skill set” is used very infrequently in that environment. Anesthesiologists are accustomed to caring for unconscious patients who may not be breathing adequately. For this reason, an anesthesiologist should be called immediately when a patient suffers a seizure. An anesthesiologist should be involved in teaching the Labor and Delivery staff about airway management.[1,2]

KEY LEARNING POINTS

1. Seizures involve loss of consciousness and violent movements, with the potential for blocked ventilation (“airway obstruction”), regurgitation and aspiration of gastric contents, as well as falls, head trauma and tongue biting.

2. Many of the sequelae of seizures, such as hypertensive brain hemorrhage and fetal and maternal hypoxic brain damage, are due to the cessation of respiration and failure to deliver oxygen to the maternal brain and the placenta.

3. Maternal hypoxia is the most common cause of “fetal distress” following an eclamptic seizure.

4. Anesthetizing the preeclamptic mother may present special challenges related to lack of maternal cooperation for neuraxial anesthesia. For obese patients, swelling of the airway tissues makes intubation more difficult. Emergency induction of anesthesia may lead to both maternal and fetal compromise.

RECOMMENDATIONS FOR QUALITY IMPROVEMENT:

1. Call for help. Notify the anesthesiologist immediately.
2. Turn patient into a lateral 'recumbent' position. The side-lying position prevents aortocaval compression, helps the tongue fall to the side of the mouth and lessens the risk of aspiration. If possible, cushion the head from injury by placing a soft object under the head.
3. Open airway with a jaw thrust and/or oral airway, if needed. Do not insert any object other than the oral airway, if needed, into the person's mouth. Be aware that nasal airways will often cause nosebleed. Check for air movement and reposition if there is no air movement. Be aware that an oral airway can make the patient vomit and may not be necessary.
4. Apply oxygen, obtain suction, and pulse oximeter to check oxygen saturation.
5. Obtain IV access.
6. Administer magnesium sulfate. (Refer to Magnesium Sulfate chapter, pg. 50)
7. Control blood pressure if necessary with IV meds, but be aware that hypoxia and hypercarbia will elevate blood pressure.
8. The initial focus should be on opening and protecting the airway and supplying the patient with oxygen. Laryngoscopy will result in an acute hypertensive episode, so pre-intubation medication such as IV Esmolol, IV Lidocaine, or IV Remifentanil should be administered.
9. Resuscitation of the mother is the key to protecting the fetus. This point is counterintuitive for many Labor and Delivery personnel, who may incorrectly focus on the baby, when it is the mother who requires top priority during and after a seizure.
10. Following a maternal seizure, fetal bradycardia is commonly seen due to maternal hypoxia. Stabilization of the mother is the first priority followed by resuscitation of the fetus.
11. Cesarean section should be reserved for the situation in which maternal and fetal resuscitation are unsuccessful in stabilizing the mother or resolving the non-reassuring fetal heart rate tracing.
12. Regular drills should be conducted in Labor and Delivery for management of the airway during an eclamptic seizure.

EVIDENCE GRADING
Level of Evidence: III-C

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SPECIAL CIRCUMSTANCES: SEVERE PREECLAMPSIA AT < 34 WEEKS

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BACKGROUND:

Preeclampsia presenting at < 37 weeks:

The criteria for diagnosing preeclampsia without severe features (mild) and severe preeclampsia are the same regardless of gestational age (Table 1).[1] Preeclampsia is generally a disorder that manifests near term with an overall incidence of 5-6% of all pregnancies.[1] Preeclampsia is also seen earlier in gestation, especially when other co-morbidities exist (e.g., diabetes, chronic hypertension, systemic lupus erythematosus).[2,3] Development of preeclampsia < 37 weeks is seen in approximately 1.5% of births and about 50% of these cases represent severe disease.[2,4,5] About 0.3% of pregnant women will develop severe preeclampsia at < 34 weeks.[2] For California, with an estimated 500,000 births annually this equates to approximately 1,500 women per year that will develop severe disease prior to 34 weeks gestation. For patients with mild disease ≥ 37 weeks or severe disease ≥ 34 weeks, delivery is indicated as the balance of maternal risk and potential neonatal benefit favors delivery.[6-8]

Severe Preeclampsia presenting < 34 weeks:

Delivery has been traditionally recommended for patients with severe preeclampsia presenting at any gestational age. However, a number of observational studies and a limited number of randomized clinical trials suggest that under appropriate conditions, patients with severe disease at < 34 weeks gestation may be conservatively managed.[4,6] These patients will be primarily those whose blood pressure can be controlled in a relatively short period of time, **without** manifestations of end-organ disease. Significant proteinuria, an indication of renal involvement, is the one exception to the recommendation for immediate delivery. Normal fetal testing is a prerequisite for conservative management.[6-8] Severe IUGR with reassuring fetal monitoring is a clinical scenario in which conservative management is a reasonable option. Patients within this scenario should be hospitalized and their status must be continuously assessed for disease progression. Delivery is indicated if there is evidence of fetal or maternal deterioration.

Treatment of maternal blood pressure should be maintained at a level that reduces the risk of maternal cerebral vascular accidents (systolic BP <160 mm Hg and diastolic BP < 105-110 mm Hg).[9,10] The level of maternal blood pressure control and recommended medications for initial treatment should include treatment with magnesium sulfate 4-6 grams over 15-20 minutes then 1-2 gm per hour (see section on magnesium sulfate, pg 50). Betamethasone for induction of fetal lung maturity and to decrease the risk of neonatal complications such as Respiratory Distress Syndrome (RDS), Intraventricular hemorrhage (IVH), and necrotizing enterocolitis (NEC), should also be given at the time of admission.

Maternal monitoring should be carried out in a facility that has the capacity to care for both the mother and the infant, specifically with the necessary equipment, personnel and neonatal care unit that can adequately care for infants delivered at a gestational age of ≤34 weeks (Table 2 below). Complications common to this group of women include seizure, stroke, Posterior Reversible Encephalopathy Syndrome (PRES), pulmonary edema, Adult Respiratory Distress Syndrome (ARDS), placental abruption, liver rupture, obstetrical hemorrhage, Disseminated Intravascular Coagulation (DIC), and acute renal failure.[2] Assessment of maternal symptoms, such as: Central Nervous System (CNS): headache, visual changes or change in mental status and Gastrointestinal (GI): epigastric, Right Upper Quadrant, (RUQ), pain or nausea and vomiting, should be carried out with each maternal vital sign assessment.

Most expert opinions[6,7,9] and other international organizations[11,12] state that delaying delivery is not recommended in the presence of the following: 1) Eclampsia; 2) **H**emolysis, **E**levated **L**iver **E**nzymes, **L**ow **P**latelet Syndrome (HELLP); 3) Pulmonary edema; 4) Severe thrombocytopenia; or 5) Coagulopathy (Table 1). ***Any patient who does not meet the criteria for continuation of pregnancy should be delivered by either induction of labor or cesarean section.*** Determining the route of delivery should take into consideration the likelihood of success based on cervical status, gestational age, fetal status, and the severity of the disease. For women with HELLP syndrome from the gestational age of fetal viability to 33 6/7 weeks of gestation, it is suggested that delivery be delayed for 24-48 hours if maternal and fetal condition remains stable to complete a course of corticosteroids for fetal benefit.[13]

Each obstetrical unit should develop a policy that delineates the conditions under which mothers and neonates can be effectively treated at that institution. A decision checklist specific to the level of care that can be provided should be used to assist physicians with decisions related to transfer. If the mother or the neonate can not be adequately cared for at the center where she presents, strong consideration should be given to transport to a center that can provide a higher level of care.

A multidisciplinary working group that includes: Obstetrician, Obstetrical Nursing, Anesthesia, Maternal Fetal Medicine (MFM), (if available), Intensivist and Intensive Care Unit (ICU) Nursing as needed should coordinate the patient's care. The care plan should address the specific problems presented by the patient's specific manifestations of preeclampsia, as well as anticipated complications. It is likely that the obstetrician, obstetrical nurse or MFM specialist will need to take the lead in this arena. The pediatric/neonatal team should be involved to provide consultation, education, and anticipatory outcome guidance based on gestational age. The patient also needs to be aware that continuation of the pregnancy is being attempted with the goal of improving fetal outcome. However, the patient also needs to understand the risks, albeit low, of fetal demise and/or significant maternal morbidity.

Table 1. Severe Preeclampsia and Management Options for Delayed Delivery[6,7]

Criteria	**Definition/Significance**	**Attempt to Delay Delivery**
Persistent headache/blurred vision or scotomata*/mental status changes**	Suggest central nervous system dysfunction	No
Persistent epigastric pain or right upper quadrant pain	Suggest liver capsule distension or rupture	No
Eclampsia	Generalized tonic clonic seizure	No
Pulmonary edema and/or hypoxia (O2 saturation < 95%)	Excessive fluid accumulation in the lungs	No
Oliguria/Renal failure	Urine output of <500/24 hours or Creatinine > 1.2 (unless chronic renal disease)	No
Hepatocellular injury	Serum transaminases > 2x normal	No
Blood Pressure	> 160/110 mm Hg BP criteria for **Severe** Preeclampsia	Yes, if responds to treatment

*Patients with eclampsia and visual disturbances should be evaluated in consultation with critical care medicine/neurology for the presence of Posterior Reversible Encephalopathy Syndrome (PRES).
** Mental status changes in the presence of severe thrombocytopenia should be evaluated in consultation with hematology for Thrombotic Thrombocytopenic Purpura (TTP) and consideration for treatment or transfer to a center with treatment capacity should be given.

Table 2: Daily Assessment for Delivery versus Continuing Pregnancy

Clinical Criteria:	**Present**	
Persistent maternal headache	Yes	No
Visual disturbance (blurred or scotomata)	Yes	No
Hypoxia (O2 saturation < 95%) or pulmonary edema on clinical exam	Yes	No
Persistent BP > 160 mm Hg systolic or > 105-110 mm Hg despite medical management	Yes	No
Oliguria (< 500 ml/24 hours)	Yes	No
Evidence of renal failure (serum Creatinine > 1.2 mg/dL	Yes	No
Thrombocytopenia (platelet count < 100,0000/mm3	Yes	No
Elevated ALT > 70 U/L	Yes	No
Evidence of hemolysis (LDH > 600, bilirubin > 1.2 mg/dL or abnormal peripheral blood smear)	Yes	No
Abnormal coagulation (elevated PT/PTT or fibrinogen < 300)	Yes	No
Abnormal Fetal NST and/or BPP	Yes	No
	Yes To ANY of above CONSIDER DELIVERY	**No To ALL of above CONTINUE PREGNANCY**

If laboratory values were normal at admission and remain normal for two consecutive days and blood pressure is stable (i.e. not requiring additional medication) then every other to every third day laboratory monitoring may be used.

Hemolysis, Elevated Liver Enzymes, Low Platelets (HELLP) Syndrome

HELLP syndrome is a variant of severe preeclampsia characterized by red blood hemolysis, thrombocytopenia, and abnormal elevations in liver transaminases.[14] The diagnostic criteria are listed in Table 3 below. Three classes of HELLP are characterized by severity of laboratory abnormalities and risk for significant adverse perinatal outcome based on the patient's platelet count.[15] The most severe manifestation (Class I) has platelet counts ≤50,000 cells/µL; Class II has platelet counts of > 50,000 and ≤ 100,000 cells/µL, and in Class III, there is mild thrombocytopenia with a platelet nadir between > 100,000 and ≤ 150,000 cells/µL. The severity of maternal, fetal and neonatal morbidity is correlated with the severity of the disease.[15] Approximately 10-15% of patients with classic HELLP syndrome will not have elevated blood pressures (BP ≥ 140/90 mm Hg)[16] and like other forms of severe preeclampsia, proteinuria is absent in 15-25% of patients.[15] The presence of subjective symptoms is seen in 64-84% of patients with Class III and Class I HELLP respectively.[15] Thus, the presence of proteinuria or elevated blood pressure is not essential for the diagnosis of HELLP syndrome and in those patients without classic features, the presence of subjective symptoms (i.e. headache, epigastric pain, nausea and vomiting, or visual disturbances) should prompt further evaluation to rule out progression of disease requiring delivery.

Table 3: Classes of HELLP Syndrome

Class	Description
I	Platelet counts < 50,000 cells/µL
II	Platelet counts > 50,000 and < 100,000 cells/µL
III	Mild thrombocytopenia Platelet nadir between > 100,000 and < 150,000 cells/µL

The majority of patients with HELLP syndrome will have elevated blood pressure spanning the range from mild to severe. The combination of severely elevated blood pressure with thrombocytopenia and abnormal coagulation parameters place the patient at increased risk for cerebral vascular accidents or other hemorrhagic complications. The frequency of seizures/eclampsia ranges from 5-12% in severe preeclampsia and HELLP Syndrome of any degree. (Class I, II, and III).[15]

Maternal and neonatal morbidity is significantly increased in pregnancies complicated by HELLP syndrome. The rate of preterm birth is high (70%) with 15% of deliveries occurring prior to 28 weeks.[16] The risk of maternal death has been estimated at 1%, and the frequency of other severe morbidities is also high including Disseminated Intravascular Coagulation (DIC): 15-30%; Pulmonary Edema: 8%; Acute Renal Failure: 3% and; Adult Respiratory Distress Syndrome (ARDS) and Stroke: both 1%. Initiation of corticosteroid therapy to decrease maternal morbidity for Class I and II HELLP Syndrome should be considered.[17]

Table 4. Diagnostic Criteria for HELLP Syndrome[18]

Hemolysis	**Elevated LDH (> 600 IU/L)*,** Microangiopathic hemolytic anemia on peripheral blood smear, low haptoglobin (< 25 mg/dL), elevated indirect bilirubin
Thrombocytopenia	Platelet count ≤ 100,000 cells/µL
Elevated Transaminases	Serum AST** ≥ 70 IU/L or twice baseline values

*Elevated lactic dehydrogenase (LDH) > 600IU/L is currently the most readily available and accurate laboratory indicator of hemolysis.
**Aspartate Aminotransferase (AST)

Diagnosis of HELLP syndrome can be challenging, as the differential diagnosis includes Thrombotic Thrombocytopenic Purpura (TTP), Hemolytic Uremic Syndrome (HUS), and Acute Fatty Liver Disease of Pregnancy (AFLP). TTP-HUS should be considered in all pregnant women with severe thrombocytopenia, severe anemia, and elevated lactic dehydrogenase (LDH) levels with minimal elevation of AST.[19] A history of proteinuria and hypertension prior to onset of hemolysis, liver abnormalities, and thrombocytopenia favor the diagnosis of preeclampsia, while high LDH levels with only modest elevation of AST favors TTP (Table 4). The distinction between TTP or HUS and severe preeclampsia or HELLP is important for therapeutic and prognostic reasons, as TTP would normally be treated with plasmapheresis.

Table 5. Differentiation between Preeclampsia, HELLP Syndrome, Acute Fatty Liver Disease of Pregnancy (AFLD), Thrombotic Thrombocytopenia Purpura (TTP), Hemolytic Uremia Syndrome (HUS) *

	Plts	LFTs	Bili	Cr	LDH	Glu	DIC	CNS
Preeclampsia	±	±	±	±	±	→	±	±
HELLP	↓/↓↓	↑↑	↑	±	↑	→	±	±
AFLD	↓↓	↑↑	↑↑↑	↑	↑	↓↓↓	↑↑↑	±
TTP	↓↓↓	↑	↑	↑	↑↑	→	±	++
HUS	↓	↑↑	↑↑	↑↑↑	↑	→	±	±

AFLD: Acute Fatty Liver Disease of Pregnancy; TTP: Thrombotic Thrombocytopenic Purpura; HUS: Hemolytic Uremia Syndrome; Plts: platelet count; LFTs: liver function test; Bili: total bilirubin level; LDH: Lactate Dehydrogenase; Glu: glucose; DIC: Disseminated Intravascular Coagulation; CNS: Central Nervous System symptoms (confusion, visual changes, headache)
*Arrows represent relative changes: one arrow equals some increase; two arrows indicate moderate increase, and three arrows equal very high increase.

Hypertension

Other health systems have defined the degree of hypertension associated with pregnancy into three categories (mild, moderate, and severe, see Table 6 below).[20] The rationale for this expanded categorization is to recognize that many patients in the moderate hypertension category are at higher risk for poor obstetrical outcome and likely merit closer observation.

Table 6. Preeclampsia Diagnostic Criteria for Three Blood Pressure Categories (mm Hg)

SOGC*, NICE**	Mild	Moderate	Severe
Systolic	140-149	150-159	> 160
Diastolic	90-99	100-109	> 110

*SOGC (Society of Obstetricians and Gynaecologists of Canada)
**NICE (National Institute for Health and Clinical Excellence)

Table 7: Preeclampsia Diagnostic Criteria for Two Blood Pressure Categories (mm Hg)

ACOG*	Mild	Severe
Systolic	140-159	> 160
Diastolic	90-109	> 110

*ACOG (American College of Obstetrics and Gynecology)

Atypical Preeclampsia

The recognition that the pathophysiology of preeclampsia is highly variable has led to the realization that the disease can present with single- or multi-organ dysfunction.[19] Cases that present as "atypical" are those that manifest at < 20 weeks gestation, more than 48 hours after birth or with any of the diagnostic criteria for severe disease in the absence of proteinuria or elevated blood pressure. Severe nausea and vomiting in the late 2nd or early 3rd trimester should raise the index of suspicion for preeclampsia. Development of preeclampsia in the presence of gestational hypertension is inversely related to the time of diagnosis of gestational hypertension.[21] Furthermore, proteinuria, in the absence of hypertension, may be the first manifestation of disease in the sequence leading to preeclampsia.[22] These women merit close antenatal follow-up (1-2 times per week) with laboratory assessment.[19] Women who present after delivery with gestational hypertension or isolated proteinuria and who have laboratory or subjective symptoms of severe preeclampsia should be treated with magnesium sulfate.

RECOMMENDATIONS FOR QUALITY IMPROVEMENT:

1. Patients with diagnostic criteria for preeclampsia without severe features (mild) at ≥ 37 weeks or severe preeclampsia at ≥ 34 weeks gestation should be delivered.

2. Patients with diagnostic criteria for severe preeclampsia at < 34 weeks gestation should be delivered if criteria outlined in Table 1, (pg. 79) are not met.

3. Patients with severe preeclampsia remote from term (< 34 weeks) should be managed at or transported to a center with experience and expertise in management of these patients as well as their potential complications.

4. Blood pressure should be controlled to a level that is between 140-160 mm Hg systolic and 90-100 mm Hg diastolic.

5. Magnesium sulfate should be used in all patients with HELLP syndrome, severe preeclampsia, or unstable patients whose disease is evolving.

6. Mode of delivery should be based on usual obstetrical indications.

7. Corticosteroids may be considered in cases of HELLP syndrome for decreasing maternal morbidity [see Magnesium Sulfate chapter, (pg. 50) and Antihypertensive Agent chapter, (pg. 45)].[23] Corticosteroids have been used in randomized controlled trials to attempt to improve maternal and fetal condition. In these studies, there was no evidence of benefit to improve overall maternal and fetal outcome (although this has been suggested in observational studies). There is evidence in the randomized trials of improvement of platelet counts with corticosteroid treatment. In clinical settings in which an improvement in platelet count is considered useful,

corticosteroids may be justified. Quality of evidence: Low; Strength of recommendation: Qualified)[13]

8. Patients with moderate hypertension (150-159 mm Hg systolic and 100-109 mm Hg diastolic) with and without proteinuria should be monitored with a heightened level of supervision, including the frequency of blood pressure measurements, laboratory studies and symptom assessment. Antihypertensive therapy should be considered in the group of patient that have blood pressures that are > 155 systolic and 105 diastolic.[10]

9. Patients with elevated blood pressure not having proteinuria but who have other diagnostic criteria of severe preeclampsia should be treated as if they have severe disease.

EVIDENCE GRADING
Level of Evidence: II-1A, III-1A

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CONSULTATION TRIGGERS IN SEVERE PREECLAMPSIA FOR ALL OBSTETRIC UNITS

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BACKGROUND

Patients with preeclampsia are at risk for numerous adverse outcomes. The Labor and Delivery team of obstetricians, nurses and anesthesiologists are the first responders, but require consultation with other specialties in a number of clinical circumstances. The following are guidelines for engaging additional practitioners in providing added clinical depth for patient care.

