Care plan for individuals at risk for preeclampsia: shared approach to education, strategies for prevention, surveillance, and follow-up

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Preeclampsia is a multisystemic disorder of pregnancy that affects 250,000 pregnant individuals in the United States and approximately 10 million worldwide per annum. Preeclampsia is associated with substantial immediate morbidity and mortality but also long-term morbidity for both mother and offspring. It is now clearly established that a low dose of aspirin given daily, beginning early in pregnancy modestly reduces the occurrence of preeclampsia. Low-dose aspirin seems safe, but because there is a paucity of information about long-term effects on the infant, it is not recommended for all pregnant individuals. Thus, several expert groups have identified clinical factors that indicate sufficient risk to recommend low-dose aspirin preventive therapy. These risk factors may be complemented by biochemical and/or biophysical tests that either indicate increased probability of preeclampsia in individuals with clinical risk factors, or more importantly, identify increased likelihood in those without other evident risk. In addition, the opportunity exists to provide this population with additional care that may prevent or mitigate the short- and long-term effects of preeclampsia. Patient and provider education, increased surveillance, behavioral modification, and other approaches to improve outcomes in these individuals can improve the chance of a healthy outcome. We assembled a group with diverse, relevant expertise (clinicians, investigators, advocates, and public and private stakeholders) to develop a care plan in which providers and pregnant individuals at risk can work together to reduce the risk of preeclampsia and associated morbidities. The plan is for care of individuals at moderate to high risk for developing preeclampsia, sufficient to receive low-dose aspirin therapy, as identified by clinical and/or laboratory findings. The recommendations are presented using the GRADE methodology with the quality of evidence upon which each is based. In addition, printable appendices with concise summaries of the care plan's recommendations for patients and healthcare providers are provided. We believe that this shared approach to care will facilitate prevention of preeclampsia and its attendant short- and long-term morbidity in patients identified as at risk for development of this disorder.

Key words: GRADE, hypertensive disorders of pregnancy, low-dose aspirin therapy, preeclampsia, prevention

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Introduction

Preeclampsia is a multisystemic disorder of pregnancy that affects 5% to 7% of pregnant individuals worldwide, that is, approximately 10 million pregnancies per annum,[1] with 94% of cases occurring in low- and middle-income countries. In the United States, the approximately 250,000 cases that occur per annum have a cost of $2.18 billion in the 12 months that follow birth or pregnancy cessation.[2] Preeclampsia during pregnancy causes substantial morbidity and mortality in the mother and fetus. The only treatment for the acute pathophysiology is delivery of the placenta at the cessation of the pregnancy. However, the impact does not end completely after birth given that both the affected individual[3,4] and infant[5,6] have an associated increased risk for cardiovascular disease later in life.

The ideal management of preeclampsia would be prevention. Thus, when several meta-analyses indicated that the daily administration of low-dose aspirin during pregnancy reduces the frequency and adverse outcomes of preeclampsia, the use of this therapy for at-risk individuals was widely endorsed.[7] Despite minimal short-term side effects and unknown long-term effects, low-dose aspirin is now being prescribed for persons at high or moderate risk of developing preeclampsia to prevent or delay its onset.

Importantly, the identification of persons at risk for preeclampsia provides opportunities beyond only low-dose aspirin therapy to improve their outcomes. Recognizing individuals at risk permits appropriate surveillance, behavioral modification, directed patient and provider education, and the opportunity to address associated psychological and socioeconomic stress. All of these should be modifiable factors that, when addressed, may reduce the occurrence of preeclampsia or mitigate the severity of the disorder. In addition, these are factors that facilitate optimal health outcomes across the lifespan and may be the focus of healthcare counseling prenatally and in individuals of childbearing age who are not pregnant.

