

Actionable Patient Safety Solutions (APSS) #11B:

Severe hypertension in pregnancy and postpartum

How to use this guide

This guide gives actions and resources for creating and sustaining safe practices for severe hypertension in pregnancy and postpartum. In it, you'll find:

- Executive summary checklist..... 342
- What we know about severe hypertension in pregnancy and postpartum..... 344
- Leadership plan 347
- Action plan 347
- Technology plan 347
- Measuring outcomes..... 348
- Conflicts of interest disclosure 349
- Workgroup 349
- References 350



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Executive summary checklist

Complications that arise from hypertensive disorders are among the leading causes of severe maternal morbidity and preventable maternal mortality.

Establish readiness across every unit

- Adopt standards for early warning signs, diagnostic criteria, monitoring, and treatment of severe preeclampsia/eclampsia (include order sets and algorithms)
- Provide unit education on protocols and unit-based drills (with post-drill debriefs)
- Process for timely triage and evaluation of pregnant and postpartum women with hypertension, including in the ED and outpatient areas
- Ensure rapid access to medications used for severe hypertension/eclampsia; medications should be stocked and immediately available on Labor & Delivery and in other areas where patients may be treated. Include a brief guide for administration and dosage.
- Develop a system plan for escalation, obtaining appropriate consultation, and maternal transport, as needed

Recognize and prevent in every patient

- Adopt a standard protocol for measurement and assessment of blood pressure (BP) and urine protein for all pregnant and postpartum women
- Implement a standard response to maternal early warning signs, including listening to and investigating patient's symptoms and signs, and assessing labs (e.g., CBC with platelets, AST, and ALT)
- Implement facility-wide standards for educating prenatal and postpartum women on symptoms and signs of hypertension and preeclampsia (Preeclampsia Foundation, 2018)
- Recognize that women with severe hypertension are at high risk for cardiovascular disease
- Use patient stories, in written and video form, to identify gaps and inspire change in your staff

Respond

- Develop facility-wide standard protocols with checklists and escalation policies for management and treatment of:
 - Severe hypertension, eclampsia, seizure prophylaxis, and magnesium overdose
 - Postpartum presentation of severe hypertension/preeclampsia
- Establish minimum requirements for protocol:
 - Notify physician or primary care provider if systolic BP ≥ 160 mm Hg or diastolic BP ≥ 110 mm Hg for 2 measurements (persistent for 15 minutes)
 - After the 2nd elevated reading, initiate treatment right away (within 60 minutes of verification)
 - Include onset and duration of magnesium sulfate therapy
 - Include escalation measures for those unresponsive to standard treatment

- Describe manner and verification of follow-up within 7-14 days postpartum
- Describe postpartum patient education for women with preeclampsia
- Refer patients with persistent symptoms to cardiac specialist
- Develop a support plan for patients, families, and staff for ICU admissions and serious complications of severe hypertension
- Reduce the likelihood of harm related to maternal severe hypertension/preeclampsia

Report and learn

- Establish a culture of huddles for high-risk patients and post-event debriefs to identify successes and opportunities
- Conduct a multidisciplinary review of all severe hypertension/eclampsia cases admitted to ICU for systems issues
- Monitor outcomes and process metrics (CPSWHC, 2016):
 - Adherence to protocols for acute management and appropriate response to early warning criteria
 - Documentation of your education of pregnant and postpartum women about symptoms and signs of preeclampsia for women at risk
 - Occurrence of severe maternal morbidity (SMM) event debrief and outcomes
 - Timeliness of medication administration, triage, and evaluation

Create a culture of safety

- Use patient stories, in written and video form, to identify gaps and inspire change in your staff

What we know about severe hypertension in pregnancy and postpartum

A leading preventable cause of maternal and neonatal morbidity and mortality

Hypertensive disorders occur in 12-22% of all pregnancies and are one of the leading conditions that impact women during pregnancy. Hypertension may be pre-existing, may be induced by pregnancy, or both may occur (Singh, Ahmed, Egondou, and Ikechukwu, 2014).