Table 1: Trigger Criteria for Consultations

Pulmonary/Fluids	Cardiac	Neurologic	Hematologic
• Pulmonary edema • Fluid overload, leaky membrane, low Colloid Oncotic Pressure • Not responding to one dose of diuretic • Shortness of breath– DDx includes r/o pulmonary embolism (spiral CT scan preferred)	• Cardiac pump failure –(DDx) includes peripartum cardiomyopathy, preeclampsia induced – need echo. • Arrhythmia (e.g. SVT, atrial fibrillation) • Difficulty breathing, (might need intubation: DDx: pulmonary edema, stridor from swelling fluids/allergic, asthmatic not responsive to initial medications, magnesium toxicity, occult Mitral Stenosis for new onset asthma in labor • Hypoxia, any cause (decreased O2Sat) – (e.g. oxygen saturation < 95% on oxygen). Trauma history (possible pneumothorax – chest tube required) • Intrinsic – cardiac pump failure, leaky membrane, COP low, bronchospasm, Extrinsic – PTX, ETT kink, FB in airway, Swelling/stridor – fluid/preeclampsia progression labor, allergic reaction	• Repeated seizures, unresponsive to initial therapy (DDx includes SAH/intracranial hemorrhage – CT required) • Altered mental status (DDx – metabolic, toxic, etc.) • Acute stroke/neurologic changes (r/o intracranial bleed) • Cortical vein thrombosis	• DIC • HELLP syndrome (e.g. platelets <50,000) • Coagulopathy, any cause • Massive transfusion/OB hemorrhage • On anticoagulants (e.g., LMWH) – timing dosing, when to hold, when to restart

DDx: Differential Diagnosis; r/o: Rule Out; CT: computed tomography; SVT: Supraventricular Tachycardia; COP: colloid osmotic pressure; PTX: Pneumothorax; ETT: Endotrachial tube kink; FB: foreign body; SAH: subarachnoid hemorrhage; DIC: Disseminated Intravascular Coagulopathy; HELLP: Hemolysis, Elevated Liver Enzymes, Low Platelet; LMWH: low molecular weight heparin

RECOMMENDATIONS FOR QUALITY IMPROVEMENT:

1. Consultation of maternal fetal medicine, anesthesia, cardiology, hematology, and/or neurology or any other sub-specialties should be strongly considered if the staff feel uncomfortable with the medical situation or if any hematologic, cardiac, pulmonary, or persistent neurologic symptoms are present.

2. Request consultations when the patient needs a higher level of care than usually provided by regular L and D staff, or the staff feel uncomfortable with the medical situation. Often the first consults are with the MFM and/or Anesthesiologist covering OB.[1,2]

3. Consultations should also be considered in the following situations:
   - There is clinical disagreement among team members about the severity of the woman's condition
   - Hypertension is resistant to standard treatment (e.g., SBP > 160 mm Hg, DBP > 105-110 mm Hg), need 3rd line drug (i.e., after labetalol, hydralazine per CMQCC/ACOG protocols)
   - Persistent low BP (e.g., SBP < 90 mm Hg) unresponsive to fluid bolus(es) of 500 ml
   - Crystalloid and/or short acting vasopressors (e.g. ephedrine due to neuroaxis blockaide)
   - Persistent oliguria (e.g., < 30 cc per hr) after fluid challenge (See Fluid Management section, pg. 71)
   - Suspected amniotic fluid or pulmonary embolism, or
   - Hemorrhage with disseminated intravascular coagulation (DIC)

EVIDENCE GRADING

Level of Evidence: C

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POSTERIOR REVERSIBLE ENCEPHALOPATHY SYNDROME (PRES)

Racine Edwards-Silva, MD, Olive View-UCLA Medical Center

BACKGROUND

Posterior reversible encephalopathy syndrome (PRES) is a transient clinical neuroradiological entity characterized by clinical signs and symptoms including hypertension, generalized seizure activity, altered mental status, headache and vision changes; along with PRES findings characteristic on head computed tomography (CT) or magnetic resonance imaging (MRI) scan.[1] Many causes of PRES have been reported in the literature including hypertensive encephalopathy, preeclampsia, eclampsia, renal failure, immunosuppressants, thrombotic thrombocytopenic purpura, systemic lupus erythematosus (SLE), and acute intermittent porphyria.[2] The nomenclature for this syndrome has undergone several changes with one radiologic journal describing this entity as Eclamptic Encephalopathy.[3] In the early postpartum period PRES is most often seen in association with severe elevated BPs, and with eclampsia. In the late postpartum period, it may be seen in the Emergency Department with a patient who presents with hypertension and seizures.

Preeclampsia and eclampsia are probably the most common causes of PRES. The true incidence of PRES complicating preeclampsia and eclampsia is unknown because neuroradiographic imaging is not routinely performed.

Symptoms: Neurologic symptoms commonly precede eclampsia. Headache and visual disturbance are the most common prodromal symptoms. These neurologic symptoms reflect the development of cerebral edema and vasospasm of cerebral and retinal vessels. Premonitory symptoms may provide an early warning of imminent eclampsia. Other common warning symptoms include nausea, vomiting, or epigastric/abdominal pain. These gastrointestinal symptoms are believed to reflect hepatocellular involvement from periportal or parenchymal necrosis, liver capsule stretching and/or hemorrhage.[4]

Treatment: PRES is usually reversible with prompt diagnosis and treatment. Early recognition and effective treatment of blood pressure in patients with PRES in the acute setting along with seizure prophylaxis decreases long-term sequelae of this condition. The antepartum patient should be stabilized and then delivered.

However, in rare cases the reversible vasogenic edema associated with PRES can progress to irreversible ischemic damage, cerebral infarction or even death. Treatment is the same as for severe preeclampsia, and neurological consultation is recommended. The underlying pathophysiology has been attributed to failure of cerebral auto-regulation and endothelial dysfunction. This impairment of cerebral auto-regulation 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.[5] This process causes the characteristic lesions seen in the occipital and posterior parietal lobes on

neuroradiologic imaging (Photos A, B, C). These radiographic cerebral abnormalities appear as intense signals on T2-weighted MRI scans and as low-density areas on CT scans. (Photos are of same patient taken at the same time, different views.)

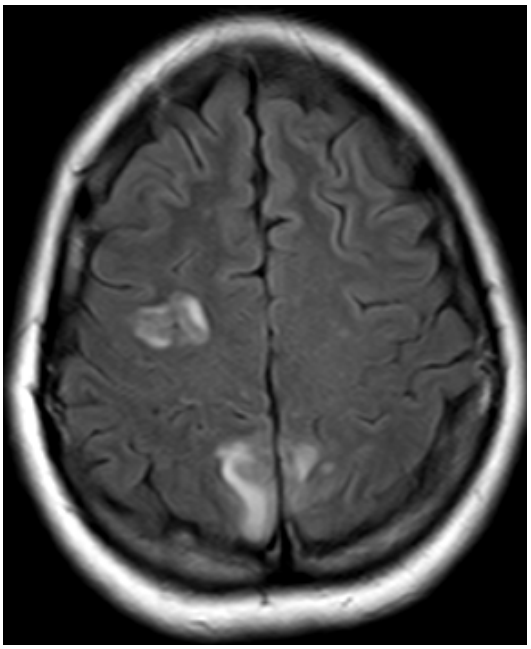

Photo A

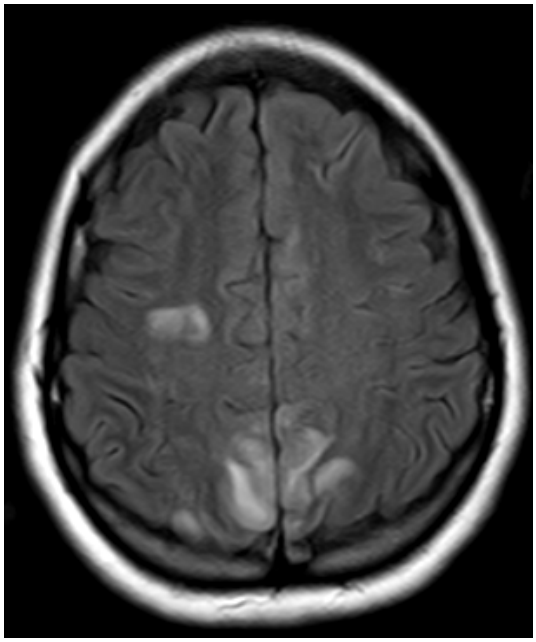

Photo B

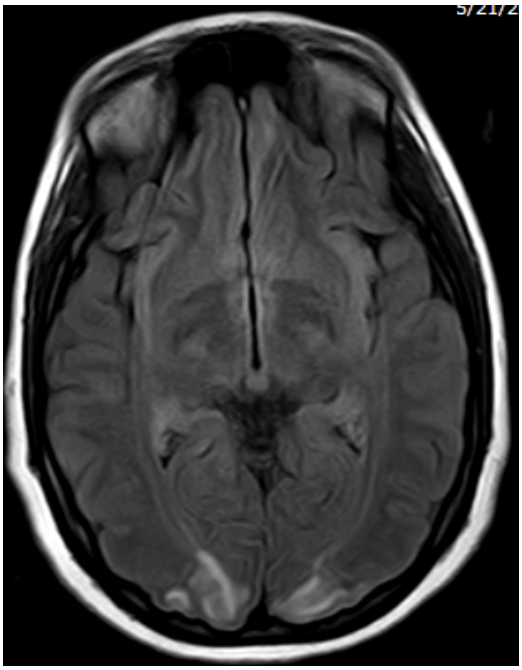

Photo C
Photos highlight involvement of the occipital region that explains the visual changes seen in preeclampsia/PRES. Photos used with kind permission of Thomas Archer, MD, University of California, San Diego, 2013.

Diagnosis: MRI is considered the most appropriate tool as an adjunct in the clinical setting to diagnosing PRES and demonstrating the characteristic brain lesions. MRI imaging is superior to CT imaging in patients with PRES or Eclamptic Encephalopathy. The hallmark feature is bilateral symmetrical vasogenic edema in the territories of the posterior cerebral circulation white matter (occipital and posterior parietal lobes). The posterior cerebral white matter edema is most evident on T2-weighted MRI images with fluid-attenuated inversion recovery (FLAIR).[6] The predominance of occipital lesions corresponds well to the neurologic manifestation of temporary cortical blindness. Neuroradiologic imaging should be strongly considered in the postpartum period with a patient who presents with headache, hypertension, seizures, or atypical neurologic symptoms such as visual changes or inability to see (blindness), in order to rule out other differential diagnoses such as a mass lesion or cerebral venous thrombosis.

KEY LEARNING POINTS

1. Upon initial discharge from the hospital, inform the recently delivered patient that there is still a measurable risk of Preeclampsia/Eclampsia in the postpartum period for up to six (6) weeks after delivery, even with an uneventful pregnancy and delivery. Although delayed postpartum preeclampsia is usually seen within the first two weeks postpartum, some patients can present up to four to six (4-6) weeks after delivery. This risk may be increased in patients who have experienced preeclampsia prior to delivery. Therefore, delayed preeclampsia should be considered in any patient within the normal six-week postpartum period.

2. It is important for Emergency Department physicians/staff to have a high index of suspicion for postpartum Preeclampsia/Eclampsia and to have early involvement of obstetric staff in the care of these patients.

3. Upon presentation to the ED, a female patient should be queried as to whether she is currently pregnant or has recently been pregnant.

4. Antihypertensive medications should be implemented for systolic BP > 160 mm Hg and/or if diastolic BP > 105-110 mm Hg that persists for 15 minutes or greater and should be considered in the group of patients that have blood pressures that are > 155 systolic and 105 diastolic.[7]

5. Treatment guidelines for severe hypertension are identical to those for severe preeclampsia/eclampsia.

RECOMMENDATIONS FOR QUALITY IMPROVEMENT:

1. Initiate established treatment algorithms for severe preeclampsia and eclampsia for control of hypertension and seizures.

2. First-line antihypertensive medication is intravenous Labetalol or Hydralazine. (See Antihypertensive Agent chapter, pg. 45)

3. Magnesium sulfate is the treatment of choice for controlling seizures in eclampsia and for prevention of recurrent seizures. This should be maintained for at least 24 hours after the last seizure. (See Magnesium Sulfate chapter, pg. 50)

4. If patient is pregnant, maternal and fetal monitoring is advised on labor and delivery as fetal status is secondary to maternal stabilization.

5. In these complex clinical cases, a multidisciplinary team of ED, OB, Anesthesia, and possibly Neurology or Critical Care is necessary.

6. Do not delay treatment to perform neuroradiologic imaging.

7. Neuroradiologic imaging is strongly advised in the postpartum period due to the numerous differential diagnoses and to exclude other intracranial pathology.

EVIDENCE GRADING
Level of Evidence: III

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EMERGENCY DEPARTMENT and NON-OBSTETRICAL VISITS

EMERGENCY DEPARTMENT RECOGNITION and TREATMENT: FOCUS ON DELAYED POSTPARTUM PREECLAMPSIA and ECLAMPSIA

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BACKGROUND:

Hypertensive disorders including preeclampsia and eclampsia are one of the leading causes of maternal morbidity and mortality. While there has been an overall decrease in the frequency of eclampsia, the frequency of postpartum and delayed eclampsia has increased[1] making it more common for patients to present to the Emergency Department (ED) with symptoms. Postpartum or delayed preeclampsia/eclampsia is frequently associated with Posterior Reversible Encephalopathy Syndrome (PRES; see pg. 88). Although obstetric consultation is warranted in every case of preeclampsia, emergency physicians should be knowledgeable of and comfortable with the initial management. Since many of these patients will present to an ED, education of ED personnel and application of diagnosis and treatment protocols are important steps in reducing morbidity and mortality associated with postpartum preeclampsia and eclampsia.

Emergency physicians should have a higher index of suspicion in order to improve the recognition and treatment of postpartum preeclampsia and eclampsia. This may require gathering historical information regarding a recent pregnancy from family members; it is important to remember that:

1. Up to 26% of eclamptic seizures occur beyond 48 hours and as late as four to six (4-6) weeks after delivery.[1,2] However, most of these cases occur in the first seven (7) days after delivery.[3]
2. As many as 78% of these patients have no previous diagnosis of hypertensive disease with the antecedent pregnancy.[2,3]
3. If medical records are not immediately available, treating personnel may have no knowledge that the patient has recently delivered, resulting in a decreased index of suspicion.[4]
4. While the clinical presentation of delayed postpartum preeclampsia may be atypical, the most common complaint is headache in up to 69% of patients.[3] Headache in a recently pregnant patient will likely be isolated but should prompt an investigation into the possibility of delayed postpartum preeclampsia.

Seizures in the first and early second trimester (< 20 weeks) or well into the postpartum period probably are due to Central Nervous System (CNS) pathology and warrant full evaluation, including computed tomography (CT) scanning of the head, lumbar puncture (if clinical evidence of meningitis or concern for hemorrhage exists), determination of electrolyte levels and urine or serum toxicologic screening. Do not overlook other

neurologic causes of seizure, particularly if the seizure occurs more than 24-48 hours after delivery.

RECOMMENDATIONS FOR QUALITY IMPROVEMENT:

1. ED triage protocols must identify patients who are currently pregnant or have delivered in the previous six (6) weeks. If the patient's medical records are not available, then simple questioning of the patient, family, Emergency Medical Services (EMS), etc., may provide this information. This information must then be clearly communicated to the treatment team.

2. ED personnel should be familiar with the risk factors and characteristics of delayed postpartum preeclampsia and eclampsia.

3. Do not overlook other neurologic causes of seizure, particularly if the seizure occurs more than 48 hours after delivery.

4. Implementation of the CMQCC protocol (see Appendix F, pg.108-109) protocol for diagnosis and treatment of preeclampsia and eclampsia in the Emergency Department. This can be reinforced through the use of educational tools in other sections of this toolkit and with the use of drills and simulations.

EVIDENCE GRADING
Level of Evidence: C

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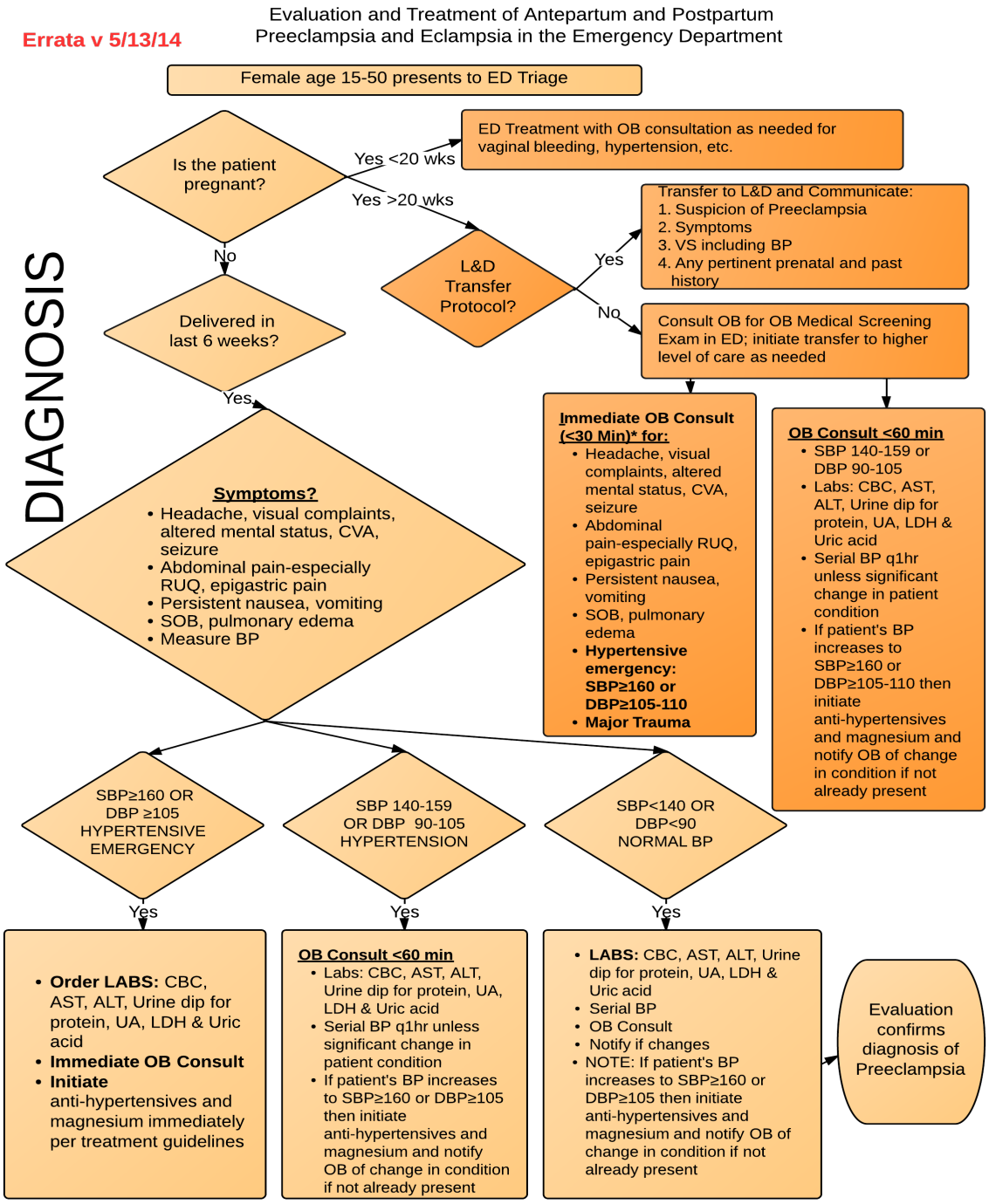
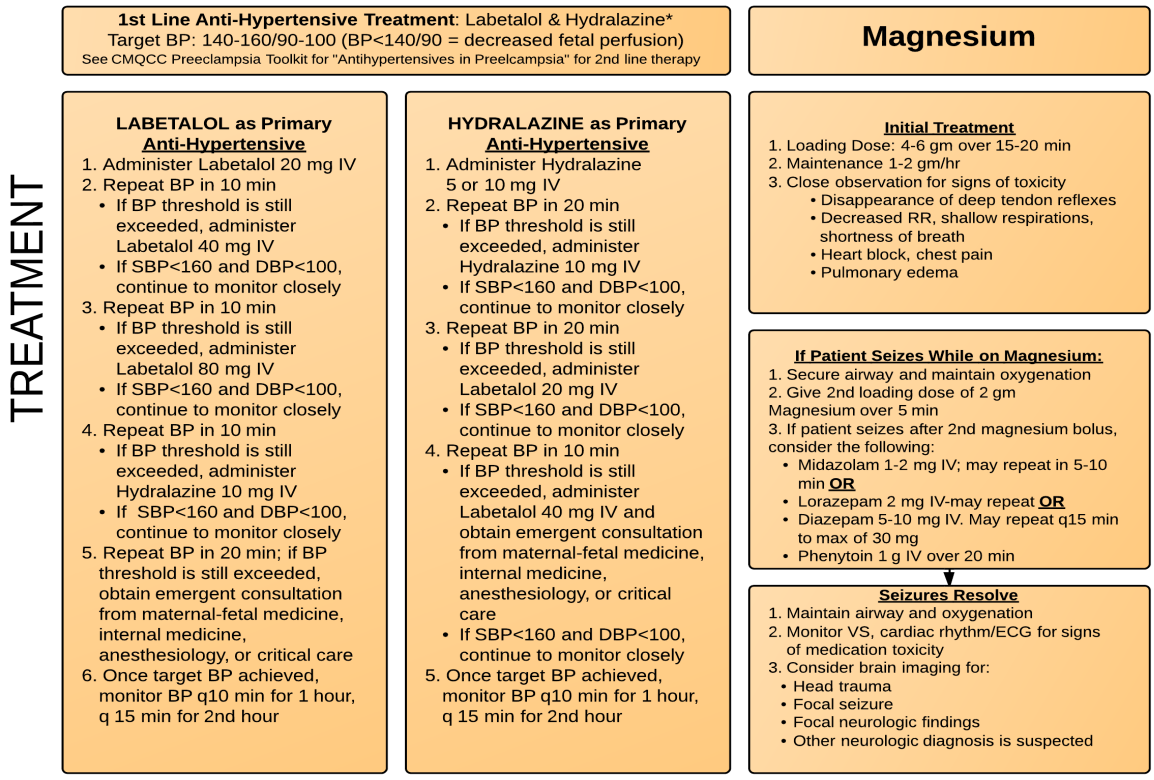
Part 1 of 2: Diagnosis - Evaluation and Treatment of Antepartum and Postpartum Preeclampsia and Eclampsia in the Emergency Department