This article presents a comprehensive care plan for persons who are deemed at moderate to high risk for developing preeclampsia. The approach presented is for care in developed countries. Many of the recommendations are beyond the scope of what can be achieved in low- and middle-income countries, which will require recommendations tailored to their needs. These recommendations are also not meant to guide care of individuals who develop preeclampsia. If preeclampsia does develop, we recommend management as presented by the American College of Obstetricians and Gynecologists (ACOG).[8] The current care plan is the product of an expert working group of clinicians, investigators, advocates, patients, and payers. The group was convened in February of 2022 to review the evidence for prenatal, intrapartum, and postpartum care provided to persons who have an identified increased risk of preeclampsia at the onset of pregnancy. A list of recommendations is provided after each section, and these recommendations are summarized in Appendix 1 (for individuals at risk) and Appendix 2 (for healthcare providers) in a format that can be downloaded and shared. Recommendations are presented with GRADE (Grading of Recommendations Assessment, Development and Evaluation) classifications indicating strength of supporting evidence and recommendations.

Background

Assessing the risk for preeclampsia

Individuals with a previous pregnancy complicated by preeclampsia, pregestational diabetes mellitus (either type 1 or 2), a multifetal gestation, chronic hypertension, or other disorders are at increased risk of developing preeclampsia.[9] Hence, obstetrical history and clinical risk factors can be used to screen and identify individuals early in pregnancy who are at higher risk of developing preeclampsia. However, these risk factors identify only a small proportion of the population that develops preeclampsia.[10] This problem has led to attempts to identify a combination of moderate risk factors,[7] and biochemical or biophysical testing,[10,11] to identify additional individuals at risk for this disorder.

Scope of the care plan

This care plan is intended to support care during the prenatal, intrapartum, and postpartum periods. Many aspects of this plan are also applicable and in accordance with current guidance for interpregnancy care.[12] In addition, the care pathway needs to account for and be applicable to both individuals and providers living and working in low-resource settings and healthcare deserts. Ideally, such persons should be able to receive care in their local community. The care plan should also be flexible and adaptable to the degree of risk that the person is facing. The plan presented herein is for pregnant individuals at moderate to high risk of developing preeclampsia. An individualized plan of care should be developed for persons at very high risk of developing preeclampsia (eg, a person with $\geq$2 of the major risk factors defined by ACOG).[7] Ideally, this plan should be developed with input from a maternal–fetal medicine specialist in conjunction with the primary obstetrical care provider. Use should be made of technological solutions to facilitate care, including telemedicine and mobile apps for patient education and for reporting and linkage between patients and providers.

Assessing strength of evidence and recommendations

The Working Group used the evidence assessment and recommendation strategy developed by the GRADE Working Group (https://www.gradeworkinggroup.org/). The GRADE strategy provides a standardized approach to the assessment and grading of evidence that is used for making recommendations.[13–16] With this approach, evidence is judged as very low-, low-, moderate-, or high-quality, and recommendations are classified as strong or qualified. The strength of a recommendation is based on the quality of evidence but also on benefit vs risk (including cost) and consistency with typical patient values and preferences. A strong recommendation is one that is

well-supported to the extent of being appropriate for virtually all individuals and able to provide a basis for healthcare policy. A qualified recommendation is one that would also be appropriate for most patients, but might not be optimal for some patients (whose values and preferences differ, or who have different attitudes toward uncertainty in estimates of effect). Another GRADE classification is a "good practice statement."[17] These are important recommendations that, however, as a result of their nature do not have evaluable direct evidence to support them (eg, "Pregnant persons should be instructed in signs and symptoms that should be communicated to health care providers."). In many cases, the converse of the statement is absurd or clearly does not conform to ethical norms (eg, "Pregnant persons should not be informed about signs and symptoms and should not report them to the care provider."). Furthermore, they are often well-supported by indirect evidence (a person who recognizes possible symptoms can report these to the care provider, which allows earlier recognition of preeclampsia, reducing risk). To acquire and assess this convoluted pathway of data is not considered an effective use of time, and because these recommendations are the obviously appropriate approach in most settings, they are presented as "ungraded good practice plans."