Approximately 15-17% of all maternal mortality is caused by hypertensive disorders which include: chronic (pre-existing/essential) hypertension, gestational hypertension, preeclampsia with or without severe features, eclampsia, and HELLP (Hemolysis, Elevated Liver Enzymes, Low Platelets) (Walker, 2000). Studies show that between 50-70% of deaths due to severe preeclampsia are preventable (WHO, 2011; Aukes et al., 2007).

During pregnancy, hypertensive disorders not only affect the mother but also may contribute to significant neonatal morbidity and mortality (Backes et al., 2011).

The spectrum of hypertensive disorders of pregnancy

There are 4 main categories within the spectrum of hypertensive disorders of pregnancy:

- **Chronic hypertension during pregnancy:** Defined as blood pressure (BP) $\geq 140/90$ mm Hg prior to the 20th week of pregnancy, and leads to complications in 5% of all pregnancies (Seely and Maxwell, 2007; Druzin, Shields, Peterson, and Cape, 2013; Yanit, Snowden, Cheng, and Caughey, 2012)
- **Gestational hypertension:** Defined as new-onset hypertension associated with a systolic BP of ≥ 140 mm Hg or diastolic BP ≥ 90 mm Hg, or both, presenting at or after 20-weeks gestation without proteinuria or other severe features of preeclampsia
- **Preeclampsia:** Defined as systolic BP ≥ 140 mm Hg or diastolic BP ≥ 90 mm Hg (on 2 occasions, at least 4 hours apart) or systolic BP ≥ 160 mm Hg or diastolic BP ≥ 110 mm Hg (within a short interval (minutes)) and associated with proteinuria ≥ 300 mg per day. In the absence of proteinuria, diagnosis can be confirmed with the inclusion of at least 1 severe feature:
 - o Thrombocytopenia (platelet count $\leq 100,000/\mu\text{L}$)
 - o Renal insufficiency
 - o Impaired liver function
 - o Pulmonary edema
 - o Cerebral or visual symptoms (preeclampsia is a multi-organ disease)
- **Preeclampsia superimposed on chronic hypertension:** preeclampsia that complicates hypertension of another cause

Causes and risk factors for severe hypertension in pregnancy and postpartum

The causes of pregnancy-induced hypertension and the risk factors are still being widely studied. However, hypertension among pregnant women in the U.S. has increased significantly over the last 2 decades, due to increased rates of obesity and diabetes (Schulkin, Power, and Leddy, 2008).

The leading patient factors among maternal deaths due to preeclampsia were (Main et al., 2015):

- Delays in seeking care - 42%
- Presumed lack of knowledge regarding the severity of a symptom or condition - 39%
- Underlying medical condition - 39%

The connection with cardiovascular disease

Some of the complications of preeclampsia may overlap with those seen in cardiovascular disease in pregnancy. This may particularly be relevant in the following settings.

If a patient with preeclampsia develops **pulmonary edema** during pregnancy or in the postpartum period, we suggest cardiac evaluation such as an echocardiogram. The standard treatment of preeclampsia includes use of magnesium sulphate infusion to prevent seizures. One of the known complications is pulmonary edema due to vascular damage in the lungs. However, in women with underlying cardiac disease or in the event of new onset peripartum cardiomyopathy, pulmonary edema may be the first presentation.

There is **overlap** in the pathophysiology of preeclampsia and peripartum cardiomyopathy. Preeclampsia has been shown to cause diastolic dysfunction, which is considered a form of cardiac toxicity. Furthermore, prevalence of preeclampsia is 4-5 times higher in women with peripartum cardiomyopathy. Therefore, early diagnosis and treatment of cardiomyopathy may decrease morbidity and even mortality (Melchiorre K et. al. Hypertension. 2011;57:708-715).

Preeclampsia complicates 2-8% of all pregnancies. Several studies have demonstrated that patients with preeclampsia are at a much higher risk of **developing cardiovascular disease in later life**. This may be due to a combination of the persistent endothelial, vascular, and metabolic derangements inherently linked to preeclampsia. The 2011 AHA guidelines for the prevention of cardiovascular disease in women added preeclampsia as an additional cardiovascular risk factor. This may provide an opportunity for these women to address modifiable risk factors to improve their long-term health outcomes.

Pregnancy may be considered as a failed “stress test” in this setting and therefore these young women may benefit from interventions to prevent cardiovascular disease (Ahmed et. al. JACC;63,No. 18,2014).