Part 2 of 2: Treatment - Evaluation and Treatment of Antepartum and Postpartum Preeclampsia and Eclampsia in the Emergency Department

Errata v 5/13/14

Evaluation and Treatment of Antepartum and Postpartum
Preeclampsia and Eclampsia in the Emergency Department



*Labetalol and Hydralazine recommendations based on 2011 ACOG Committee Opinion #514 and Practice Bulletin #33, Reaffirmed 2012

EDUCATION AND PATIENT INFORMATION

PRENATAL AND POSTPARTUM PATIENT COUNSELING OR EDUCATION*

Meredith Drews, Preeclampsia Foundation
Eleni Tsigas, Preeclampsia Foundation
*With acknowledgement of support from Whitney B. You, MD, MPH, LCDR, MC, USN, U.S. Naval Medical Center, Bethesda, MD

BACKGROUND

Interventions for women with preeclampsia in the prenatal period include increased monitoring, magnesium sulfate, antihypertensive medications and corticosteroids for fetal lung maturation, if indicated. To maximally benefit from these resources, however, women must first seek medical care in a timely fashion.[1]

Women are less likely to seek care if they do not understand the signs and symptoms of preeclampsia. Several recent studies emphasized the value of educating mothers and providers to report signs and symptoms of severe preeclampsia that commonly precede eclampsia, hypertensive encephalopathy, pulmonary edema or stroke.[2-8] These recommendations are further supported by studies showing women who are diagnosed with preeclampsia, and receive timely and proper monitoring, have fewer adverse events than those with delayed diagnosis.[4] This knowledge deficit appears modifiable, regardless of literacy level or initial understanding of preeclampsia, as pregnant women who had acknowledged receiving information about the disease, demonstrated greater preeclampsia-specific knowledge.[9]

Further, many clinicians and patients are unaware that preeclampsia can either occur or persist following delivery. It is also important to remember that the natural progression of postpartum hypertension includes an initial decrease in blood pressure (BP) within 48 hours, but BP rises again between three to six (3-6) days postpartum.[10] Preeclampsia may occur up to six (6) weeks postpartum.[11,12] Postpartum hypertension/preeclampsia is either secondary to persistence or exacerbation of hypertension in women with previous gestational hypertension, preeclampsia, chronic hypertension or because of *de novo* (new onset) condition. In cases of late postpartum eclampsia, researchers found that nearly all of the patients had at least one prodromal symptom and half had more than one symptom that heralded the eclamptic seizure. Only 33% of women sought care for their symptoms, suggesting a need for proper patient education which may have led to better outcomes.[3]

KEY LEARNING POINTS

1. Many women have a limited understanding of preeclampsia, its signs and symptoms and its danger to both the mother and baby.[1]
2. Lack of understanding of preeclampsia and its prodromal symptoms is even more profound among women with low literacy levels.[13]
3. Health care providers may often overlook patients' complaints that in retrospect were predictors of increased risk or evidence of disease.
4. There is currently minimal education for a postpartum mother regarding preeclampsia at discharge from the hospital.
5. Many hospitals have discharge paperwork for obstetric patients that include warning signs that should be reported to their doctors or that require immediate evaluation at a hospital. Symptoms of preeclampsia should be included in that list.
6. Many hospitals now also include videos on matters relating to new mothers that they may watch prior to discharge. These videos provide both a verbal and visual way to reinforce the warning signs of preeclampsia and what and when women need to communicate with their doctors.[14]
7. New mothers may often disregard symptoms since they may not know what they "should" be feeling postpartum. Family members are key partners in preventing maternal deaths by intervening when their spouse or partner complains of shortness of breath, relentless headache and other concerning symptoms.

RECOMMENDATIONS FOR QUALITY IMPROVEMENT:

1. A clear and simply written list of patient symptoms should be shared with expectant mothers and attending family members during prenatal visits and upon discharge from the hospital.[9,15]
2. A pictogram (Figure 1) showing the symptoms in visual format can be helpful to those women with language barriers or who may be struggling to understand the physician's instructions regarding preeclampsia.[16,17]
3. Physicians and nurses should ask open-ended questions to ensure that the patient understands what they have been told. For example, after going over a list of symptoms say, "We've gone over a lot of information today. What would make you call or come in to the hospital?"[18-22]

4. Hospitals with video education abilities should include a video on preeclampsia for patient education.

5. Women who have experienced preeclampsia prior to delivery or while in the hospital should see their OB within one week if they are on medication or two weeks if they are not on medications after discharge. A postpartum clinic visit should be established prior to discharge.

6. Women who have experienced preeclampsia prior to delivery or while in the hospital should be encouraged to monitor their blood pressure at home with instructions to call their physician if their pressures reach or exceed 140/90.

7. It is recommended that all patient discharge instructions (verbal and written) should include recognition of and response to preeclampsia symptoms that nurses review these instructions with the patient and her family prior to discharge.

Figure 1. Preeclampsia Foundation Signs and Symptoms Information Sheet

Preeclampsia symptoms can be conveyed via a pictorial information sheet.[13]
(Note: This is available from the Preeclampsia Foundation for a modest shipping and handling fee. A Spanish version is also available.)

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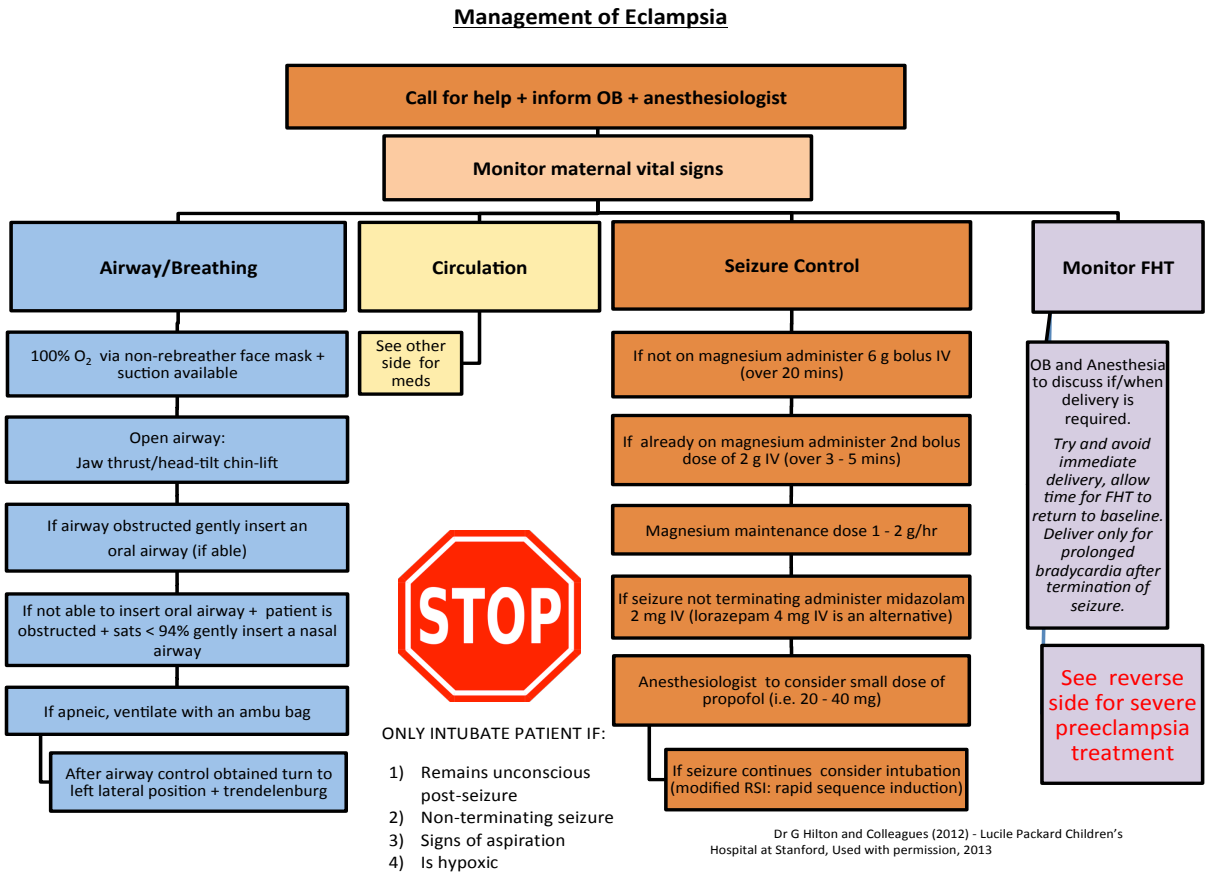
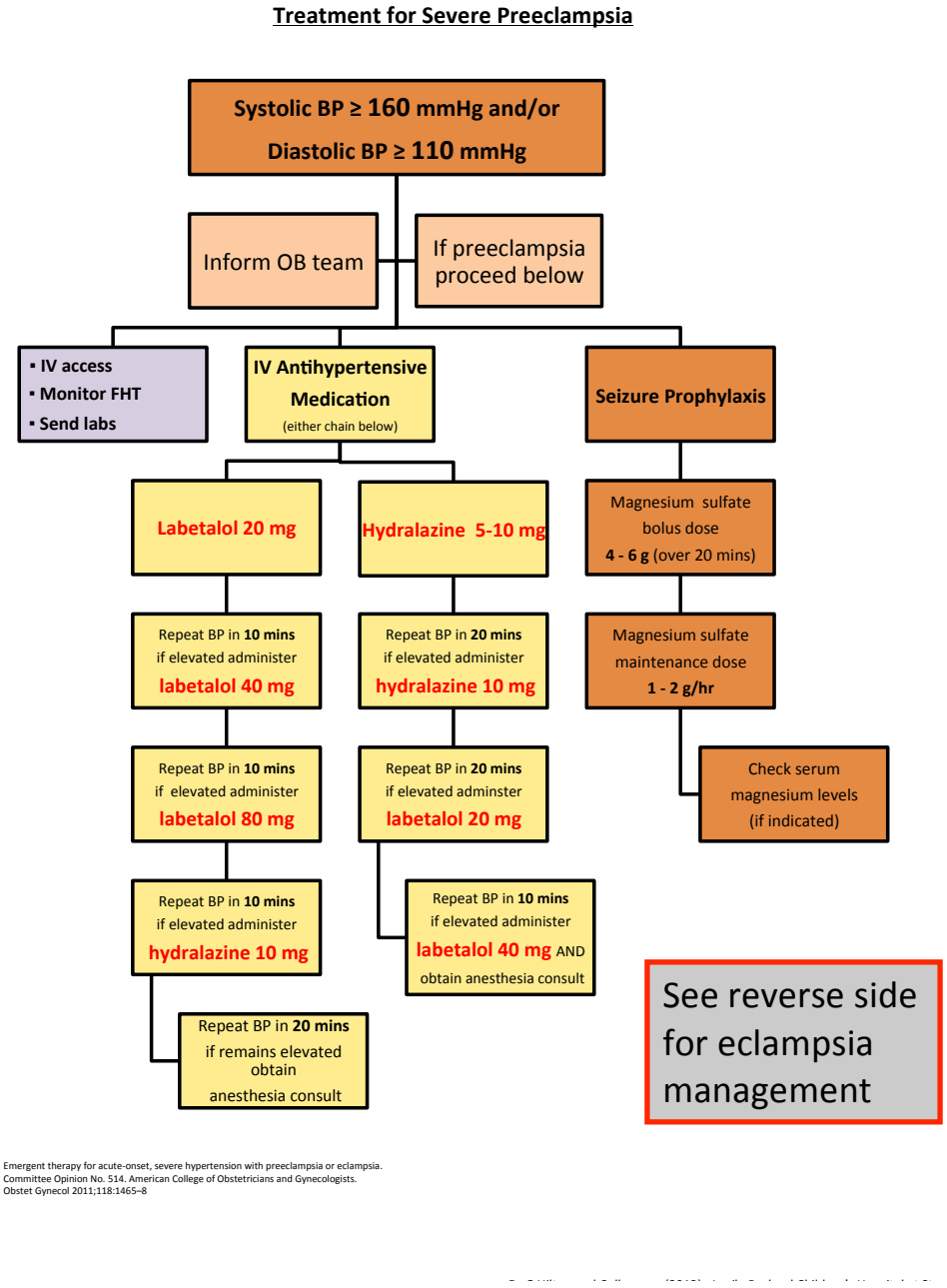
APPENDICES

Algorithms: Appendices A-F

Appendix A: Sample Management of Eclampsia Algorithm

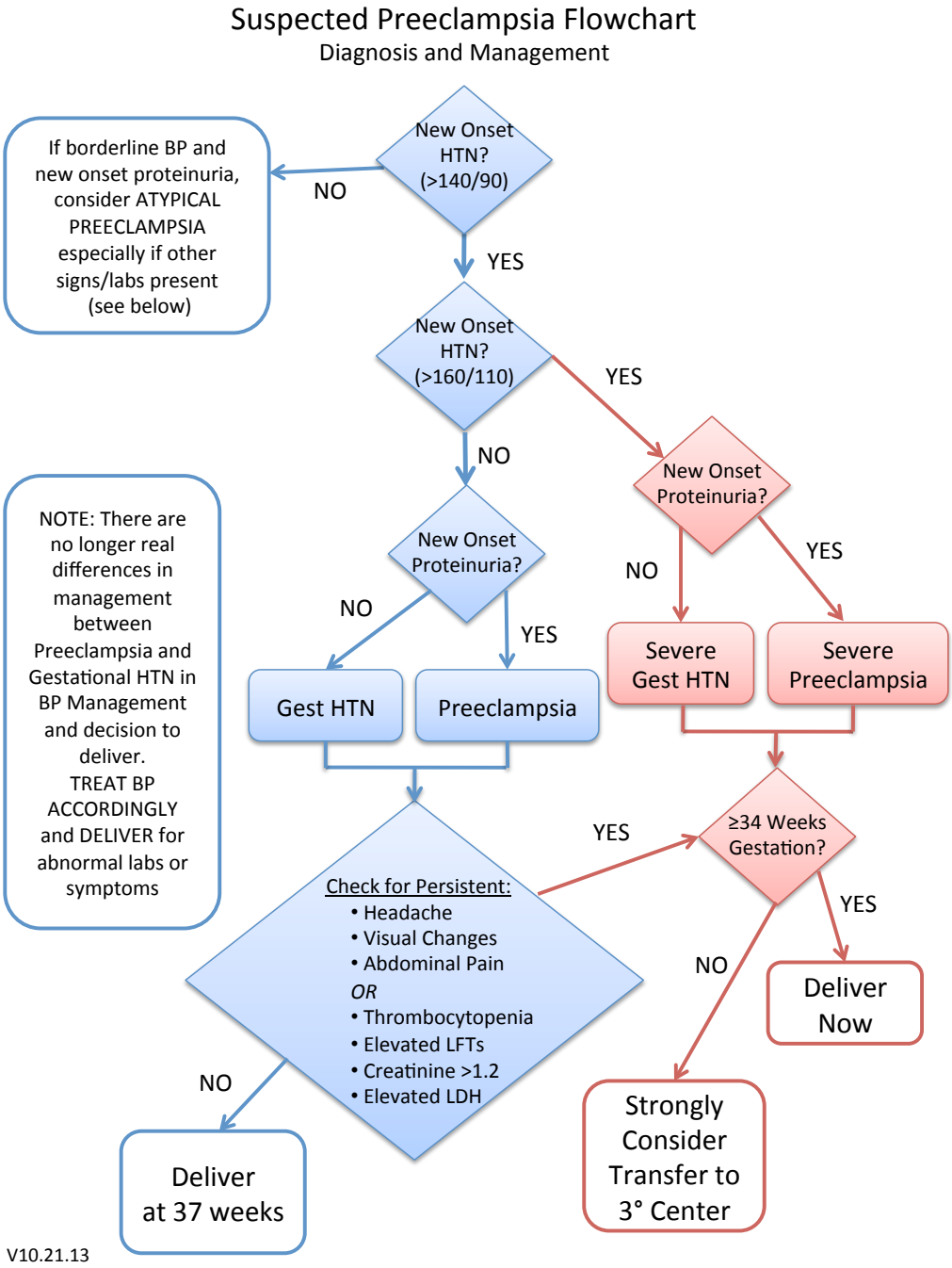


Appendix B: Sample Treatment of Severe Preeclampsia Algorithm



Dr. G Hilton and Colleagues (2012) - Lucile Packard Children's Hospital at Stanford, Used with permission, 2013

Appendix C: Suspected Preeclampsia Algorithm Diagnosis and Management



Appendix D: Preeclampsia Early Recognition Tool (PERT)

Preeclampsia Early Recognition Tool (PERT)

ASSESS	NORMAL (GREEN)	WORRISOME (YELLOW)	SEVERE (RED)
Awareness	Alert/oriented	•Agitated/confused •Drowsy •Difficulty speaking	•Unresponsive
Headache	None	•Mild headache •Nausea, vomiting	•Unrelieved headache
Vision	None	•Blurred or impaired	•Temporary blindness
Systolic BP (mm HG)	100-139	140-159	≥160
Diastolic BP (mm HG)	50-89	90-105	≥105
HR	61-110	111-129	≥130
Respiration	11-24	25-30	<10 or >30
SOB	Absent	Present	Present
O2 Sat (%)	≥95	91-94	≤90
Pain: Abdomen or Chest	None	•Nausea, vomiting •Chest pain •Abdominal pain	•Nausea, vomiting •Chest pain •Abdominal pain
Fetal Signs	•Category I •Reactive NST	•Category II •IUGR •Non-reactive NST	•Category III
Urine Output (ml/hr)	≥50	30-49	≤30 (in 2 hrs)
Proteinuria (Level of proteinuria is not an accurate predictor of pregnancy outcome)	Trace	•≥ +1** •≥300mg/24 hours	
Platelets	>100	50-100	<50
AST/ALT	<70	>70	>70
Creatinine	<0.8	0.9-1.1	>1.2
Magnesium Sulfate Toxicity	•DTR +1 •Respiration 16-20	•Depression of patellar reflexes	•Respiration <12

GREEN = NORMAL
Proceed with protocol

YELLOW = WORRISOME
Increase assessment frequency

# Triggers	TO DO
1	•Notify provider
≥2	•Notify charge RN •In-person evaluation •Order labs/tests •Anesthesia consult •Consider magnesium sulfate •Supplemental oxygen