Identifying pregnant patients at sufficient risk to be considered for the care plan

Several organizations have agreed to use the recommendations of the United States Preventive Services Task Force (USPSTF),[18] which are endorsed by ACOG[7] and the Society for Maternal-Fetal Medicine (SMFM),[19] to assess clinical risks sufficient to consider pregnant individuals candidates for aspirin therapy (Table 1). In this decision tree, persons with 1 of several high-risk factors are considered at sufficient risk to be candidates for aspirin preventive therapy. Pregnant individuals with >1 of the several moderate risk factors are also candidates for aspirin therapy. It is this Working Group's recommendation that these same risk criteria be sufficient to enter a pregnant person into this recommended care plan.

In addition, there are now several biochemical or biophysical tests in development for prediction of preeclampsia.[20–23] These are designed to increase the predictive value of clinical risk assessment. These tests might be used to identify persons without evident clinical risk but who, on the basis of assessment with this testing, could be identified as candidates for low-dose aspirin therapy. As such tests become part of clinical care, individuals with testing results judged by advisory groups (eg, ACOG or SMFM) as sufficient to recommend low-dose aspirin would also benefit from the Care Plan for Individuals at Risk for Preeclampsia.

Recommendations

- Individuals with risk at least sufficient for recommending prophylactic low-dose aspirin therapy are considered candidates for this care plan.
  - o Ungraded good practice plan

Social determinants of health considerations

Social determinants of health (SDOH), as defined by the Centers for Disease Control and Prevention, are "conditions in the places where people live, learn, work, and play that affect a wide range of health risks and outcomes." SDOH domains include healthcare access and quality, education access, economic stability, neighborhood and built environment, and social and community contexts. On an individual level, unstable or unsafe housing, social exclusion, limited access to healthy food, inability to find transportation to healthcare appointments, low health literacy, being subject to racial or ethnic bias, or residing in a food desert are all examples of SDOH inequity.

Relevant to the care plan, SDOH inequities have been independently identified as risk factors for preeclampsia. In addition to implementing the recommendations within the plan, it is a responsibility of the healthcare team to modify and supplement healthcare and education according to the SDOH of their patients on an individual basis. Research has shown that addressing adverse SDOH requires a multifaceted approach that includes interventions at the national, local community, and individual levels.[24,25] For example, at-home self-monitoring of blood pressure (SMBP) and telemedicine can serve as equitable solutions for individuals with limited access to transportation, childcare, and/or social and community support. However, the cost of SMBP (equipment and training) and access to resources for telemedicine appointments must also be considered. Thus, networking with community resources and public health programs is an important component of how healthcare institutions address SDOH assessment and intervention. To support equity of care, the Working Group encourages providers and their institutions to consider universal SDOH screening and developing plans of action for when needs are identified. SDOH screening should include questions to identify food insecurity, housing instability, lack of transportation, and interpersonal violence. Multiple tools for SDOH screening have been validated for use and are being integrated into electronic health records to best meet the needs of specific communities.[26]

Recommendations

- Care providers should conduct SDOH screening at initial antenatal visit.
  - o Ungraded good practice plan
- Care plan recommendations and resources should be adapted on the basis of SDOH and socioeconomic status.
  - o Ungraded good practice plan

General considerations for care of individuals at increased risk of preeclampsia

Management of preexisting conditions

In pregnant persons at risk for preeclampsia because of a preexisting condition, efforts should be made to optimally treat that condition preconceptionally and/or at the time of presentation during pregnancy. Although the management of each of these conditions is beyond the scope of this Care Plan, the management of chronic hypertension deserves special considerations as an approach to prevention. Recent evidence indicates that aggressive treatment of blood pressure