Preventing severe hypertension in pregnancy and postpartum

No clear strategies have emerged to prevent the onset of preeclampsia, although low-dose aspirin taken daily starting at the end of the 1st trimester has been shown to reduce preeclampsia among high risk women (“Emergent therapy for acute-onset, severe hypertension during pregnancy and the postpartum period”, 2015).

In the past, the focus was placed on prevention of eclamptic seizures, which are associated with an increase in both neonatal and maternal morbidity and mortality. The incidence of eclamptic seizures can be reduced with administration of magnesium sulfate (Sibai, 2004; Martin et al., 2005).

Unlike the relatively straightforward prophylaxis of eclamptic seizures, there is a gap in knowledge and application of therapeutic interventions for stroke prevention through controlled BP. Typically, treatment of systolic BP ≥ 160 mm Hg, and/or diastolic BP ≥ 105 mm Hg has been recommended (Kayem *et al.*, 2011). In practice, clinicians institute therapies at a lower level of systolic or diastolic blood pressures.

Treatment for severe hypertension in pregnancy and postpartum

Early recognition and timely treatment of preeclampsia is a critical factor in reducing maternal

and neonatal morbidity and mortality. Delay in treating hypertension is the primary cause of concern. When a patient is diagnosed with preeclampsia, it is important to recognize worsening signs and symptoms to try and prevent progression to eclampsia or stroke.

The most important intervention in the treatment for preeclampsia/eclampsia is delivery of the fetus and placenta. The phrase “delivery is the cure” is widely accepted, however in many cases preeclampsia/eclampsia may continue for a variable amount of time after delivery. Therefore prophylaxis with magnesium sulfate is recommended for 24 hours post-delivery. For this reason, new mothers with previous complications of preeclampsia should continue to be evaluated post-delivery. Serious clinical outcomes can continue postpartum for days and even weeks (Chescheir, 2015).

The majority of women who die of severe preeclampsia die from stroke (Bushnell and Chireau, 2011). Stroke can only be prevented with rapid administration of antihypertensive medications. The key to saving lives from complications of severe preeclampsia is administration of antihypertensive medication within 30-60 minutes (“Emergent therapy for acute-onset, severe hypertension during pregnancy and the postpartum period”, 2017).

Maternal morbidity and mortality in the U.S. and globally

Global maternal mortality

Global maternal deaths have fallen 44% since 1990, but there are still more than 303,000 women who die each year from complications related to pregnancy, delivery, or within the first 6 weeks after delivery (WHO, 2015). The majority of deaths (64%) occur from the day of delivery through 41 days postpartum (Creanga *et al.*, 2015). This equates to approximately 830 women dying every day, with 550 occurring in sub-Saharan Africa, 180 in Southern Asia, and 5 in developed countries (WHO, 2015). In some developing countries, the maternal mortality rate is as high as 1% of live births (AbouZahr, 1998).

Maternal mortality in the U.S.

Within the U.S., it is estimated that approximately 600 women die each year, which is 14 per 100,000 live births (CDC, 2015; WHO and UNICEF, 2015). While that number seems to pale in comparison on the global scale, the U.S. ranks 46th in the world for maternal mortality (Agrawal, 2015). Of all industrialized countries, the U.S. lags behind Kazakhstan, Libya, and Qatar, and is one of only 13 countries whose maternal mortality rates have continued to increase instead of improve (by declining) over the last 25 years (Kempner, 2015).

The reasons for the overall increase in maternal mortality within the U.S. are unclear. Delaying childbearing and using assisted reproductive technology (e.g., in-vitro fertilization) have given rise to older mothers with an increased risk of complications than younger women (Bewley *et al.*, 2005). Additionally, the obesity epidemic gives rise to chronic conditions such as hypertension, diabetes, and chronic heart disease which increase the risk of complications during pregnancy (CDC, 2015; Kuklina *et al.*, 2009; Albrecht *et al.*, 2010; Kuklina *et al.*, 2012).

More than one-third of maternal deaths in the U.S. are preventable, and 40% could be avoided if women had access to quality care (Berg *et al.*, 2005). Most notably, black women have a 3- to 4-fold increased risk of death due to pregnancy compared to any other race or ethnicity (Creanga *et al.*, 2014; Callaghan, Mackay and Berg, 2008). The reasons are extremely complex and not well documented.