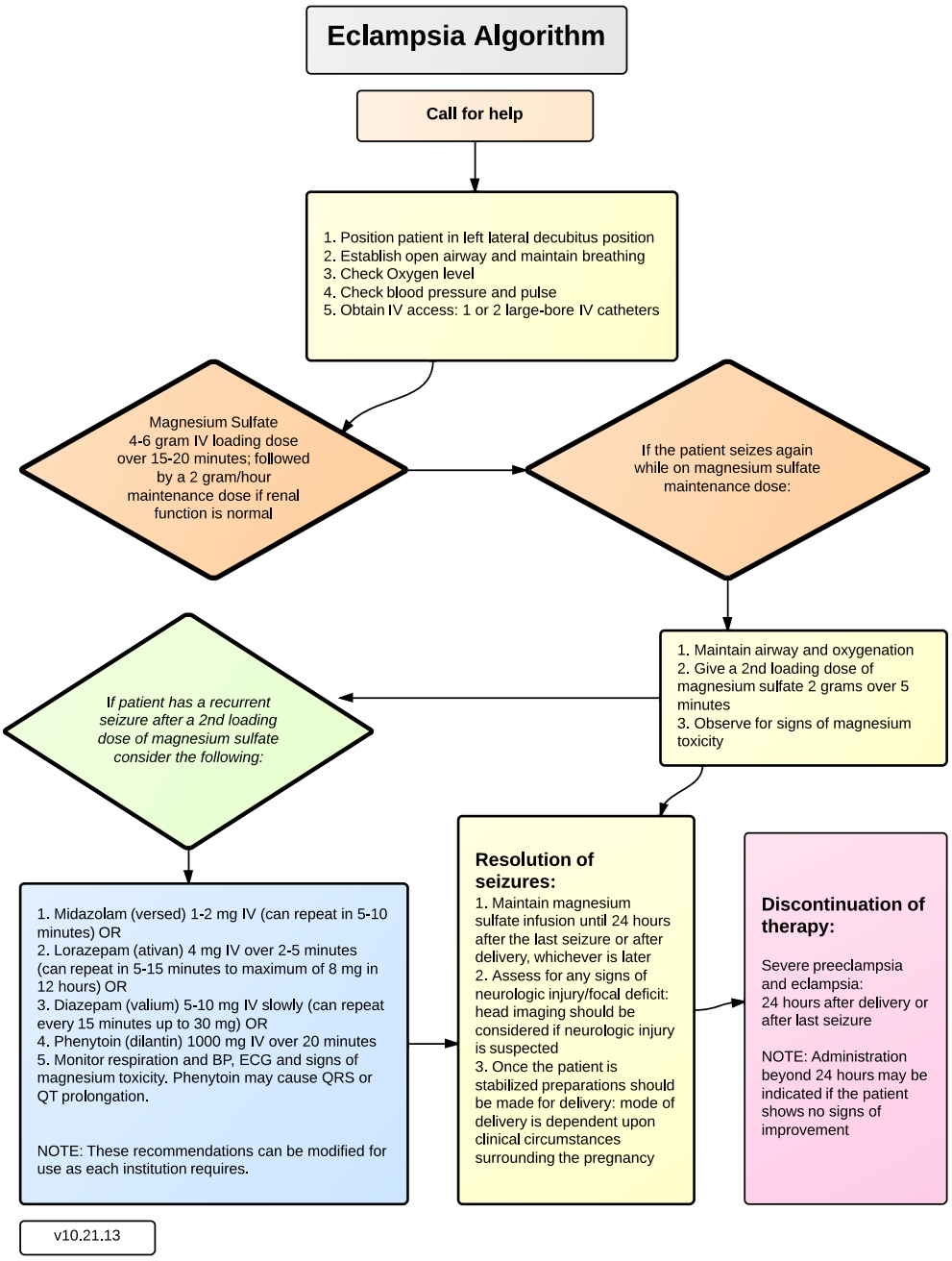
**Physician should be made aware of worsening or new-onset proteinuria

RED = SEVERE

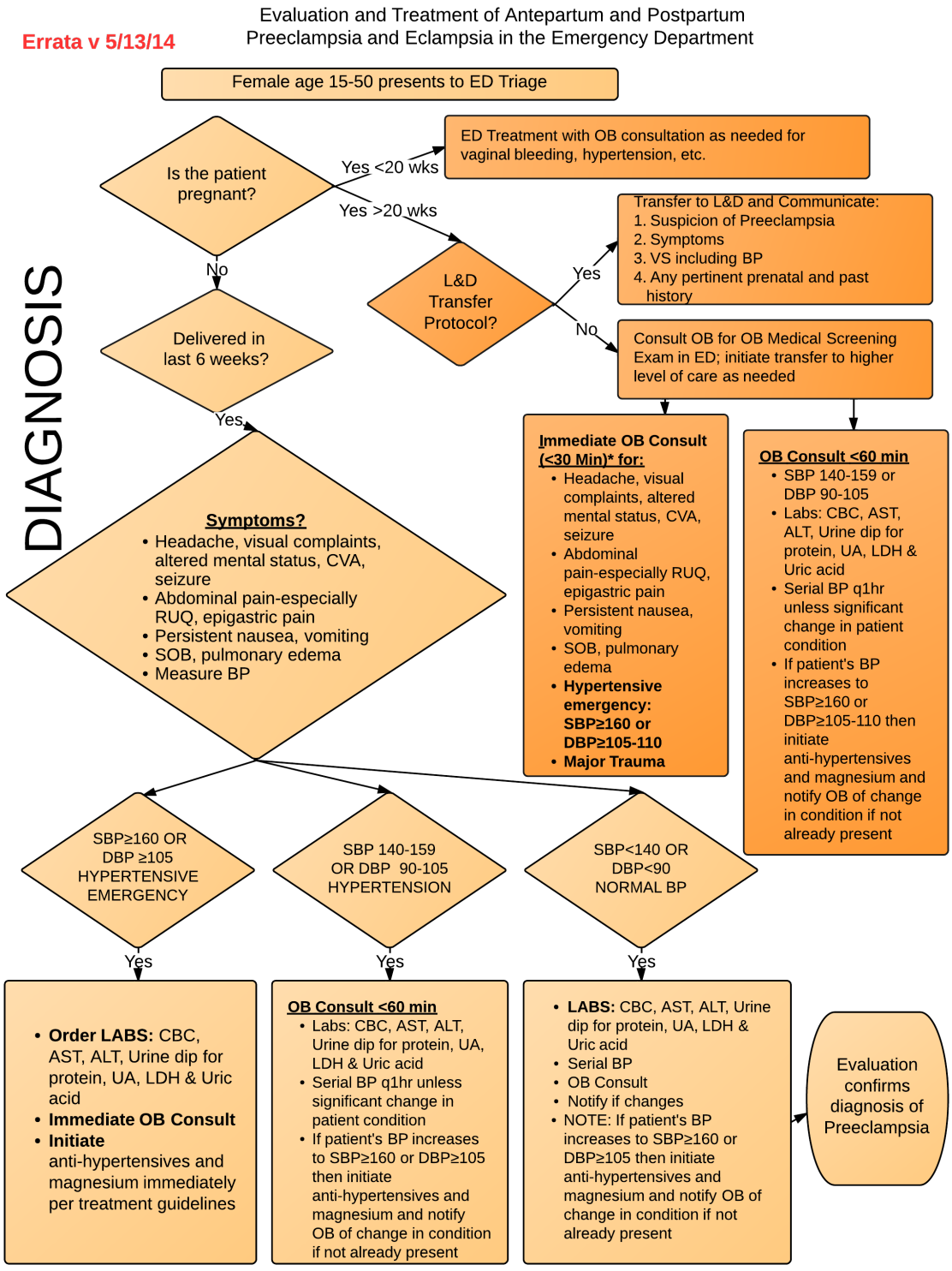
Trigger: 1 of any type listed below	TO DO
1 of any type	• Immediate evaluation • Transfer to higher acuity level • 1:1 staff ratio
Awareness Headache Visual	• Consider Neurology consult • CT Scan • R/O SAH/intracranial hemorrhage
BP	• Labetalol/hydralazine in 30 min • In-person evaluation • Magnesium sulfate loading or maintenance infusion
Chest Pain	• Consider CT angiogram
Respiration SOB O2 SAT	• O2 at 10 L per rebreather mask • R/O pulmonary edema • Chest x-ray

11.8.13.v1

Appendix E: Eclampsia Algorithm

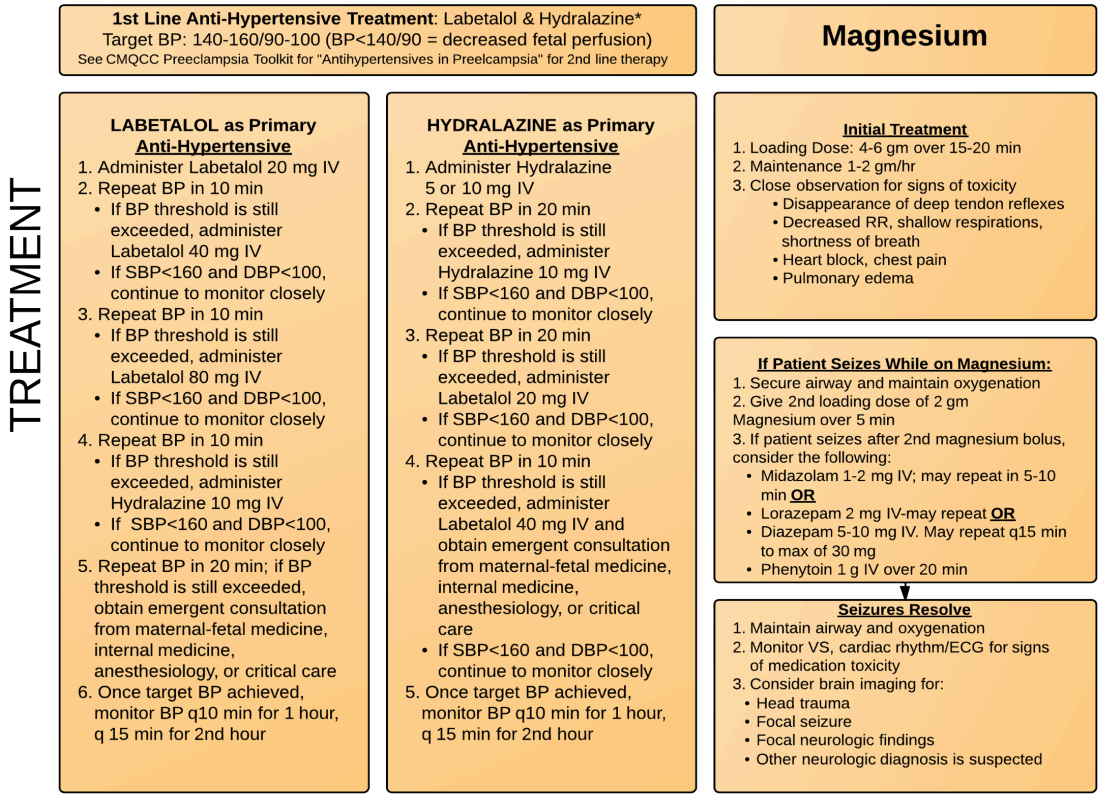


Appendix F: Evaluation and Treatment of Antepartum and Postpartum Preeclampsia and Eclampsia in the Emergency Department Part 1 AND 2



Errata v 5/13/14

Evaluation and Treatment of Antepartum and Postpartum
Preeclampsia and Eclampsia in the Emergency Department



*Labetalol and Hydralazine recommendations based on 2011 ACOG Committee Opinion #514 and Practice Bulletin #33, Reaffirmed 2012

Simulations/Drills: Appendices G-N

Appendix G: Severe Preeclampsia/Eclampsia In LDR v2.0 SimMan 3G: General Information

Severe Preeclampsia and Eclampsia in LDR v2.0 SimMan3G

Part 1 – General Information

Authors: Mark Meyer MD, Darin Bowers MA – Southern California Permanente Medical Group

Scenario	SimMan3G – LDR Severe Preeclampsia & Eclampsia v2.0 (Labor/Delivery/Recovery)
Scenario Time	15-20 minutes
Debriefing Time	20-45 minutes – longer if used as 1st scenario and requires more time to discuss non-technical skills (teamwork, communication, etc.) and CMQCC guidelines
Target Group	L&D nurses, OB physicians, Anesthesiologists, CRNA's, & scrub techs.
Case Summary	This is a case of a patient on L&D who is being induced for mild preeclampsia. The patient develops severe preeclampsia and eclampsia that requires anti-hypertensive treatment as well as additional magnesium to control seizures. Despite maximal magnesium therapy, the patient continues to seize and the patient will require additional medications to control her seizures. In addition, the patient's SpO2 will fall due to airway occlusion during/after the seizure. Simple repositioning of the head and opening the airway will restore SpO2. No intubation is required, but this could be required, if desired. This case is designed to ensure staff are following ACOG & CMQCC guidelines for appropriate treatment of preeclampsia and eclampsia. Therefore, there is a great emphasis on appropriate medication dosing and timing per these guidelines. It is critical that the participants recognize the patient is seizing. Unfortunately, the effectiveness of the SimMan3G seizure feature is limited, so confederate may be required to point out the seizure if the team does not recognize this. Fetal monitoring simulators can also be used, however, a non-reassuring fetal heart tracing may prompt the treatment team to move the patient to the OR before the patient has received appropriate treatment for eclampsia and is stable for urgent c-section.
Teaching Personnel	1. GUI operator 2. Observer to note team communication and medical management skills – will serve as lead debriefer 3. Family member to voice observation of seizure signs if staff doesn't recognize seizure (essential if using SimMan Classic and SimMan3G) 4. OB physician for clinical expertise if the lead debriefer is not OB 5. Voice of patient – could be GUI operator
Participants	1. 1-2 OB Physicians 2. 2-4 L&D nurses – varies depending on usual staffing on your unit 3. 1 CNM 4. Anesthesiologist and/or CRNA
Learning Objectives	1. Demonstrate effective teamwork and communication skills with a focus on adequate shared mental model and role clarity. This includes clear identification of all team members and SBAR to new team members as they arrive. 2. Diagnose severe preeclampsia 3. Treat hypertension per CMQCC Preeclampsia/Eclampsia guidelines 4. Provide appropriate initial management of eclamptic seizures with magnesium 5. Manage eclamptic seizures when magnesium is ineffective 6. Maintain airway and oxygenation in seizing and post-ictal patient
References	1. Emergent therapy for acute-onset, severe hypertension with pre- eclampsia or eclampsia. Committee Opinion No. 514. American College of Obstetricians and Gynecologists. Obstet Gynecol 2011;118: 1465–8 2. Preeclampsia care guidelines and compendium of best practices. California Maternal Quality Care Collaborative (CMQCC). 2013.

Used with permission, Kaiser Permanente and Mark Meyer, MD and Darin Bowers, MA 2013.

Appendix H: Severe Preeclampsia/Eclampsia In LDR v2.0 SimMan 3G: Learning Objectives

Severe Preeclampsia and Eclampsia in LDR v2.0 SimMan3G

Part 2 – Learning Objectives

Authors: Mark Meyer MD, Sarah Katel MD, Darin Bowers MA - KP Southern California

Cognitive Skills/Medical Management	1. Diagnose severe preeclampsia based upon signs and symptoms a. Hypertensive Emergency i.e. SBP ≥160 OR DBP ≥105 b. Neuro: Headache, Visual Complaints, Altered Mental Status, CVA, Seizure c. Abdominal pain – especially RUQ or epigastric pain d. Persistent nausea and vomiting e. Shortness of breath – pulmonary edema 2. Treat hypertension per 2011 ACOG guidelines – 1st line agents a. Target BP =140/90 (BP<140/90 = ↓fetal perfusion) b. Labetalol – escalating doses 20mg,40mg,80mg q10 min prn c. Hydralazine – escalating doses 5-10mg, 10 mg, q20 min prn 3. Provide appropriate management of eclampsia a. Initial magnesium load and drip – already done in this case b. Additional 2g magnesium bolus for recurrent seizure c. Additional agents for seizure despite maximal magnesium therapy i. Benzodiazepines ii. Phenytoin d. Maintain airway and oxygenation i. Maintain open airway ii. Provide 100% O2 iii. Definitive airway with intubation per anesthesia e. Consider neuro imaging if seizure is focal and/or other neuro diagnosis is suspected
Psychomotor Skills	1. Maintain airway with repositioning, jaw thrust, etc. as needed 2. Provide 100% O2 3. Perform endotracheal intubation if indicated (If anesthesiologist present)
Critical Actions	1. Make diagnosis of severe preeclampsia 2. Diagnose hypertensive emergency and manage per 2011 ACOG guidelines 3. Provide adequate control of seizures with magnesium and secondary agents if needed. 4. Airway management after seizure
Unacceptable Actions	1. Taking patient to the OR for c-section before BP and seizures controlled

Appendix I: Severe Preeclampsia/Eclampsia In LDR v2.0 SimMan 3G: Patient Background Information

Severe Preeclampsia and Eclampsia in LDR v2.0 SimMan3G

Part 3 – Patient Background Information

Authors: Mark Meyer MD, Darin Bowers MA – Southern California Permanente Medical Group

Patient Information and Background OPTION #1	
Age	28
Weight	182 lb
HPI	28 y/o G1P0 at 39 weeks admitted several hours ago after presenting to L&D triage with severe swelling BP was slightly elevated at 142/93. Patient was otherwise asymptomatic . Patient was given magnesium bolus and is currently on magnesium drip. Laboratory evaluation was WNL except for proteinuria..
PMHx	None
Medications	Prenatal Vitamins
Allergies	Sulfa
Social Hx	Married, sales person at Nordstrom's. No ETOH, Drugs, Tobacco.
Presentation	Patient calls the nurse after developing a moderate headache. The nurse should evaluate the patient's VS and note that she is now markedly hypertensive.
Vital Signs	Most recent set before nurse enters room: T 98.2 P 93 R 16 BP 142/93

Appendix J: Severe Preeclampsia/Eclampsia In LDR v2.0 SimMan 3G: Equipment/ Materials List

Severe Preeclampsia and Eclampsia in LDR Unit v2.0 SimMan3G

Part 4 – Equipment/Materials List

Authors: Mark Meyer MD, Darin Bowers MA - Southern California Permanente Medical Group

Simulation Equipment:

	Option #1 – SimMan 3G		
	For video debriefing:		Webcam
			Additional laptop with Laerdal's Debrief Viewer software installed
			Digital Projector
			Flash drive to transfer Debrief Viewer files between laptops
	Power strip		
	Foam tape		

Patient Care Equipment:

	ID band on SimMan3G	
	IV in place	
	IVF - 0.9NS or whatever IVF you prefer in this setting	
	BP cuff and pulse oximeter	
	100% O2 Non-Rebreather Mask	
	Adult ambu bag and oxygen tubing	
	Suction module, canister, tubing, yankauer tip	
	Stool for shoulder dystocia	
	Fetal monitor - OPTIONAL	
	Delivery room set up	
	Epidural setup – Optional	
	Adult crash cart that includes:	
		Airway equipment for intubation OPTIONAL
		Defibrillator that can be used as cardiac monitor

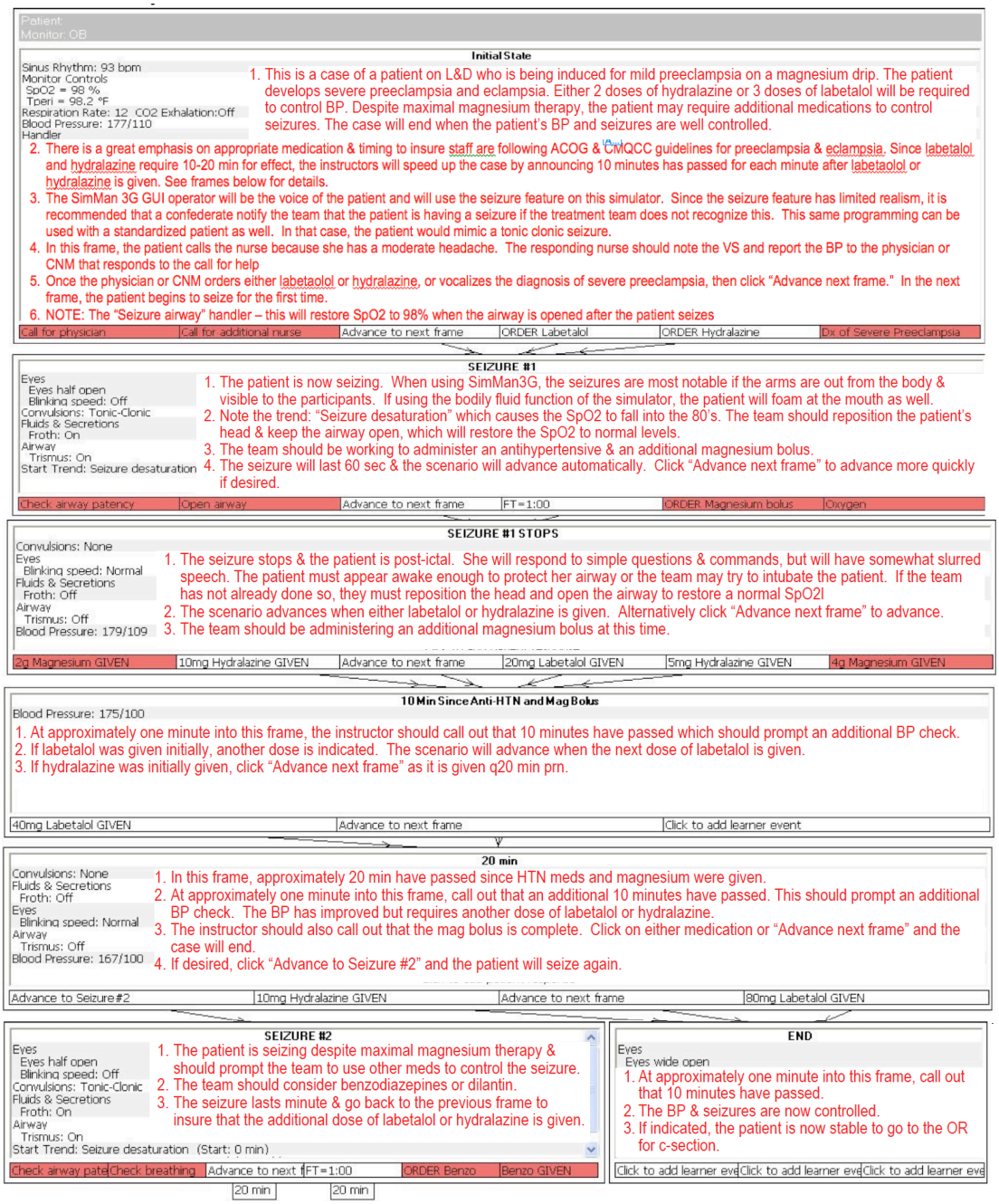
Medications:

		Magnesium 6g
		Magnesium 4g
		Magnesium 2g
		Pitocin OPTIONAL
		Labetaolol
		Hydralazine
		Benzodiazepine – Ativan, Versed, or Valium

Appendix K: Severe Preeclampsia/Eclampsia In LDR v2.0 SimMan 3G: Program Algorithm & GUI Notes

Severe Preeclampsia and Eclampsia in LDR Unit v2.0 SimMan3G

Part 5 - Program Algorithm & GUI Notes



Used with permission, Kaiser Permanente and Mark Meyer, MD and Darin Bowers, MA 2013.