TABLE 1
Risk factors for developing preeclampsia

Risk factors	Degree of risk and recommendation
Current pregnancy • Multifetal pregnancy (twins, triplets, etc.) Obstetrical history • History of preeclampsia in previous pregnancy • History of eclampsia in previous pregnancy Medical history • Autoimmune disease (antiphospholipid syndrome or systemic lupus erythematosus, etc.) • Chronic hypertension • Diabetes mellitus, type 1 or 2 • Renal disease (chronic kidney disease)	High risk: These risk factors represent a risk of approximately ≥8% for developing preeclampsia. Recommendation: For all individuals with 1 of these risk factors: daily use of low-dose aspirin[a] initiated between 12 and 28 wk gestation (preferably before 16 wks gestation).
Current pregnancy • Nulliparity • In vitro fertilization Obstetrical history • Adverse pregnancy outcome in previous pregnancy • Low birthweight or small for gestational age • >10-y interval after previous pregnancy Medical history • Age ≥35 y • Obesity (BMI >30) Demographic factors • Family history of preeclampsia (first-degree relative such as mother or sister) • Social influences on health o Black race o Lower income	Moderate risk: These risk factors are associated with an independent risk for preeclampsia, but some are a stronger risk than others, and some are more consistently associated with preeclampsia than others. Recommendation: For individuals with ≥2 of these risk factors: consider daily use of low-dose aspirin[a] initiated between 12 and 28 wk gestation (preferably before 16 wks gestation).

BMI, body mass index.

Source.[18,19,37]

[a] Contraindications to aspirin include: history of aspirin hypersensitivity such as urticaria, hypersensitivity to other salicylates, known hypersensitivity to nonsteroidal antiinflammatory drugs, nasal polyps, and history of aspirin-induced bronchospasm in persons with asthma. In addition, the following are relative contraindications: active peptic ulcer disease or other source of gastrointestinal bleeding, history of gastrointestinal bleeding, and severe liver dysfunction.

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(indication for treatment: ≥140/90 mm Hg) for persons with chronic hypertension during pregnancy reduces the risk and severity of preeclampsia and reduces morbidity for the infant.[27] These individuals should be informed of this evidence and hypertension therapy as recommended by SMFM, and managed accordingly.[28]

COVID-19 and preeclampsia

Pregnant individuals who contract COVID-19 are more likely to develop serious illness than are nonpregnant persons with this infection. COVID-19 infection during pregnancy is also associated with increased risk of preeclampsia.[29] In addition, symptoms of COVID-19 and symptoms of preeclampsia have similar features, which can confound diagnosis.[29] Vaccination is very effective for increasing COVID-19 antibodies. These antibodies also cross the placenta and are present in breast milk to provide protection to the newborn.[30,31] Thus, all pregnant and nonpregnant individuals are encouraged to receive the full course of COVID-19 vaccines and boosters.[32] Because pregnant individuals at risk for preeclampsia have an elevated risk, the Working Group recommends that these individuals be counseled about the increased risk and that COVID-19 vaccines be strongly encouraged.

Recommendations

- Pregnant persons with increased risk of preeclampsia because of preexisting medical conditions are recommended to have these disorders carefully monitored and appropriately treated.
  - o Moderate-quality evidence
  - o Strong recommendation
- In particular, pregnant persons with chronic hypertension and a blood pressure ≥140/90 mm Hg are recommended to receive antihypertensive therapy.
  - o High-quality evidence
  - o Strong recommendation
- The Working Group recommends that individuals at risk for preeclampsia be encouraged to receive a COVID-19 vaccine or booster if not fully vaccinated.
  - o Moderate-quality evidence
  - o Strong recommendation

Preventive strategies during pregnancy for individuals at risk for preeclampsia

Preventive pharmacologic therapies

Use of low-dose aspirin is consistently associated with a reduced risk of preeclampsia in high-risk persons, with relative risks (RRs) in meta-analyses ranging from 0.57 to 0.92.[33–36] Offering low-dose aspirin for the prevention of preeclampsia to individuals at risk for preeclampsia is thus the consensus recommendation of ACOG, SMFM, and the USPSTF.[18,19,37] It is beyond the scope of this care plan to review the research evidence that has addressed specific doses, timing, and duration of aspirin therapy given local practice variation and differences in recommendations and eligibility criteria among professional societies. However, the Working Group **strongly recommends consistent adherence to the risk factor assessment and low-dose aspirin regimen recommended by the**