Moreover, severe maternal morbidity is much more prevalent and preventable, affecting tens of thousands of women each year (Callaghan, Creanga, and Kuklina, 2012; Callaghan, Mackay and Berg, 2008).

Leadership plan

Hospital governance, senior administrative leadership, clinical leadership, and safety/risk management leadership need to work collaboratively to reduce severe hypertension in pregnancy and postpartum.

- Individual practices, hospitals, and hospital systems should develop systems of care that deliver risk-appropriate care to women pre- and post-delivery
- A multidisciplinary team should be built to give quality care to a woman with severe preeclampsia. The team should be comprised of an obstetric provider credentialed to perform cesarean sections, nursing, anesthesiology, NICU, laboratory, blood bank, social work, and other sub-specialties as needed (Aukes *et al.*, 2007).
- Actively participate in regional and state perinatal collaboratives
- Use patient stories, in written and video form, to identify gaps and inspire change in your staff:
 - The story of Joan Donnelly, as told by her husband, Todd Heiden, is an example of a case of preventable death due to unrecognized postpartum eclampsia. You can view it for free here: youtu.be/dyh46ilcmkQ.

Action plan

The Council on Patient Safety in Women’s Health Care developed comprehensive bundles and lists of resources that apply to the prevention of harm from severe preeclampsia (CPSWHC, 2016). The bundles are a roadmap for hospitals to use in the prevention of harm.

Technology plan

These suggested practices and technologies have shown proven benefit or, in some cases, are the only known technologies for certain tasks. If you know of other options not listed here, please complete the form for the PSMF Technology Vetting Workgroup to consider:

patientsafetymovement.org/actionable-solutions/apss-workgroups/technology-vetting/

System or practice

ONC Meaningful Use Certified Electronic Health Record (EHR) System with the following capabilities:

- Computerized Provider Order Entry (CPOE)
- Drug-drug interaction check
- Drug-allergy interaction check
- Clinical Decision Support tools (CDS)

Blood pressure measurement devices

- Smart devices that track BP at home

Measuring outcomes

Topic 1: Severe maternal morbidity (SMM) among preeclampsia cases

Outcome measure formula

Numerator: Among the denominator, cases with any SMM code

Denominator: All mothers during their birth admission, excluding ectopics and miscarriages, with one of the following diagnosis codes:

- Preeclampsia (with or without severe features or with blood pressures in the severe range)
- Eclampsia
- Preeclampsia superimposed on chronic hypertension

Metric recommendations

Direct Impact: All pregnant patients

Lives Spared Harm:

$Lives\ Spared\ Harm = (SMM\ Rate_{baseline} - SMM\ Rate_{measurement}) \times Denominator_{baseline}$

Note

Since this is a morbidity measure, the lives saved calculation is not applicable.

Data collection

HDD File (ICD9/ICD10)

Outcome measure formula

Numerator: Among the denominator, all cases with any non-transfusion SMM code

Denominator: All mothers during their birth admission, excluding ectopics and miscarriages, with one of the following diagnosis codes:

- Preeclampsia (with or without severe features or with blood pressures in the severe range)
- Eclampsia
- Preeclampsia superimposed on chronic hypertension

Metric recommendations

Direct Impact: All pregnant patients

Lives Spared Harm:

$Lives\ Spared\ Harm = (SMM\ Rate_{baseline} - SMM\ Rate_{measurement}) \times Denominator_{baseline}$

Note

Since this is a morbidity measure, the lives saved calculation is not applicable.

Data Collection

HDD File (ICD9/ICD10)

Conflicts of interest disclosure

The Patient Safety Movement Foundation partners with as many stakeholders as possible to focus on how to address patient safety challenges. The recommendations in the APSS are developed by workgroups that may include patient safety experts, healthcare technology professionals, hospital leaders, patient advocates, and medical technology industry volunteers. Some of the APSS recommend technologies offered by companies involved in the Patient Safety Movement Foundation that the workgroups have concluded, based on available evidence, are beneficial in addressing the patient safety issues addressed in the APSS. Workgroup members are required to disclose any potential conflicts of interest.

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