Appendix L: Severe Preeclampsia/Eclampsia In LDR v2.0 SimMan 3G: Debriefing Objectives

Severe Preeclampsia and Eclampsia in LDR v2.0 SimMan3G

Part 6 – Debriefing Objectives

Authors: Mark Meyer MD, Darin Bowers MA – Southern California Permanente Medical Group

Scenario	v2.0 LDR Severe Preeclampsia_Eclampsia.sce
Est. Debriefing Time	20-30 minutes
Debriefing Objectives (4-5 Max) **Non-Technical** 1. Shared Mental Model 2. Role Clarity **Medical Management** 3. Hypertension 4. Seizures 5. Airway/oxygenation	**NON-TECHNICAL SKILLS** **SHARED MENTAL MODEL**- "Does everyone know what's going on?" 1. **SBAR responding team members to establish Shared Mental Model** a. **Stiutaton/Background** – suggested components required – Age, Gravida, Parity, Gestational age, VS with emphasis on BP, allergies, what interventions/treatments have already been given, pertinent symptoms, and any contraindications to treatment – in this case, asthma would be contraindication for using labetalol b. **Assessment –** What is our assessment of this patient's condition? e.g. "This patient has severe preeclampsia" c. **Recommendations** **i.** Are these consistent with CMQCC recommendations? **ii.** Initial recommendations don't have to be comprehensive, but rather, adequate to generate and share a general treatment plan. Details (e.g.dosing) can come later **iii.** Sample: "We need to treat the patient's hypertension, monitor VS and EFM closely, draw labs call for anesthesia, and be prepared if the patient begins to seize." **iv.** Commonly, team may only receive Situation and Background from the nurse. Focus on encouraging the nursing staff to give their assessment and recommendation d. Did entire team and/or latecomers get adequate report? 2. **Team Leader(s) give SBAR back to team after initial assessment is complete** a. Critical as first responder often does not provide assessment and plan. This can be due to limited information, but often this is medical cultural issue i.e. not all team members are comfortable speaking up. b. Provides clear plan to team and provides opportunity for team feedback **ROLE CLARITY -** only complete if it includes "Task Clarity as well 1. **Clear Role Assignment** a. Leader(s) – often a physician/nurse team form the most effective leadership b. Did personnel identify themselves? e.g. OB physician, midwife, nurse, anesthesia, etc. c. Primary nurse assigns tasks vs. "self selection" of roles/tasks 2. **"Task Clarity"** - clear verbalization of who is doing what task(s). a. The tasks that must be done are often not clearly assigned as part of the team member's role. e.g. There are several nursing tasks, but it may not be clear who is doing each. c. Regardless of how roles and tasks are assigned, these must be verbalized clearly so that entire team knows who is responsible for necessary task **MEDICAL MANAGEMENT SKILLS** 1. **Treat hypertension per CMQCC guidelines** a. Initial treatment given <30 minutes is CMQCC goal b. Appropriate drugs, dosing, indications and timing for repeated dosing? 2. **Eclampsia/ Seizure** a. Magnesium given in timely fashion? Additional mag given if necessary? b. Medications for treatment of seizures refractory to magnesium – E.g. benzodiazepines. c. Maintain airway & oxygenation in seizing and post-ictal patient d. See CMQCC guidelines for more details

Appendix M: Severe Preeclampsia/Eclampsia In LDR v2.0 SimMan 3G: Debriefing Guide/Evaluation

Part 7 Debriefing Guide/Evaluation – Make notes & time of notable behavior for use during video debriefing

Shared Mental Model/SBAR 1. Nurse to team responding to call for help a. Are all elements present? b. What elements are missing, why? 2. Did the responding team "receive" the report? a. Report given only to physician? b. Team doing other tasks and not listening? c. Team leader gather team for report? 3. Report given to team members who arrive later? 4. Does physician give SBAR back to team after initial assessment?	**Shared Mental Model/SBAR Notes** 1. SBAR elements? 2. Did team "receive" report? 3. New team members get report? 4. Physician gives SBAR back to team?
Role Clarity 1. Clear nursing and physician leader? 2. Other Roles clearly established? a. Self-assignment b. Team leader assigns roles/tasks 3. Are roles clearly verbalized to ALL team members?	**Role Clarity Notes** 1. Clear nursing & physician leader? 2. Roles clearly established? 3. Roles clearly verbalized?
Situational Awareness & Assertion 1. Ongoing monitoring & crosschecking? (Assess condition & response to treatment) 2. Recognizes critical information in timely fashion i.e. "The Gorilla" 3. Effective assertion to appropriate team member? e.g. 2 challenge rule, etc.	**Situational Awareness & Assertion Notes** 1. Monitoring of situation? 2. Recognizes critical information 3. Effective assertion?
Closed Loop Communication 1. Responds appropriately to input from team? (leaders open to input, rationale for actions?) 2. Readback of orders	**Closed Loop Communication Notes** 1. Responds to input? 2. Readback of orders
Cognitive Skills/ Medical Management 1. Critical medical management actions (varies with each scenario) 2. Considers other diagnoses when patient doesn't respond as expected 3. Avoids medication errors	**Cognitive Skills/ Medical Management Notes** 1. Critical medical management actions? 2. Considers other diagnoses when appropriate? 3. Avoids medication errors?
Psychomotor Skills/Equipment Competency 1. Quickly locates critical equipment 2. Competent with critical equipment/systems	**Psychomotor Skills/Equipment Competency Notes** 1. Locates critical equipment 2. Competent with equipment

Used with permission, Kaiser Permanente and Mark Meyer, MD and Darin Bowers, MA 2013.

Appendix N: Simulation Scenario: Hypertension in Pregnancy, HELLP with Seizure

Simulation: HELLP with Seizure

Leslie Cragin, CNM, California Nurse Midwives Association
Ana Delgado, CNM, California Nurse Midwives Association
Ocean Berg, RN, MSN, IBCLC, Nurse Family Partnership Program, San Francisco

Topic: Hypertension in Pregnancy Scenario: HELLP with seizure
Duration of Scenario: 6 - 13 min
General Description of the Scenario:
Jackie is a 17 yo G1P0 @ 36 weeks by sure normal LMP. She came to triage accompanied by her sister after beginning uterine contractions 8 hours ago, that have been increasing in intensity and frequency. The contractions are every 3-4 minutes, lasting a minute. Jackie complains of a strong headache beginning 2 days ago. The baby is moving less than before labor began. She was admitted for labor 4 hours ago with V/E 4cm, 70%, -2 station.

Brief Medical/OB History:

- Regular visits, no chart available
- Fundal height = 34
- Admit labs: hgb 9.2, hct 30, platelets 90,000

Objectives:

Cognitive:

1. Accurately identify risk factors for severe preeclampsia/HELLP
2. Identify the differential diagnosis for eclampsia
3. Identify medications to be used in managing an eclamptic seizure
4. Know the steps in management eclampsia

Technical:

1. Provide protection from injury and patent airway during seizure
2. Evaluate for interval to delivery
3. Evaluate fetal status
4. Prepare for fetal resuscitation and potentially postpartum hemorrhage

Behavioral:

1. Calls for help in a timely manner
2. Communication with team
3. Maintains a calm demeanor during the emergency
4. Clear communication with the frightened family members

Roles of the participants:
RN, CNM, extra RN, obstetrician,

- Facilitator taps out fetal heart rate
- MD is slow to come in after being called– doesn't intervene or direct but does ask what is happening

Roles of the Confederates:

- Patient in PartoPants©, Significant other

Equipment: Partopants, bed, sheets, footstool, baby, IV pole/set/fluid, Doppler or fetoscope, delivery set,
Simulator: Actress as Patient with PartoPants
Opening scene: Mother is laboring with _____

Progression of Scenario

Time	Events for Actress and Confederates	Appropriate Actions	Symptoms/Results of inappropriate action
0-5 min	Patient **(IV in place)**; midwife/OB RN and significant other in room Patient in labor with ctx q3 min FHR 120's Pt begins to seize at about 5 minutes into scenario - seizure lasts 90 seconds Fetal bradycardia to 80 BPM for 3 min begins with seizure and lasts 3 min	Clean hands Begins assessment: talks with patient Requests vital signs Asks about urine and proteinuria May ask for additional labs May turn mom into side-lying Notes FHR	 Initial vitals 138/89 P=110 No pain meds given yet No proteinuria Vaginal exam if done 8 cm, 100 % 0 station BP stays in this range - never severely elevated
4/5-10 min	Seizure resolves Sister asks what is happening FHR 160's then back to normal Pt is postictal/sleepy Pt involuntarily pushes Vaginal exam	Pt turned to L side, O2 on Mag. sulfate ordered: 4-6 gm IV over 15 minutes or 5 gm IM in each buttock if no IV No BP meds since BP is not elevated Calls for help Evaluates FHR Gives accurate concise report to attending STOP SCENARIO	If no Mag. ordered by 2 min postictal, another seizure begins- this should be treated with MgSO4, diazepam ok, but NOT optimal

Guide for review of simulation:
(Remember to focus on cues from the video; these are only triggers for discussion.)
General:

1. How did that feel?
2. Would someone give an overview of the scenario?
3. What did you see?
4. What went well?
5. What didn't?
6. Was there anything in the **10 commandments** that would've helped you? (Translated and modified with permission from CAPE, Center for Advanced Pediatric and Perinatal Education (CAPE) 2007; Anderson et al., 2006. Ten Commandments of Simulation: 1) know your environment; 2) anticipate and plan for crises; 3) assume a leadership role; 4) communicate effectively; 5) distribute workload optimally; 6) allocate attention wisely; 7) utilize all available information; 8) utilize all available resources; 9) call for help early enough; 10) maintain professional behavior.)

Cognitive:

1. What were you thinking when you heard about the report?
2. What are the risk factors for pre-eclampsia/severe and HELLP?
3. What are the signs and symptoms of HELLP?
4. What labs would help to evaluate this pt?
5. What other emergencies/complications follow eclampsia (PPH, neonatal compromise)?

Technical:

1. What should be done to protect the patient?
2. What are the components of intrauterine resuscitation?
3. What are the medications to be used in eclampsia with severe HTN?

Behavioral: Focus on 2-3 points

1. Know your environment and team
2. Plan and anticipate
3. Assume the role of leader
    a. Who was the leader?
    b. How did that go? (ask leader and participants)
4. Communicate in an effective manner with the team, the patient and her family
    a. How was the interaction between the midwife/OB and nurse?
    b. How was the communication with the patient?
5. Delegate appropriately
6. Allocate attention wisely
7. Use all your available resources
8. Use all your available information
9. Call for help in a timely manner
    a. What made you call for help?
10. Maintain professional conduct/attitude at all times.

Used with permission of Leslie Cragin, CNM, Ana Delgado, CNM, Ocean Berg, RN, MSN, IBCLC.

Patient Education: Appendices O-Q

Appendix O: Preeclampsia Foundation Signs and Symptoms Information Sheet

To order materials, go to: www.preeclampsia.org/market-place

Appendix P: SAMPLE: Discharge Instructions Following Delivery with Diagnosed Preeclampsia

[NAME OF HOSPITAL, CLINIC OR PRACTICE]
[PHONE NUMBER]

DISCHARGE INSTRUCTIONS FOLLOWING DELIVERY OF BABY
PREECLAMPSIA

During your hospitalization, you have been treated for preeclampsia or HELLP syndrome. Preeclampsia is a problem that can occur in the late stages of pregnancy and even *during the first few weeks postpartum* (after delivery of your baby), and causes high blood pressure, protein in the urine and sometimes other symptoms such as headaches, blurred vision, breathlessness, and swelling of the hands or face. In the past, it has been called "toxemia" or "pregnancy-induced hypertension". HELLP syndrome is a variation of preeclampsia that directly affects your liver and blood platelets.

Preeclampsia can be mild or severe. If it isn't treated, preeclampsia can turn into a serious problem called "eclampsia" in which seizures occur.

When you go home, follow these instructions:

- Keep follow-up appointments with your doctor. These may be very frequent and are very important for your health.
- Take all medications prescribed for you exactly as ordered.
- Weigh yourself at the same time each day. Write down your weight and take this record with you to your doctor visits.
- If ordered by your doctor, monitor your blood pressure at home.
- Ask your doctor if you need to check your urine at home for protein.
- Eat a healthy, balanced diet. Your doctor will tell you if you need to follow any special restrictions in what you eat.
- Don't smoke.
- Don't drink alcohol or use any drugs not prescribed to you.
- Ask your doctor before taking any medications that he or she didn't prescribe for you. This includes any over-the-counter medications.

Call your doctor if:

- Your blood pressure is greater than _____ systolic (the top or first number).
- Your blood pressure is greater than _____ diastolic (the bottom or second number).
- You have a severe headache or dizziness.
- You have any headache that is not relieved with Tylenol or ibuprofen (e.g., Advil™, Motrin ™).
- You have pain in your belly, especially the right upper area below your ribs.
- You have blurry or double vision, see spots or auras.
- Your swelling is worse.
- You gain more than 3 pounds in 3 days.
- You have serious difficulty catching your breath.
- You have any new or unusual symptoms.
- You have any questions or concerns.

If you have any of the above symptoms, call [phone number] immediately. If you are unable to reach your physician you need to go to the emergency room for evaluation. Be sure to tell them you just had a baby and you had preeclampsia.

Additional information about preeclampsia can be found at www.preeclampsia.org. There you will find accurate information about preeclampsia and related disorders of pregnancy, as well as a very friendly and helpful community of women with whom you can discuss any concerns or questions.

Used with permission from Central Baptist Hospital Lexington, KY, 2013 and The Preeclampsia Foundation.

Appendix Q: SAMPLE: Discharge Sheet for Preeclampsia, Eclampsia and HELLP Syndrome Patients

Discharge Information for Patients with Diagnosis of Preeclampsia, HELLP Syndrome or Eclampsia

Your Medications include the following:
1) _____ To be taken every ____ hours.

2) _____ To be taken every ____ hours.

3) _____ To be taken every ____ hours.

Your postpartum follow-up appointment has been made with Dr. _____ in_____ days.
Date: _____Time:_____

You have been instructed to check your blood pressure at home daily: Yes____ No____

Call your healthcare provider_____ Phone Number: _____
if your blood pressure is greater than _____ systolic (top number)
and/or
If your blood pressure is greater than _____ diastolic (bottom number)

Call your healthcare provider if:
• Your temperature is greater than 100.4.
• Your bleeding is greater than a heavy menses.
• You have any headache that is not relieved with Tylenol™ or ibuprofen (e.g., Advil™, Motrin™).
• You have pain in your belly, especially the upper area below your ribs.
• You have blurry or double vision, see spots or flashing lights.
• Your swelling is worse.
• You gain more than 3 pounds in 3 days.
• You have serious difficulty catching your breath.
• You have any new or unusual symptoms.
• You have any questions or concerns.

Miscellaneous: Appendices R-W

Appendix R: Prenatal Care Monitoring: Documentation of Diagnosis and Accurate ICD-9 Coding

Sarah Kilpatrick MD, PhD, Cedars Sinai Medical Center

Diagnostic accuracy

A large proportion of preeclampsia related deaths are preventable.[1,2] Of preventable deaths and near-miss morbidities a large proportion of the preventable factors are provider related including delay in diagnosis, and incomplete or inappropriate management.[3,4] Making a timely and correct diagnosis is fundamental for improving outcomes in preeclampsia. Further, an inaccurate diagnosis of preeclampsia is not uncommon. Only 45% of the ICD-9 diagnoses of preeclampsia without severe features (mild) were confirmed by chart review.[5] Half of these were gestational hypertension and the other half severe preeclampsia. This study illustrates that even in a university hospital there is significant confusion around the classification of hypertension in pregnancy. If the diagnosis is not clear or is inaccurate (i.e., she is diagnosed with preeclampsia without severe features (mild) but she actually has severe preeclampsia), it is not surprising that she may receive the wrong treatment (e.g., expectant management rather than delivery). The need for clear diagnostic accuracy is even more important in a progressive disease, such as preeclampsia, that will typically worsen as the pregnancy progresses and correspondingly requires changes in management. Because the treatment will change as the disease evolves and or the gestational age advances, the provider must appropriately reevaluate the patient to capture the evolution of the disease. The correct diagnosis based on signs and symptoms for gestational hypertension, preeclampsia without severe features (mild), severe preeclampsia, eclampsia, or superimposed preeclampsia must be made and appropriately documented. All interventions should be based on diagnosis and gestational age of the pregnancy.

Recommendations:

1. Clearly document and communicate initial diagnosis based on initial signs and symptoms.

2. Clearly document and communicate initial treatment plan, and plan for reevaluation based on initial diagnosis and gestational age.

3. Clearly document and communicate any changes in diagnosis and plan.

4. Hospital coders should review progress notes to identify most advanced stage of preeclampsia during hospital admission to code for discharge diagnosis.

Table 1: ICD-9 Codes for Hypertensive Diseases in Pregnancy and Postpartum*

ICD-9 Code	Description
642.0	Benign essential hypertension complicating pregnancy, childbirth, and the puerperium
642.1	Hypertension secondary to renal disease, complicating pregnancy, childbirth, and the puerperium
642.2	Other pre-existing hypertension complicating pregnancy, childbirth, and puerperium
642.3	Transient hypertension of pregnancy (gestational hypertension)
642.4	Mild or unspecified preeclampsia
642.5	Severe preeclampsia
642.6	Eclampsia
642.7	Preeclampsia or eclampsia superimposed on preexisting hypertension

*5th digits are used to denote the current episode of care (e.g. delivered, antepartum, postpartum)

Table 2: ICD-10 Codes for Hypertensive Diseases in Pregnancy and Postpartum**

ICD-10 Code	Description
010.01	Preexisting essential hypertension complicating pregnancy
010.02	Preexisting essential hypertension complicating childbirth
010.03	Preexisting essential hypertension complicating the puerperium
011	Preexisting hypertension with preeclampsia
013	Gestational hypertension without significant proteinuria
014	*Preeclampsia [excludes preexisting hypertension with preeclampsia (011)]: see specific codes below:*
014.0	Mild to moderate preeclampsia
014.1	Severe preeclampsia [excludes HELLP syndrome (014.2)]
014.2	HELLP syndrome (HELLP)
014.9	Unspecified preeclampsia
015.0	Eclampsia in pregnancy
015.1	Eclampsia in labor
015.2	Eclampsia in the puerperium
015.9	Eclampsia, unspecified as to time period

**Additional digits are used to denote the trimester (1, 2, 3, and 0=unspecified)

Suggested Strategies for Data Quality Improvement Opportunities

What strategies can be used to improve the quality of coding of hypertensive diseases in pregnancy? The release of new definitions for preeclampsia will create an educational opportunity that should be embraced. Small posters with the new definitions (and codes) should be placed on Labor and Delivery units and shared with the hospital coders. As a follow-up to a Grand Rounds on Preeclampsia, diagnostic criteria can be reinforced by going over a few cases at serial department meetings and asking the physicians to select the "right" diagnostic category. Finally, as a QI effort, as cases are reviewed in Perinatal Quality review Committees, attention can be focused on the correct categorization. Feedback can be quite effective.

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Appendix S: Sample Preeclampsia/Eclampsia Medication Toolbox List

Each institution should prepare its own medication toolbox specific to its protocols.