SMFM and ACOG,[19,37] which is 81 mg per day initiated between 12 and 28 weeks' gestation (optimally before 16 weeks' gestation) and continued daily until birth or pregnancy cessation. Although not included in current ACOG recommendations, there are reasonable data to support the use of aspirin doses >100 mg as acceptable alternatives to the 81-mg dosage.[38]

Further, it should be emphasized that low-dose aspirin has an excellent safety profile in pregnancy, with no increased risk of placental abruption or peripartum bleeding, congenital malformations, or other adverse fetal or neonatal effects.[39−41] For this reason, ACOG and SMFM recently proposed that some practices—particularly those where most persons cared for meet high- or moderate-risk criteria for preeclampsia—should consider universal, practice-wide implementation of low-dose aspirin.[37]

Clinical practices should implement programs to support adherence to daily use of low-dose aspirin, when possible, given that adherence is associated with improved outcomes. In one prospective cohort study, persons with <90% adherence to daily use of low-dose aspirin (compared with those with ≥90% adherence) had higher rates of a wide range of adverse pregnancy outcomes, including preterm preeclampsia, intrauterine growth restriction, and preterm birth, as measured objectively by evaluating platelet function and blood levels of salicylic acid.[42] Adherence and strategies to improve adherence to healthcare recommendations are challenges that are not unique to use of low-dose aspirin. Use of decision-aids during a shared decision-making process can help identify individual strategies to improve adherence. Additional strategies that have demonstrated effectiveness in improving adherence to healthcare recommendations include (but are not limited to) daily count-type pillboxes,[43] education programs,[44] and telemonitoring or mobile health applications.[45]

Unfortunately, aside from low-dose aspirin, there is limited evidence on pharmacologic therapies that are safe and effective for the prevention of preeclampsia in all at-risk individuals. Newer drugs, including statins and antiplatelet agents, show promise in early testing but require more research.

Recommendations

- The use of low-dose aspirin as counseled by ACOG and SMFM at 81 mg per day initiated between 12 and 28 weeks of gestation (optimally before 16 weeks) and continued daily until birth or pregnancy cessation is recommended for at-risk patients.[19,37] There are reasonable data to support that aspirin doses >100 mg may be acceptable alternatives to 81 mg.[38]
  - o High-quality evidence
  - o Strong recommendation
- The Working Group encourages that low-dose aspirin therapy be supported via shared decision-making and other strategies that facilitate adherence.
  - o Ungraded good practice plan

Preventive behavioral strategies

Low-dose aspirin therapy opened a new era for prevention of preeclampsia. However, and importantly, many behaviors also influence the development of preeclampsia. Healthful behaviors are well-established to be associated with decreased risk for cardiovascular disease in nonpregnant persons and lowered risk for development of adverse pregnancy outcomes among pregnant persons. There is growing, high-level evidence from randomized controlled trials (RCTs) and meta-analyses that support the effectiveness of specific nutrition[46−51] and exercise[52−56] approaches for prevention of preeclampsia.

Nutrition and nutritional supplements

A healthy diet and appropriate intake of nutrients is foundational for the health of an individual and fetus during pregnancy.[57] In the past, some dietary patterns have been associated with increased risk for preeclampsia; however, studies of this relationship have often had conflicting results.[57] More recently, evidence has suggested that nutritional strategies such as diets including a balance of nutrient-dense foods from each food group (ie, grains, fruits and vegetables, protein foods, and dairy) and limiting foods or drinks with added sugar, saturated fat, and sodium (Mediterranean-style diet) are beneficial.[51] Raghavan et al[51] conducted a systematic review of nutrition during pregnancy and found an association between a Mediterranean-style diet and reduced frequency of preeclampsia in persons who were White and low-risk. This reduced rate of preeclampsia was also found in recent studies that included mixed, racially diverse populations, with similar benefits found for Black and White persons.[48,58]