L&D Severe Preeclampsia & Eclampsia Box – Content and Dose Guideline	
Magnesium 20 grams/500 ml bag	**IV (Use Magnesium Sulfate Continuous Infusion under L&D protocol in Alaris Pump Library):** *Initial (Loading Dose):* 4-6 g (100 ml – 150 ml) over 20 minutes *Maintenance Dose:* 1-2 g/hour (25 ml/hr – 50 ml/hr) continuous infusion
Labetalol 100mg/20ml vial	***Initial: Draw 4 ml from the vial.*** **20 mg (4 ml)** IV bolus followed by **40 mg (8 ml)** if not effective within 10 minutes; then **80 mg (16 ml)** every 10 minutes (maximum total dose of 300 mg/60ml)
Hydralazine 20mg/ml vial	***Initial: Draw 0.25 ml from the vial.*** **5-10 mg (0.25-0.5 ml)** doses IV every 15-20 minutes
Esmolol 100mg/10ml vial **(By Anesthesiologists ONLY)**	**1-2 mg/kg (0.1-0.2 ml/kg)** IV over 1 minute
Propofol 10mg/ml, 20ml vial **(By Anesthesiologists ONLY)**	**30-40 mg (3-4 ml)** IV bolus
Calcium gluconate 1000 mg/10ml vial	1000 mg/10 ml IV over 2-5 minutes
Labetalol 200 mg tablets	200 mg PO and repeated in 30 minutes if needed
Nifedipine 10 mg PO	10 mg PO and repeated in 30 minutes if needed
Supply contents	3 ml, 10 ml, and 20 ml syringes, appropriate needles and appropriate tubing sets

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Appendix T: Special Considerations for Treatment of Severe Hypertension: Amphetamine/Cocaine Drug Abuse and Hypotension

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Drug abuse is very common in women of childbearing age, with 12-21% of women 18-35 years using illicit drugs,[1] especially cocaine and methamphetamine.[2] Many drugs not only affect maternal and fetal well-being, as well as alter maternal responses to prescribed medications and treatment. In particular, acute and chronic amphetamine or cocaine use may result in physiologic and pharmacodynamic changes that prove difficult to manage in the parturient.

Cocaine blocks the presynaptic reuptake of sympathomimetic neurotransmitters including dopamine, serotonin and norepinephrine. Thus, the acute use of cocaine results in the relative neurotransmitter concentrations increasing at the catecholamine's site of action, producing adrenergic stimulation both centrally and peripherally. Cocaine may cause intense vasoconstriction producing hypertension, coronary ischemia, and reduced uterine artery blood flow; other effects include tachycardia, arrhythmias, altered sensorium, and hyperthermia. With chronic abuse of cocaine the sympathomimetic neurotransmitters become depleted and hypotension and lethargy may ensue.

Common treatment of cocaine/amphetamine induced hypertension and tachycardia may include the use of hydralazine and labetalol.[3] However beta-blockers, including labetalol (beta-adrenergic to alpha-adrenergic blocking 7:1 when administered IV[4]) may produce unopposed alpha-adrenergic stimulation with worsening of coronary and peripheral vasoconstriction.[5] Indeed, phentolamine may be the drug of choice for cocaine/amphetamine-induced hypertension.

Treatment of hypertension in the patient with chronic cocaine/amphetamine abuse may cause an exaggerated decrease in blood pressure. Hypotension may be difficult to treat due to altered vasopressor response and depleted endogenous catecholamine stores. Unexpected, severe hypotension may also occur after regional anesthesia or general anesthesia.

Please note the following references for this statement:[6-8]

Also noteworthy, ketamine administration may exacerbate symptoms of acute cocaine use, due to ketamine's sympathetic nervous system stimulation.

Amphetamines indirectly stimulate the sympathetic nervous system, causing the release of catecholamines from presynaptic vesicles. The symptoms are similar to cocaine intoxication and may include hypertension, arrhythmias, tachycardia, dilated pupils, hyperreflexia and even hyperthermia. Use of regional anesthesia may be associated with unpredictable hypotension, resistant to treatment. Cardiac arrest has also been reported following both regional and general anesthesia.

Parturients chronically using either cocaine or amphetamines are in a state of catecholamine depletion and potentially altered adrenergic receptor responses. Trauma patients may also exhibit catecholamine depletion, having maintained their blood pressure through extensive release of stored catecholamines. The initial antihypertensive treatment of elevated blood pressure due to acute intoxication with cocaine/amphetamine or even pain with coincident significant trauma may exacerbate subsequent hypotension.

Treatment of hypotension may be difficult in the catecholamine-depleted patient.

Ephedrine's mechanism of action includes a direct effect as well as a significant secondary release of norepinephrine, which would be decreased in the catecholamine-depleted state, considerably blunting ephedrine's effectiveness. The vasopressors of choice should be direct acting agents, administered intravenously. Preferred agents include phenylephrine, epinephrine and norepinephrine. While norepinephrine has the strongest direct acting vasoconstriction, it should be administered via central access. Please note that greater than typical bolus doses may be required. Infusions may also be very useful, depending on circumstances. Typical doses of direct acting vasopressors are listed below:

Phenylephrine 100 mcg IV bolus
Epinephrine 50-100 mcg IV bolus (stronger)
Norepinephrine 4-8 mcg IV bolus or infusion 2-20 mcg/min[4] (risk of skin ischemia if given through small peripheral IV, prefer central line or secondarily large bore IV fast flowing)

Note that the same phenomenon of hypotension 'resistant' to vasopressor treatment has been reported following double calcium channel blocker usage – i.e., magnesium sulfate plus nifedipine. The physiologic difficulty with dual calcium channel blockers is post-depolarization low intracellular calcium. Normally the rise in intracellular calcium triggers a much greater release of calcium from the sarcoplasmic reticulum, causing contraction of the muscle cell. In the setting of post-dual calcium channel blocker hypotension, vasopressors may not be effective, because of calcium depletion. Fortunately, treatment with calcium (1 gram $CaCl_2$ IV) may reverse the primary problem – low intracellular calcium.

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Appendix U: Sample Nursing Management Policy and Procedure

Nursing Management of Preeclampsia
Sample Policy and Procedure

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Ocean Berg, RN, MSN, CNS, Nurse Family Partnership Program, San Francisco
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PURPOSE:
To outline the nursing management of inpatients who have preeclampsia including special considerations for management of patients on magnesium sulfate, patients on antihypertensive medications and management of eclampsia.

BACKGROUND:
Preeclampsia is a hypertensive disorder of pregnancy characterized by vasospasm and endothelial damage, which may impact the cardiovascular, renal, hematological, neurologic, and hepatic systems as well as the uteroplacental unit. It is of unknown etiology. Preeclampsia is characterized by new onset of hypertension and proteinuria after 20 weeks gestation in a previously normotensive woman.

- Hypertension: two blood pressure reading of > 140 systolic OR > 90 diastolic taken at least six hours apart
- Proteinuria: 0.3 gm of protein in a 24 hour urine collection

REPORTABLE CONDITIONS:
Notify provider for:

1. Repeated blood pressure greater than 160 systolic OR greater than 105-110 diastolic (taken at least 15 minutes apart).
2. New or worsening complaint of any of the following:
    a. Headache
    b. Visual changes
    c. Right Upper Quadrant (RUQ) or epigastric pain
3. Abnormal lab values

ADMISSION:

1. Assess for absence or presence of:
    a. Headache
    b. Visual changes
    c. Right upper quadrant or epigastric pain
    d. Nausea/vomiting
    e. General malaise.
2. Assess upper or lower deep tendon reflexes.
3. Auscultate for lung sounds, noting any presence of rales, rhonchi, wheezing, etc.
4. Assess for generalized edema and significant, rapid weight gain.

5. Assess blood pressure using an appropriately sized blood pressure cuff with patient sitting or in the upright position with the patient's arm at the level of the heart. Do not reposition the patient to her left side and retake blood pressure. It will give a false lower reading.
6. Apply external fetal monitor (if viable fetus).
7. Prepare to obtain IV access as ordered by provider.
8. Prepare to administer medications to lower blood pressure and prevent seizure activity.
9. Prepare to monitor intake and output.
10. Maintain activity as ordered by provider. If on bedrest, maintain side-lying position as much as possible, avoiding supine position, and change position every two hours or more often as needed.
11. Provide emotional support and opportunity for patient family to verbalize questions, concerns and/or fears.
12. Assess maternal vital signs including: blood pressure as described above, respiratory rate, heart rate, temperature, and oxygen saturation.
13. Prepare to assess lab values as ordered.
14. Ensure oxygen and suction equipment are present and functioning.
15. Implement measures to decrease stress level, such as provision of a quiet environment and low lighting.
16. Monitor temperature per department protocol.
17. Assess intake and output (I&O) every 1 hour.

ANTEPARTUM ONGOING ASSESSMENT:

Goals of patient management are:

1. Early recognition of severe or worsening preeclampsia or development of eclampsia.
2. Prolongation of pregnancy to optimize fetal maturation must be weighed against risks of pregnancy continuation.

Preeclampsia without severe features (mild):

1. Obtain blood pressure, pulse, respirations, and oxygen saturation every 4 hours.
2. Assess lung sounds every 4 hours.
3. Assess deep tendon reflexes (DTRs), Clonus, edema, level of consciousness (LOC), headache (HA) visual disturbances, epigastric pain every 8 hours.
4. Obtain Non Stress Test (NST) or monitor Fetal Heart Rate (FHR) with uterine activity for 30 minutes every shift or as condition warrants.
5. Assess fetal movement every shift.

Severe Preeclampsia:

1. Obtain blood pressure, pulse, respirations, and oxygen saturation hourly.
2. Assess lung sounds every 2 hours.
3. Assess deep tendon reflexes (DTR's), Clonus, edema, level of consciousness (LOC), Headache (HA) visual disturbances, epigastric pain every 4 hours.

4. Monitor FHR and uterine activity continuously.

INTRAPARTUM ONGOING ASSESSMENT:

Preeclampsia without severe features (mild):

1. Obtain blood pressure, pulse, respirations, and oxygen saturation every 60 minutes.
2. Assess lung sounds every 4 hours.
3. Assess deep tendon reflexes (DTRs), clonus, edema, level of consciousness (LOC), headache (HA) visual disturbances, epigastric pain every 8 hours.
4. Monitor FHR and uterine activity continuously.

Severe Preeclampsia:

1. Obtain blood pressure, pulse, respirations, and oxygen saturation every 30 minutes.
2. Assess lung sounds every 2 hours.
3. Assess Deep Tendon Reflexes (DTRs), clonus, edema, level of consciousness (LOC), headache (HA) visual disturbances, epigastric pain every 4 hours.
4. Monitor FHR and uterine activity continuously.

POSTPARTUM TO DISCHARGE ONGOING ASSESSMENT:

Preeclampsia without severe features (mild):

1. Obtain blood pressure, pulse, respirations, and oxygen saturation every 4 hours.
2. Assess lung sounds every 4 hours.
3. Assess deep tendon reflexes (DTRs), Clonus, edema, level of consciousness (LOC), headache (HA) visual disturbances, epigastric pain every 8 hours.

Severe Preeclampsia:

1. Obtain blood pressure, pulse, respirations, and oxygen saturation every 60 minutes for first 24 hours after delivery then every 4 hours.
2. Assess lung sounds every 2 hours for first 24 hours after delivery then every 4 hours.
3. Assess deep tendon reflexes (DTRs), clonus, edema, level of consciousness (LOC), headache (HA) visual disturbances, epigastric pain every 4 hours.

MAGNESIUM SULFATE:

Magnesium sulfate is administered as a first line drug to prevent maternal eclamptic seizures. (See Magnesium Sulfate chapter, pg. 50)

ANTIHYPERTENSIVES:

Background:

1. A sustained systolic blood pressure greater than 160 mm Hg OR greater than 105-110 mm Hg diastolic is treated with IV antihypertensive medication to protect the patient from cerebral vascular accident.
2. The goal is a diastolic pressure of 90-100 mm Hg to maintain perfusion.
3. Labetalol is a combined alpha and beta-blocker, resulting in decreased peripheral vascular resistance without altering heart rate or cardiac output. Its use is contraindicated in patients with bronchial asthma, heart block and severe bradycardia.
4. Hydralazine is a vasodilator and results in vasodilation of vascular smooth muscle.

Administration:

1. Ensure presence of mainline IV infusion.
2. Monitor the fetal heart rate continuously if a viable fetus is present.
3. Maintain bedrest during and for 3 hours following medication administration. Assess for postural hypotension prior to ambulation.
4. If unable to control blood pressure, contact physician regarding consideration of other medications and/or transfer to a higher level of care.
5. Hydralazine (Apresoline):
   a. Administer initial dose IV push over 1-2 minutes. (Usual dose range is 5-10 mg.)
   b. May repeat dose at 20-minute intervals until desired blood pressure is achieved or a cumulative dose of 30-40 mg is reached.
6. Labetalol:
   a. *IV Push:*
      i. Administer initial dose IV push over 2 minutes. (Usual dose is 10-20 mg.)
      ii. Repeat doses may be given at 10-minute intervals.
   b. *Continuous IV:*
      i. Consider collaborative care with intensive care unit.
      ii. Initiation of continuous cardiac monitoring.
      iii Infuse a continuous labetalol infusion pump until diastolic pressure is 90-100 mm Hg.
   c. Maximum dose is 300 mg/24 hours.

Reportable Conditions:

1. Notify provider for:
    a. Diastolic blood pressure less than 80 or greater than 105-110 following medication administration.
    b. Category II or III fetal heart rate tracing following antihypertensive administration.
    c. Sustained maternal heart rate less than 50 bpm or greater than 120 bpm during or within 30 minutes following medication administration.

ECLAMPSIA MANAGEMENT:

Background:

- Eclampsia is characterized by convulsions and loss of consciousness, which can occur without warning during the antepartum, intrapartum or postpartum period.
- The eclamptic patient is at risk for aspiration and cerebral hemorrhage.
- Fetal bradycardia frequently occurs during and following an eclamptic seizure.
- Best treatment for baby is maternal stabilization.

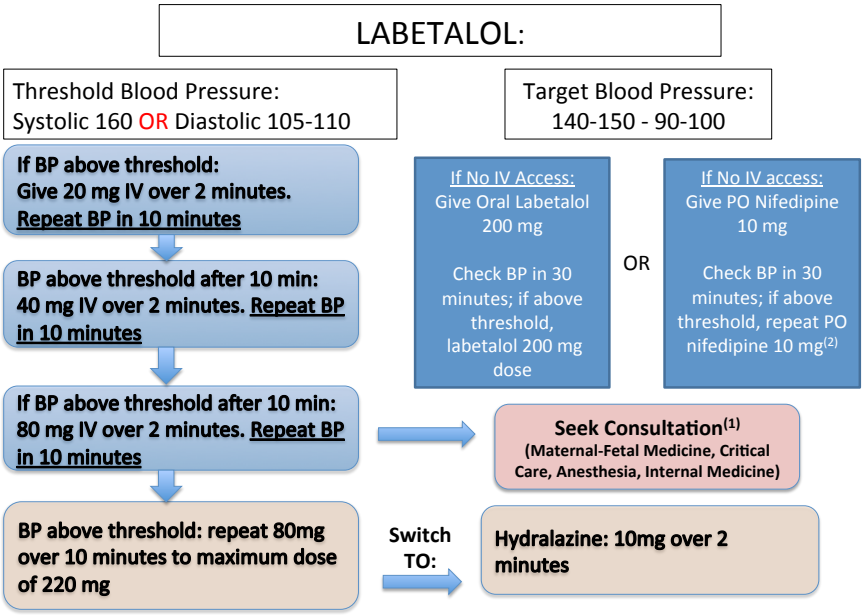
MANAGEMENT:

1. Notify charge nurse, attending provider, and anesthesiologist/CRNA immediately. Initiate emergency pager (if institution has instituted).
2. Position patient on side.
3. Protect from injury.
4. Prepare to administer magnesium sulfate.
5. Anticipate obtaining lab tests (magnesium level, blood for liver enzymes, kidney function, etc.).
6. Following seizure:
    a. Suction mouth.
    b. Give oxygen by non-rebreather mask at 10 liters per minute.
    c. Provide ventilatory support as needed.
    d. Assess blood pressure, pulse, and respirations every 5 minutes.
    e. Assess oxygen saturation and level of consciousness every 15 minutes until stable for a minimum of one hour.
    f. Monitor fetal heart rate and uterine activity continuously if viable fetus is present.
    g. Observe for signs and symptoms of placental abruption or impending delivery.
    h. Obtain order for indwelling catheter.

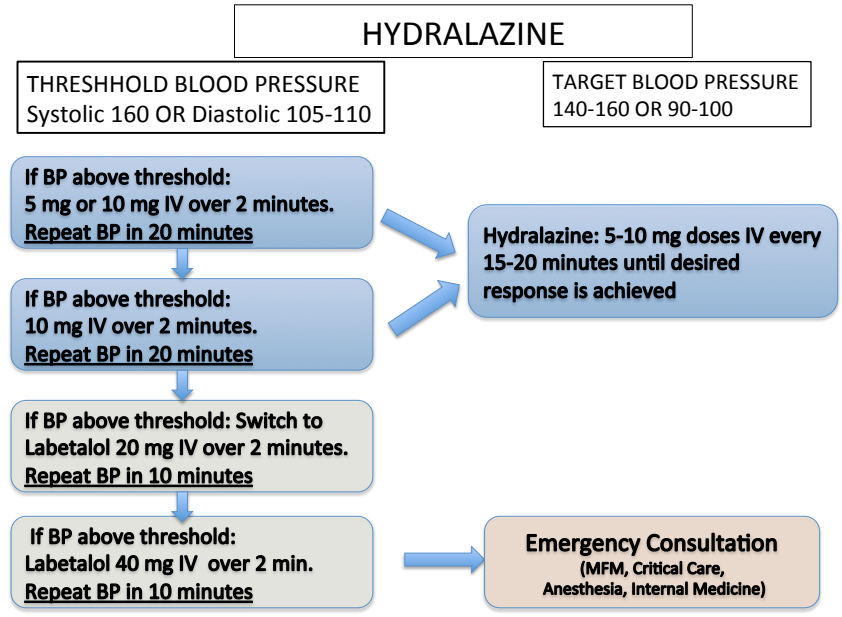
Appendix V: Daily Assessment for Delivery versus Continuing Pregnancy

Clinical Criteria:	**Present**	
Persistent maternal headache	Yes	No
Visual disturbance (blurred or scotomata)	Yes	No
Hypoxia (O2 saturation < 95%) or pulmonary edema on clinical exam	Yes	No
Persistent BP > 160 mm Hg systolic or > 105-110 mm Hg despite medical management	Yes	No
Oliguria (< 500 ml/24 hours)	Yes	No
Evidence of renal failure (serum Creatinine > 1.2 mg/dL	Yes	No
Thrombocytopenia (platelet count < 100,0000/mm3	Yes	No
Elevated ALT > 70 U/L	Yes	No
Evidence of hemolysis (LDH > 600, bilirubin > 1.2 mg/dL or abnormal peripheral blood smear)	Yes	No
Abnormal coagulation (elevated PT/PTT or fibrinogen < 300)	Yes	No
Abnormal Fetal NST and/or BPP	Yes	No
	Yes To ANY of above CONSIDER DELIVERY	**No To ALL of above CONTINUE PREGNANCY**

Appendix W: Labetalol and Hydralazine Recommendations



Adapted from ACOG Committee Opinion #514; (1) MFM, Critical Care, Anesthesia, Internal Medicine; (2) Raheem I, Saaid R, Omar S, Tan P. Oral nifedipine versus intravenous labetalol for acute blood pressure control in hypertensive emergencies of pregnancy: a randomised trial. *BJOG*. 2012;119:78-85.



ACOG Committee Opinion #514, 2011; ACOG Practice Bulletin #33. Reaffirmed 2012.

Appendix X: Classification of Evidence Grading

Evidence Categories

Type of Study or Evidence	
I	Evidence obtained from at least one properly designed randomized controlled trial.
II-1	Evidence obtained from well-designed controlled trials without randomization.
II-2	Evidence obtained from well-designed cohort or case-control analytic studies, preferably from more than one center or research group.
II-3	Evidence obtained from multiple time series with or without intervention. Well-done QI studies with statistical process control analyses or the like fall into this category. Dramatic results in uncontrolled experiments also could be regarded as this type of evidence.
III	Opinions of respected authorities, based on clinical experience, descriptive studies, or reports of expert committees.

Level of Recommendations	
A	Recommendations based on high quality and consistent evidence.
B	Recommendations based on limited or inconsistent evidence.
C	Recommendations based primarily on consensus and expert opinion.

Adapted from United States Preventive Services Task Force (USPST) and ACOG

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1

Generic Slide

2

Improving Health Care Response to Preeclampsia: A California Quality Improvement Toolkit

Funding for the development of this toolkit was provided by:
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3

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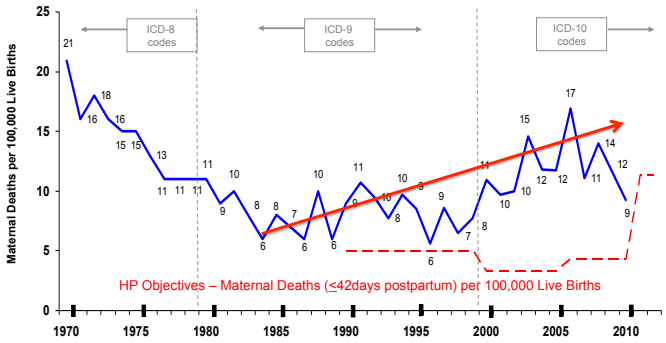
4

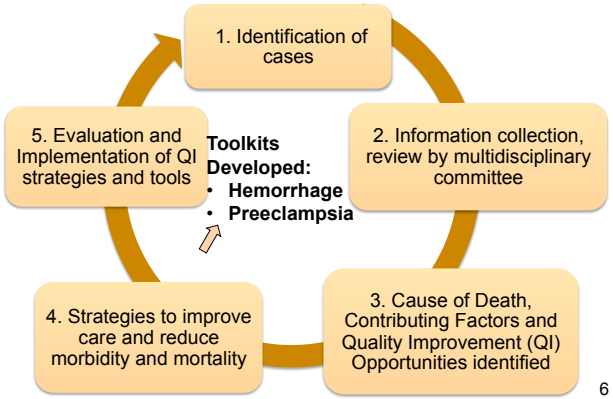
Maternal Mortality Rate, California Residents; 1970-2010



SOURCE: State of California, Department of Public Health, California Birth and Death Statistical Master Files, 1970-2010. Maternal mortality for California (deaths ≤ 42 days postpartum) was calculated using the ICD-8 cause of death classification for 1970-1978, ICD-9 classification for 1979-1998 and ICD-10 classification for 1999-2010. Healthy People Objectives: HP2000: 5.0 deaths per 100,000 live births; HP2010: 3.3 deaths, later revised to 4.3 deaths per 100,000 live births, and; HP2020: 11.4 deaths per 100,000 live births. Produced by California Department of Public Health, Center for Family Health, Maternal, Child and Adolescent Health Division, December, 2012.

5

California Pregnancy-Associated Mortality Review (CA-PAMR) Quality Improvement Review Cycle



6

CA-PAMR: Chance to Alter Outcome
Grouped Cause of Death; 2002-2004 (N=145)

Grouped Cause of Death	Chance to Alter Outcome			
	Strong / Good (%)	Some (%)	None (%)	**Total** N (%)
Obstetric hemorrhage	69	25	6	16 (11)
Deep vein thrombosis/ pulmonary embolism	53	40	7	15 (10)
Sepsis/infection	50	40	10	10 (7)
Preeclampsia/eclampsia	**50**	**50**	**0**	**25 (17)**
Cardiomyopathy and other cardiovascular causes	25	61	14	28 (19)
Cerebral vascular accident	22	0	78	9 (6)
Amniotic fluid embolism	0	87	13	15 (10)
All other causes of death	46	46	8	26 (18)
Total (%)	**40**	**48**	**12**	**145**

7

Executive Summary: Hypertension in Pregnancy

American College of Obstetricians and Gynecologists

Obstet Gynecol 2013;122:1122-31

8

Diagnosis Criteria for Preeclampsia

Blood pressure	• Greater than or equal to 140 mm Hg systolic or greater than or equal to 90 mm Hg diastolic on two occasions at least 4 hours apart after 20 weeks of gestation in a woman with a previously normal blood pressure • Greater than or equal to 160 mm Hg systolic or greater than or equal to 110 mm Hg diastolic, hypertension can be confirmed within a short interval (minutes) to facilitate timely antihypertensive therapy
and	
Proteinuria	• Greater than or equal to 300 mg per 24-hour urine collection (or this amount extrapolated from a timed collection) or • Protein/creatinine ratio greater than or equal to 0.3* • Dipstick reading of 1+ (used only if other quantitative methods not available)
Or in the absence of proteinuria, new-onset hypertension with the new onset of any of the following:	
Thrombocytopenia	• Platelet count less than 100,000/microliter
Renal insufficiency	• Serum creatinine concentrations greater than 1.1 mg/dL or a doubling of the serum creatinine concentration in the absence of other renal disease
Impaired liver function	• Elevated blood concentrations of liver transaminases to twice normal concentration
Pulmonary edema	
Cerebral or visual symptoms	

*Each measured as mg/dL.

Executive Summary: Hypertension in Pregnancy, American College of Obstetricians and Gynecologist, Obstet Gynecol 2013;122:1122-31. Copyright permission received.

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Diagnosis of Severe Preeclampsia

- Systolic blood pressure of 160 mm Hg or higher, or diastolic blood pressure of 110 mm Hg or higher on two occasions at least 4 hours apart while the patient is on bed rest (unless antihypertensive therapy is initiated before this time)
- Thrombocytopenia (platelet count less than 100,000/microliter)
- Impaired liver function as indicated by abnormally elevated blood concentrations of liver enzymes (to twice normal concentration), severe persistent right upper quadrant or epigastric pain unresponsive to medication and not accounted for by alternative diagnoses, or both
- Progressive renal insufficiency (serum creatinine concentration greater than 1.1 mg/dL or a doubling of the serum creatinine concentration in the absence of other renal disease)
- Pulmonary edema
- New-onset cerebral or visual disturbances

Executive Summary: Hypertension in Pregnancy, American College of Obstetricians and Gynecologist, Obstet Gynecol 2013;122:1122-31. Copyright permission received.

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However…

- Acute onset, <u>persistent</u> (lasting 15 min or more), severe systolic (≥160 mm Hg) or severe diastolic hypertension (≥ 110 mm Hg) or both in pregnant or postpartum women with preeclampsia/eclampsia constitutes a hypertensive emergency* and <u>it is inadvisable to wait 4 hrs for treatment</u>.
- If BP is still elevated above threshold after 15 min, treat with antihypertensive medication within 30-60 min.

*Emergent Therapy for Acute-Onset, Severe Hypertension With Preeclampsia or Eclampsia, ACOG Committee Opinion, # 514, December 2011

11

Hemolysis, Elevated Liver Enzymes, and Low Platelets Syndrome (HELLP) and Eclampsia

- Women with severe preeclampsia and hepatic involvement may develop HELLP syndrome. In one study, HELLP syndrome occurred in approximately 20% of women with severe preeclampsia.
- As with severe preeclampsia, HELLP syndrome is associated with an increased risk of adverse outcomes including: placental abruption, renal failure, subcapsular hepatic hematoma, recurrent preeclampsia, preterm delivery, and fetal or maternal death.
- Eclampsia – Seizures with preeclampsia.

ACOG Practice Bulletin #33, Reaffirmed 2012; ACOG Committee Opinion #514, 2012; Tuffnell D, Jankowitcz D, Lindow S, et al. BJOG 2005;112:875-880.

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The Deadly Triad

Severe Preeclampsia -
HELLP Syndrome - Eclampsia

Associated with an increased risk of adverse outcomes such as:

- Placental Abruption
- Renal Failure
- Subcapsular Hepatic Hematoma
- Preterm Delivery
- Fetal or Maternal Death
- Recurrent Preeclampsia

ACOG Practice Bulletin #33, Reaffirmed 2012; ACOG Committee Opinion #514, 2012; Tuffnell D, Jankowitcz D, Lindow S, et al. BJOG 2005;112:875-880.

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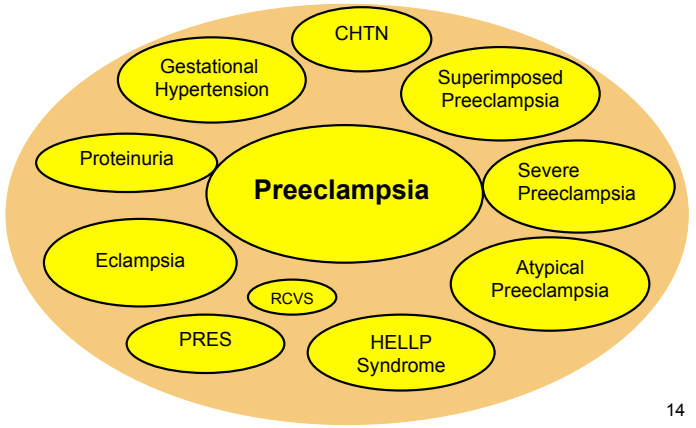
Spectrum of Preeclampsia



14

Key Clinical Pearl

Forty percent of patients with **New-onset** hypertension or **New-onset** proteinuria will develop classic preeclampsia.

Barton JR, Sibai BM. Prediction and prevention of recurrent preeclampsia. Obstet Gynecol. 2008;112(2 PART 1): 359-372.

15

Key Clinical Pearl

Patients presenting with vague symptoms of:

- headache
- abdominal pain
- shortness of breath
- generalized swelling
- complaints of "I just don't feel right"

should be evaluated for atypical presentations of preeclampsia or "severe features"

Sibai BM, Stella CL. Diagnosis and management of atypical preeclampsia-eclampsia. Am J Obstet Gynecol. May 2009;200(5):481 e481-487.

16

Laboratory Evaluation of Preeclampsia

- Initial lab studies should include:
  - CBC with platelet count
  - AST, ALT, LDH
  - Creatinine, Bilirubin, Uric acid, Glucose
- For women with acute abdominal pain, add:
  - Serum amylase, lipase and ammonia

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ACOG Executive Summary on Hypertension In Pregnancy, Nov 2013

1. The term "mild" preeclampsia is discouraged for clinical classification. The recommended terminology is:
   a. "**preeclampsia without severe features**" (mild)
   b. "**preeclampsia with severe features**" (severe)
2. Proteinuria **is not** a requirement to diagnose preeclampsia with **new onset** hypertension.
3. The **total** amount of proteinuria > 5g in 24 hours has been eliminated from the diagnosis of severe preeclampsia.
4. **Early** treatment of **severe** hypertension is mandatory at the threshold levels of **160 mm Hg** systolic or **110 mm Hg** diastolic.
5. Magnesium sulfate for seizure prophylaxis is **indicated** for **severe** preeclampsia and **should not** be administered universally for preeclampsia without severe features (mild).

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ACOG Executive Summary on Hypertension In Pregnancy, Nov 2013

6. Preeclampsia with onset **prior to 34 weeks** is most often **severe** and should be managed at a facility with appropriate resources for management of serious maternal **and** neonatal complications.
7. Induction of labor **at 37 weeks** is indicated for preeclampsia **and** gestational hypertension.
8. The **postpartum period** is potentially dangerous. Patient education for early detection **during** and **after** pregnancy is important.
9. Long-term health effects should be discussed.

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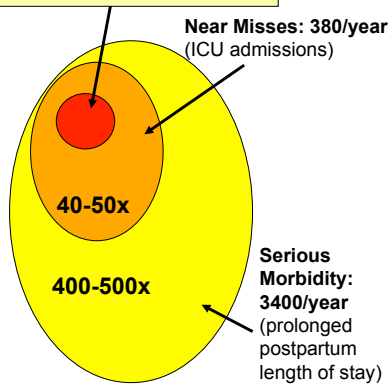
Maternal Morbidity and Mortality: Preeclampsia

About 8 Preeclampsia Related Mortalities/2007 in CA



Source: 2007 All-California Rapid Cycle Maternal/Infant Database for CA Births: CMQCC

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CA-PAMR Causes of Death (Top 5), 2002-2004

Grouped Cause of Death, *per CA-PAMR Committee*	Pregnancy-Related Deaths N (%)
Cardiovascular disease	29 (20)
Cardiomyopathy	19 (13)
Other cardiovascular	10 (7)
Preeclampsia/eclampsia	25 (17)
Obstetric hemorrhage	16 (11)
Amniotic fluid embolism	15 (10)
DVT/ PE	15 (10)
Other	45 (31)
TOTAL	**145**

Pregnancy-Related Mortality Rate: 1.6 deaths /100,000 live births

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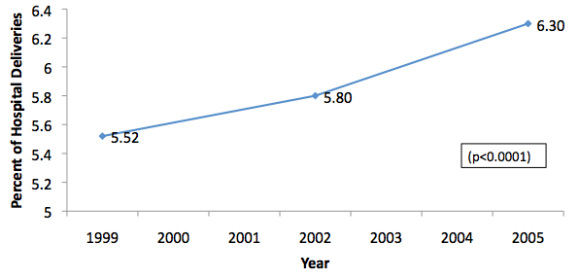
Maternal Hypertension in California, 1999-2005

All maternal hypertension identified at time of hospitalization for labor and delivery (includes pre-gestational and gestational hypertension)



Source:
http://www.cdph.ca.gov/programs/mcah/Documents/MO-CAPAMR-TrendsinMaternalMorbidityinCalifornia-1999-2005-TechnicalReport.pdf

22

Impact of Hypertension in CA-PAMR Cohort, 2002-2004

- Cohort of pregnancy-related deaths, N=145
  - 25 (17%) of deaths were grouped as "Preeclampsia/ Eclampsia" cause of death
- Over half of all pregnancy-related deaths had HTN diagnoses
  - 50 (34%) had inpatient diagnosis of HTN
  - 57 (39%) had **any** diagnosis of HTN (inpatient, prenatal, preexisting)

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How Do Women Die Of Preeclampsia in CA?

CA-PAMR Final Cause of Death Among Preeclampsia Cases, 2002-2004 (n=25)

Final Cause of Death	Number	%	Rate/100,000
Stroke	16		1.0
Hemorrhagic	*14*	64.0%	
Thrombotic	*2*	*(87.5%)*	
		(12.5%)	
Hepatic (liver) Failure	4	16.0%	.25
Cardiac Failure	2	8.0%	
Hemorrhage/DIC	1	4.0%	
Multi-organ failure	1	4.0%	
ARDS	1	4.0%	

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Cause of U.S. Maternal Mortality

- CDC Review of 14 years of coded data: 1979-1992
- 4024 maternal deaths
- 790 (19.6%) from preeclampsia

Table 2. Specific Causes of Death Among Women Who Died of Preeclampsia or Eclampsia

Cause of death	Percent of deaths		
	Preeclampsia	Eclampsia	Total
Cerebrovascular events	17.3	21.4	38.7
Cerebrovascular hemorrhage	15.8	18.8	34.7
Cerebral edema	1.1	1.8	2.9
Cerebral embolus	0.4	0.8	1.1
Renal or hepatic failure	7.2	5.4	12.5
HELLP syndrome	4.8	2.3	7.1
Other complications of hypertension	13.9	11.8	25.7
Not specified hypertension	7.6	8.3	15.9
Preeclampsia and eclampsia	50.8	49.2	100

HELLP = hemolysis, elevated liver enzymes, and low platelet count syndrome.

90% of CVA were from hemorrhage

MacKay AP, Berg CJ, Atrash HK. Obstetrics and Gynecology 2001;97:533-538

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Key Clinical Pearl

Controlling blood pressure
is the optimal intervention
to prevent deaths due to stroke
in women with preeclampsia.

Over the last decade, the UK has focused QI efforts on aggressive treatment of both systolic and diastolic blood pressure and has demonstrated a reduction in deaths.

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Preeclampsia Mortality Rates in California and UK

Cause of Death among Preeclampsia Cases	CA-PAMR (2002-04) Rate/100,000 Live Births	UK CMACE (2003-05) Rate/100,000 Live Births
Stroke	1.0	.47
Pulmonary/Respiratory	.06	.00
Hepatic	.25	.19
OVERALL	1.6	.66

*The overall mortality rate for preeclampsia in California is **greater than 2 times** that of the UK, largely due to differences in deaths caused by stroke.*

27

Gestational Age Groups of CA-PAMR Deaths, 2002 to 2004

GESTATIONAL AGE GROUPS	CA-PAMR PREECLAMPSIA DEATHS N (%)	CA-PAMR NON-PREECLAMPSIA DEATHS N (%)
<24 weeks	0 (0)	2 (2%)
24-31w6d	2 (8%)	13 (11%)
32-36w6d	**12 (48%) -- 56%**	**29 (24%) --37%**
≥37 weeks	11 (44%)	76 (63%)
TOTAL	**25**	**120**

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Expectant Management of Pregnancies with Preeclampsia < 34 Weeks Gestation

Maternal Stabilization refers to:

- Seizure prophylaxis
- BP control
- Adequate maternal cardio-pulmonary function

- AND
  - Consultation with:
    - NICU
    - MFM
    - Anesthesia and/or
    - Critical care services

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Expectant Management in Pregnancies with Severe Preeclampsia < 34 Weeks Gestation

Expectant management recommendations:

With stable maternal/fetal conditions, continued pregnancy should be undertaken only at facilities with adequate maternal and neonatal intensive care resources

Administer corticosteroids for fetal lung maturity benefit

ACOG Executive Summary: Hypertension in Pregnancy. Obstet Gynecol 2013;122:1122-31

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Key Clinical Pearl

In patients with severe **preterm** preeclampsia, the disease can rapidly progress to significant maternal morbidity and/or mortality.

31

Management of Suspected Severe Preeclampsia < 34 Weeks Gestation

No contraindications to expectant management – Short Term

Initial 24-48 hours observation

- Initiate antenatal corticosteroids if not previously administered
- Initiate 24 hour urine monitoring as appropriate
- Ongoing assessment of maternal symptoms, BP, urine output
- Daily lab evaluation (minimum) for HELLP and renal function
- May observe on an antepartum ward after initial evaluation

Proceed to delivery for:

- Recurrent severe hypertension despite therapy
- Other contraindications to expectant management

Antenatal corticosteroid treatment completed:

- Expectant management not contraindicated
- Consider ongoing in-patient expectant management

Adapted from Sibai BM. Evaluation and management of severe preeclampsia before 34 weeks' gestation. American Journal of Obstetrics & Gynecology, September 2011, pg. 191-198.

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Expectant Management of Pregnancies < 34 Weeks Gestation (From CMQCC Preeclampsia Toolkit, 2013)

Severe Preeclampsia and Management Options for Delayed Delivery

Criteria	Definition/Significance	Attempt to Delay Delivery
Maternal headache **Blurred vision or Scotomata*** **Mental status changes****	Suggest central nervous system dysfunction	No
Persistent epigastric pain or right upper quadrant pain	Suggest liver capsule distension or rupture	No
Eclampsia	Generalized tonic clonic seizure	No
Pulmonary edema or Hypoxia (O2 saturation < 95%)	Excessive fluid accumulation in the lungs	No
Oliguria/Renal failure	Urine output of <500/24 hours or Creatinine >1.2	No
Hepatocellular Injury	Serum transaminases >2x normal	No
Blood Pressure	> 160/110 mm Hg BP criteria for **Severe** Preeclampsia	Yes, if responds to treatment

See notes for *,**, explanation.

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Management of Suspected Severe Preeclampsia < 34 Weeks Gestation

Long Term Management

Consider ongoing, inpatient expectant management:

- Monitor vital signs frequently (at least each shift)
- At least daily maternal assessment for subjective symptoms of severe preeclampsia
- At least daily assessment of fetal well-being
- Serial evaluation for HELLP syndrome and of renal function
- Serial estimation of fetal growth and amniotic fluid volume

Adapted from Sibai BM. Evaluation and management of severe preeclampsia before 34 weeks' gestation. American Journal of Obstetrics & Gynecology, September 2011, pg. 191-198.

34

Management of Suspected Severe Preeclampsia < 34 Weeks Gestation

Long Term Management

- **Proceed to delivery at 34 weeks gestation or earlier if any of the following are present:**
- New-onset contraindications to expectant management (see slide 32)
- Recurrent symptoms of severe preeclampsia
- Recurrent severe hypertension despite therapy
- HELLP syndrome
- Significant renal dysfunction
- Abruptio placentae
- Fetal growth restriction, oligohydramnios, or abnormal fetal testing

Adapted from Sibai BM. Evaluation and management of severe preeclampsia before 34 weeks' gestation. American Journal of Obstetrics & Gynecology, September 2011, pg. 191-198.

35

Key Clinical Pearl

All patients with **severe** preeclampsia, irrespective of gestational age, should have an evaluation by an obstetrician as soon possible.

36

Factors Associated with Maternal Morbidities in both Developing **and** Developed Countries

- Lack of and/or poor prenatal care
  - Delay in early diagnosis and treatment
  - Progression to severe eclampsia
- Lack of access to hospital care
  - Lack of access to transportation to clinic
  - Lack of transport from clinic to hospital
  - Lack of transport from hospital to tertiary facility
- Lack of well-trained staff and personnel
- Lack of proper resources
  - Medications, Equipment, Laboratory and ICU

Magnitude may differ, but the QI issues are similar

Ghulmiyyah L, Sabai BM. Maternal Mortality from Preeclampsia/Eclampsia. Semin Perinatol 2012;36:56-59.

37

Factors Contributing to Pregnancy-Related Deaths, CA-PAMR 2002-2004

Contributing Factor (at least one factor probably or definitely contributed)	**Preeclampsia N (%)**	**TOTAL N (%)**
OVERALL	**25 (100%)**	**129 (89%)**
PATIENT FACTORS	16 (64%)	104 (72%)
Underlying significant medical conditions	8 (50%)	40 (39%)
Delay or failure to seek care	10 (63%)	27 (26%)
Lack of understanding the importance of a health event	9 (56%)	16 (15%)
HEALTHCARE PROFESSIONALS	24 (96%)	115 (79%)
Delay in diagnosis	**22 (92%)**	**62 (54%)**
Use of ineffective treatment	**19 (79%)**	**48 (42%)**
Misdiagnosis	13 (54%)	36 (31%)
Failure to refer or seek consultation	6 (25%)	26 (23%)
HEALTHCARE FACILITY	12 (48%)	72 (50%)

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Key Clinical Pearl

An organized tool to identify "**clinical signs**," of high concern or triggers can aid clinicians to recognize and respond in a more timely manner to avoid delays in diagnosis and treatment.

39

Preeclampsia Early Recognition Tool

ASSESS	NORMAL (GREEN)	WORRISOME (YELLOW)	SEVERE (RED)
Awareness	Alert/oriented	•Agitated/confused •Drowsy •Difficulty speaking	•Unresponsive
Headache	None	•Mild headache •Nausea, vomiting	•Unrelieved headache
Vision	None	•Blurred or impaired	•Temporary blindness
Systolic BP (mm HG)	100-139	140-159	≥160
Diastolic BP (mm HG)	50-89	90-105	≥105
HR	61-110	111-129	≥130
Respiration	11-24	25-30	<10 or >30
SOB	Absent	Present	Present
O2 Sat (%)	≥95	91-94	≤90
Pain: Abdomen or Chest	None	•Nausea, vomiting •Chest pain •Abdominal pain	•Nausea, vomiting •Chest pain •Abdominal pain
Fetal Signs	•Category I •Reactive NST	•Category II •IUGR •Non-reactive NST	•Category III
Urine Output (ml/hr)	≥50	30-49	≤30 (in 2 hrs)
Proteinuria (Level of proteinuria is not an accurate predictor of pregnancy outcome)	Trace	•> +1** •≥300mg/24 hours	
Platelets	>100	50-100	<50
AST/ALT	<70	>70	>70
Creatinine	<0.8	0.9-1.1	>1.2
Magnesium Sulfate Toxicity	•DTR +1 •Respiration 16-20	•Depression of patellar reflexes	•Respiration <12

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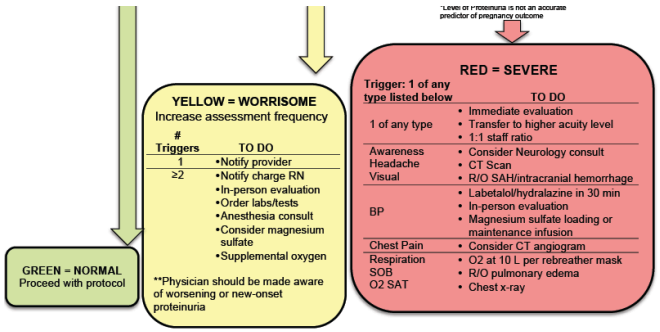
Clinical Signs to Watch for:



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Eclampsia

- Eclampsia is defined as NEW ONSET *grand mal* seizures in a woman with preeclampsia
- Incidence is 1 in 1,000 deliveries in U.S.
- Mortality from eclampsia ranges from approximately 1% in the developed world, to as high as 15% in the developing world

Ghulmiyyah L, Sabai BM. Maternal Mortality from Preeclampsia/Eclampsia. Semin Perinatol 2012;36:56-59.

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Characterization of Symptoms Immediately Preceding Eclampsia

- 3,267 deliveries and 46 cases of eclampsia (1.4%)
- Most common prodromal neurological symptoms (regardless of the degree of hypertension OR whether the seizure occurred antepartum or postpartum):
  - Headaches (80%)
  - Visual disturbance (45%),
- 20% of women with eclampsia reported no neurologic symptoms before the seizure

Cooray SD, Edmonds SM, Tong S, et al. Characterization of Symptoms Immediately Preceding Eclampsia. Obstetrics & Gynecology, Vol 118(5):1000-1004, November 2011.

43

PREECLAMPSIA TOOLKIT TREATMENT RECOMMENDATIONS

44

Preeclampsia Toolkit BP Treatment Recommendations

Systolic ≥ 160	Diastolic ≥ 110	Repeat BP and treat within 60 minutes (ideally ASAP)
≥155	≥105-110	Alternative triggers*

These recommendations apply to all forms of hypertension in pregnancy:

Gestational HTN - Preeclampsia - Severe Preeclampsia

* Based on Martin 2005: Martin J, Thigpen B, Moore R, et al. Stroke and severe preeclampsia and eclampsia: a paradigm shift focusing on systolic blood pressure. Obstet Gynecol 2005; 105(2):246-254.

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ACOG PRACTICE BULLETIN

Clinical Management Guidelines for Obstetrician–Gynecologists
Number 33, January 2002

This Practice Bulletin was developed by the ACOG Committee on Practice Bulletins—Obstetrics with the assistance of Larry C. Gilstrap III, MD,

Diagnosis and Management of Preeclampsia and Eclampsia

Reaffirmed 2012

Summary of Recommendations

The following recommendations are based on good and consistent scientific evidence (Level A):

- Magnesium sulfate should be used for the prevention and treatment of seizures in women with severe preeclampsia or eclampsia.

growth restriction.

- Expectant management should be considered for women remote from term who have mild preeclampsia.
- Antihypertensive therapy (with either hydralazine or labetalol) should be used for treatment of diastolic blood pressure levels of 105–110 mm Hg or higher.

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Preventing Stroke from Preeclampsia

Blood Pressure Comparisons: Baseline and Pre-stroke

Measure	Pregnancy Baseline (mm Hg)	Pre-stroke (mm Hg)
Mean systolic BP	110.9 ± 10.7 (n=25)	175.4 ± 9.7 (n=24)
Systolic BP range	90-136	159-198
Systolic BP % ≥ 160	0	95.8 (n=27/28)
Mean diastolic BP	67.4 ± 6.5 (n=25)	98.0 ± 9.0 (n=24)
Diastolic BP range	58-80	81-113
Diastolic BP % ≥ 110	0	12.5 (n=3)
Diastolic BP 5 ≥ 105	0	20.8 (n=5)

Adapted from Martin JN, Thigpen BD, Moore RC, Rose CH, Cushman J, May. Stroke and Severe Preeclampsia and Eclampsia: A Paradigm Shift Focusing on Systolic Blood Pressure, OG 2005;105-246.

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Key Clinical Pearl

- ***The*** critical initial step in decreasing maternal morbidity and mortality is to administer **anti-hypertensive** medications within 60 minutes of documentation of persistent (retested within 15 minutes) BP ≥160 systolic, and/or >105-110 diastolic.
- Ideally, antihypertensive medications should be administered as soon as possible, and availability of a "preeclampsia box" will facilitate rapid treatment.
- In Martin et al., stroke occurred in:
  - 23/24 (95.8%) women with systolic BP ≥ 160mm Hg
  - **24/24 (100%) had a BP ≥ 155 mm Hg**
  - 3/24 (12.5%) women with diastolic BP > 110mm Hg
  - **5/28 (20.8%) women with diastolic BP > 105mm Hg**

Martin JN, Thigpen BD, Moore RC, Rose CH, Cushman J, May. Stroke and Severe Preeclampsia and Eclampsia: A Paradigm Shift Focusing on Systolic Blood Pressure, Obstet Gynecol 2005;105-246.

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Labor and Delivery Medication Box and Dose Guidelines for Severe Preeclampsia and Eclampsia

L&D Severe Preeclampsia & Eclampsia Box – Content and Dose Guideline	
Magnesium 20 grams/500 ml bag	**IV (Use Magnesium Sulfate Continuous Infusion under L&D protocol in Alaris Pump Library):** *Initial (Loading Dose):* 4-6 g (100 ml – 150 ml) over 20 minutes *Maintenance Dose:* 1-2 g/hour (25 ml/hr – 50 ml/hr) continuous infusion
Labetalol 100mg/20ml vial	***Initial: Draw 4 ml from the vial.*** **20 mg (4 ml)** IV bolus followed by **40 mg (8 ml)** if not effective within 10 minutes; then **80 mg (16 ml)** every 10 minutes (maximum total dose of 300 mg/60ml)
Hydralazine 20mg/ml vial	***Initial: Draw 0.25 ml from the vial.*** **5-10 mg (0.25-0.5 ml)** doses IV every 15-20 minutes
Esmolol 100mg/10ml vial **(By Anesthesiologists ONLY)**	**1-2 mg/kg (0.1-0.2 ml/kg)** IV over 1 minute
Propofol 10mg/ml, 20ml vial **(By Anesthesiologists ONLY)**	**30-40 mg (3-4 ml)** IV bolus
Calcium gluconate 1000 mg/10ml vial	1000 mg/10 ml IV over 2-5 minutes
Labetalol 200 mg tablets	200 mg PO and repeated in 30 minutes if needed
Nifedipine 10 mg PO	10 mg PO and repeated in 30 minutes if needed
Supply contents	3 ml, 10 ml, and 20 ml syringes, appropriate needles and appropriate tubing sets

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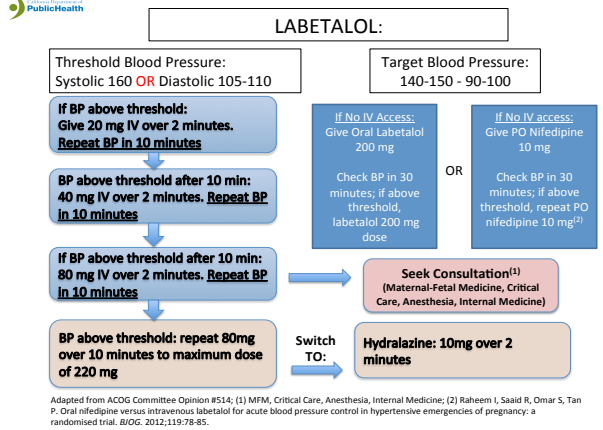
Protocol for Labetalol Treatment



Adapted from ACOG Committee Opinion #514; (1) MFM, Critical Care, Anesthesia, Internal Medicine; (2) Raheem I, Saaid R, Omar S, Tan P. Oral nifedipine versus intravenous labetalol for acute blood pressure control in hypertensive emergencies of pregnancy: a randomised trial. *BJOG*. 2012;119:78-85.

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Hypertensive Medication Administration Oral v. IV

- IV Labetalol
  - Onset: 2-5 min
  - Peak: 5 min
- IV Hydralazine
  - Onset: 5-20 min
  - Peak: 15-30 min
- PO Labetalol:
  - Onset: 20 min-2 hrs
  - Peak: 1-4 hrs
- PO Nifedipine
  - Onset: 5-20 min*
  - Peak: 30-60 min

*PO, (oral) not sublingual nifedipine, onset of action is 15-30 minutes depending on the reference source.

* Cohan J, Checcio L. Nifedipine in the Management of Hypertensive Emergencies: Report of Two Cases and Review of the Literature. 1985 Nov;3(6):524-30
Raheem I, Saiid R, Omar S, et al. Oral nifedipine versus intravenous labetalol for acute blood pressure control in hypertensive emergencies of pregnancy: a randomized trial. BJOG 2012;119:78-85.

http://www.uspharmacist.com/content/d/feature/i/1444/c/27112/
Current Cardiovascular Drugs, edited by William H. Frishman, Angela Cheng-Lai, James Nawarskas, 4th edition 2005 pg. 2-186

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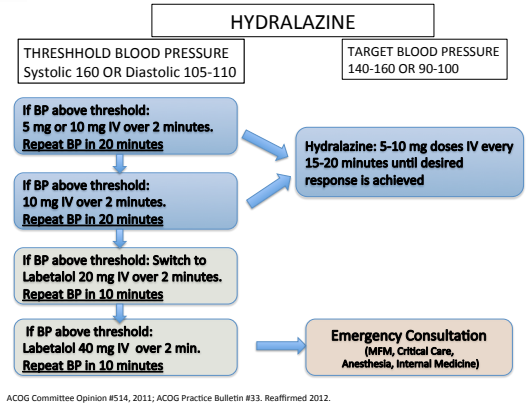
Hypertensive Medication Administration Oral versus IV

- First line therapy recommendations for acute treatment of critically elevated BP in pregnant women (160/105-110) are with either IV labetalol or hydralazine.
- In the event that acute treatment is needed in a patient without IV access oral nifedipine may be used (10 mg) and may be repeated in 30 minutes.
- PO (oral) nifedipine appears equally as efficacious as IV labetalol in correcting severe BP elevations.
- Oral labetalol would be expected to be less effective in acutely lowering the BP due to its' slower onset to peak and thus should be used only if nifedipine is not available in a patient without IV access.

ACOG Practice Bulletin #33, Reaffirmed 2012; ACOG Committee Opinion #514, 2012; Tuffnell D, Jankowitcz D, Lindow S, et al. BJOG 2005;112:875-880.

52

ACOG Protocol for Hydralazine Treatment



ACOG Committee Opinion #514, 2011; ACOG Practice Bulletin #33. Reaffirmed 2012.

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Magnesium Sulfate

- Primary effect is via CNS depression
- Improves blood flow to CNS via small vessel vasodilation
- Blood pressure after magnesium infusion:
  - 6 gm loading then 2 gm/hr.

	sBP mm Hg	sBP 30 min	sBP 120 min	dBP mm Hg	dBP 30 min	dBP 120 min
Mild Group	145 ±10	143 ±13	141 ±14	87 ±10	79 ±9	82 ±9

- Magnesium sulfate should **not** be considered a **antihypertensive** medication

Belfort M, Allred J, Dildy G. Magnesium sulfate decreases cerebral perfusion pressure in preeclampsia.Hypertens Pregnancy. 2008;27(4):315-27.

54

Magnesium Sulfate in the Management of Preeclampsia

Magpie Trial Collaboration Group. Do women with pre-eclampsia, and their babies, benefit from magnesium sulfate?

- 58% reduction in seizures
- 45% reduction in maternal death*
- 33% reduction in placental abruption

*The 45% reduction in maternal death is not statistically significant but clinically important.

Altman D, Carroli G, Duley L, et al. The Magpie Trial: a randomized placebo-controlled trial; *Lancet* 2002;359:1877–90.

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Recommendations for Women Who Should Be Treated With Magnesium

	Preeclampsia without severe features	Severe Preeclampsia	Eclampsia
ACOG	**	X	X
NICE		X	X
SOGC	X*	X	X
CMQCC	X*	X	X
WHO	X	X	X

***ACOG Executive Summary, 2013: for preeclampsia without severe features, it is suggested that magnesium sulfate not be administered universally for the prevention of eclampsia.*

** Should be considered: Numbers needed to treat (**NNT**) = **109 for "mild", 63 for "severe"***

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Key Clinical Pearl

- Magnesium sulfate therapy for seizure prophylaxis should be administered to any patients with:
  - Severe Preeclampsia
  - Preeclampsia ***with*** "severe features" i.e., subjective neurological symptoms (headache or blurry vision), abdominal pain, epigastric pain AND
  - ***should be considered*** in patients with mild preeclampsia (preeclampsia ***without*** severe features)

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Key Clinical Pearl

Algorithms for acute treatment of severe hypertension and eclampsia should be readily available or preferably posted in all clinical areas that may encounter pregnant women.

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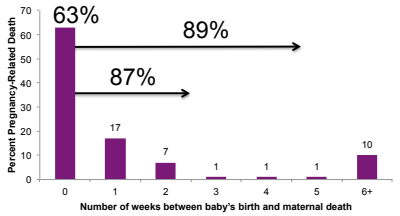
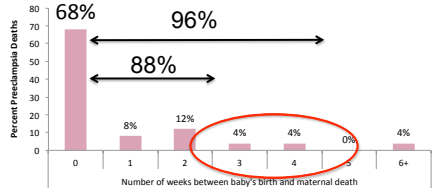
Timing of Pregnancy-Related Deaths, CA-PAMR, 2002 to 2004



Non-Preeclampsia Deaths (n=129)



Preeclampsia Deaths (n=25)

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Postpartum Case Study

- 24 year-old G2, P0-0-1-0 @ 39 wks
- Prenatal course unremarkable, GBS (+)
- Blood pressure normal throughout prenatal period
- Presented to the office with complaint of regular uterine contractions
- Cervical exam: 3 cm dilated
- BP: 142/95
- Urinalysis negative for protein

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Postpartum Case Study (continued) Status on Admission

- The patient was admitted for spontaneous labor and gestational hypertension
- On admission to Labor and Delivery
  - BP 133/74
  - Urinalysis negative
  - Platelet count: 187,000/unit
  - AST 14
  - ALT 18
  - Uric Acid 5.5

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Postpartum Case Study (continued) Course in Labor

- BP remained modestly elevated throughout labor and the postpartum stay
- Fetal heart rate consistently Category 1 (normal) tracing
- Patient had primary late term c/section for failure to progress on day 2
- Postpartum course was unremarkable. No documented complaints of headache, blurred vision or epigastric pain

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Postpartum Case Study (continued) Post-op Day # 3

- Patient complained of “acute, crushing headache”, pain rated 8/10. D/C orders already written
- Received hydrocodone 15 mg/acetaminophen 650 mg
- Discharged 30 minutes later; no follow-up of headache documented

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Postpartum Case Study (continued) Post Discharge

- Post-op day #4: Patient reported worsening headache to family
- Post-op day #5: Progressively worsening headache and new-onset visual changes
- 911 call placed by family
- Initial seizure occurred shortly thereafter
- Multiple seizures witnessed by family
- Intubated in the field and transported to hospital
  - Started on MgSO4, ativan, keppra, labetalol
- Helicopter transport to tertiary center, neurology ICU

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Postpartum Case Study (continued) Post-op Day 6 to 9

- Extubated shortly after admission
- BP's remained elevated; BP max 148/98; SBP mostly 130's; DBP mostly 80's
- Platelet count 370,000, AST 30, ALT 33, Creatinine 0.9 mg/dl
- Urinalysis: Negative for protein
- Persistent, mild headache with some postural component
  - Anesthesia consult obtained; Conservative treatment
- MRI: "no evidence of ischemic injury"; no parieto-occipital edema suggestive of PRES*

*PRES: Posterior Reversible Encephalopathy Syndrome

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Late Postpartum Eclampsia

- >48 hours following delivery, up to 4 weeks PP
- Accounts for approximately 15% of cases of eclampsia
- 63% had no antepartum hypertensive diagnosis
- The magnitude of blood pressure elevation does ***not*** appear to be predictive of eclampsia
- The most common presenting symptom was headache, which occurred in about 70% of patients; other prodromal symptoms included shortness of breath, blurry vision, nausea or vomiting, edema, neurological deficit, and epigastric pain

Al-Safi Z, Imudia A, Filetti L, et al. Delayed Postpartum Preeclampsia and Eclampsia. Obstet Gynecol. 2011;118(5):1102-1107.

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Eclampsia: Observations from 67 recent cases

- 67 cases of eclampsia managed over 4 years
- 1:310 deliveries
- 21% had no proteinuria
- 21% had no DBP in excess of 90 mmHg
- 37% of first eclamptic seizures occurred postpartum
- 16% of first eclamptic seizures occurred late postpartum (3-11 days postpartum)

Sibai BM, McCubbin JH, Anderson GD, et al. Eclampsia. Observations from 67 Recent Cases. Obstet Gynecol; 58:609, 1981.

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Eclampsia: Maternal-Perinatal Outcome In 254 Consecutive Cases

- 254 consecutive cases of eclampsia over 12 years
- 83,720 deliveries, for an incidence of one in 330
- 49 patients (19%) did not have proteinuria
- 58 patients (23%) did not have hypertension
- 73 occurred postpartum, half of which occurred >48 hours after delivery
- Over half of postpartum cases, (40 cases/16%) occurred in the late postpartum period
- 18 of these 40 cases were normotensive; all 18 had symptoms of headache or visual disturbance

Sibai BM. Eclampsia VI. Maternal-perinatal outcome in 254 consecutive cases. Am J Obstet Gynecol Sep 163(3):1049-1054; discussion 1054-1065 1990.

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Key Clinical Pearls

- Early post-discharge follow-up recommended for **all patients** diagnosed with preeclampsia/ eclampsia
- Preeclampsia Toolkit recommends post-discharge follow-up:
  - within 3-7 days if medication was used during labor and delivery OR postpartum
  - within 7-14 days if no medication was used
- **Postpartum** patients presenting to the ED with hypertension, preeclampsia or eclampsia should either be assessed by **or admitted to an obstetrical service**

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Patient Education Materials

This and many other patient education materials can be ordered from www.preeclampsia.org/market-place

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Key Clinical Pearls

- Use of preeclampsia-specific checklists, team training and communication strategies, and continuous process improvement strategies will likely reduce hypertensive related morbidity.
- Use of patient education strategies, targeted to the educational level of the patients, is essential for increasing patient awareness of signs and symptoms of preeclampsia.

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Getting The Job Done in Your Institution

- Establish tools / new recommendations
- Establish champions and collaborators
- Provide *convincing rationale* for change
- Get providers to adopt the changes
- Provide *convincing evidence* that the proposed changes in clinical care will improve outcome
- ***Distribute the convincing rationale and evidence***

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A California Toolkit to Transform Maternity Care

Improving Health Care Response to Preeclampsia: A California Quality Improvement Toolkit

THIS COLLABORATIE PROJECT WAS DEVELOPED BY:
THE PREECLAMPSIA TASK FORCE
CALIFORNIA MATERNAL QUALITY CARE COLLABORATIE
MATERNAL, CHILD AND ADOLESCENT HEALTH DIVISION; CENTER FOR FAMILY HEALTH
CALIFORNIA DEPARTMENT OF PUBLIC HEALTH

For More Information and to Download the Toolkit

- Visit our website: www.cmqcc.org
- Or contact us: info@cmqcc.org

Available online at www.cmqcc.org

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