Thus, the Working Group endorses these dietary recommendations on the basis of available evidence. When available, dietary counseling provided by a registered dietitian nutritionist will be valuable. Dietary counseling and education promoting a healthy dietary pattern specific to the individual's personal and cultural preferences (that includes calorie and nutrient needs, as recommended in the 2020−2025 Dietary Guidelines for Americans) are advised.[46]

The use of nutritional supplements, specifically vitamin D and calcium, has been evaluated for its effect on preeclampsia. Vitamin D supplementation alone was associated with a reduced risk ratio for preeclampsia (RR, 0.48; 95% confidence interval [CI], 0.30−0.79) in 4 small RCTs.[49] Doses of 600 IU (the recommended dietary allowance) seem to provide the same effect as higher doses.[50]

Calcium supplementation in doses of ≥1000 mg per day reduced the risk of high blood pressure by 35% (RR, 0.65; 95% CI, 0.53−0.81; 12 trials; n=15,470) and of preeclampsia by 55% (RR, 45%; 95% CI, 0.31−0.65; 13 trials; n=15,730).[47] Several studies suggest that 500 mg per day may also be effective.[47] For preeclampsia, the benefit of calcium supplementation was present only in populations consuming a low-calcium diet before supplementation.

Although there have been concerns about nephrolithiasis during pregnancy, evidence of increased risk during pregnancy is equivocal.[59,60] The risk with vitamin D and calcium supplementation is also not clear, but is likely dose- and duration-related.[61] It is also unlikely that the doses of vitamin D and calcium used

during the limited duration of pregnancy increase the risk of nephrolithiasis. Because of the potential for benefit and the low probability of adverse effects, vitamin D supplementation in the range of 600 to 2000 IU (4000 IU per day is the usual recommended intake), taken throughout pregnancy, is recommended by the Working Group for persons at high risk of preeclampsia. The dose of 600 to 2000 IU per day should be inclusive of the amount of vitamin D in a prenatal vitamin or multivitamin if the individual is taking one of such types of vitamin supplements. The preferred approach to calcium augmentation is diet counseling and modification to achieve intake of 1000 mg per day for individuals with a diet assessed as low in calcium (<800 mg per day). For individuals with low calcium intake unable to increase dietary intake, 500 mg of calcium supplementation per day is suggested.

For people enrolled in the Special Supplemental Nutrition Program for Women, Infants, and Children (WIC), an effort to coordinate nutrition care should be made between prenatal care providers and WIC health professionals. Anyone eligible for WIC, but not yet enrolled, should be provided with assistance in pursuing enrollment.

Recommendations

- Diet counseling and education tailored to the individual's preferences and caloric needs should be provided.
  - o Ungraded good practice plan
- Follow the Dietary Guidelines for pregnancy:
  - o Balance of nutrient-dense foods from each food group (ie, grains, fruits and vegetables, protein foods, and dairy).
  - o Limit foods/drinks with added sugar, saturated fat, and sodium.
  - o Follow a Mediterranean-style diet.
    - ■ Moderate-quality evidence
    - ■ Qualified recommendation
- The Working Group suggests supplementing with a daily dose of vitamin D (600−2000 IU that include the amount of vitamin D in the prenatal vitamin or multivitamin, if taken).
  - o Low-quality evidence
  - o Qualified recommendation
- The Working Group suggests dietary counseling and modification for individuals with low calcium intake (<800 mg per day) to increase intake to 1000 mg per day. If these persons cannot increase dietary intake, a 500-mg calcium supplement per day is advised.
  - o Moderate-quality evidence
  - o Qualified recommendation
- Refer to and coordinate with WIC when applicable.
  - o Ungraded good practice plan

Exercise

Exercise recommendations during pregnancy do not differ from those for nonpregnant individuals per ACOG.[52] The recommendations cite benefits of exercise in pregnancy to reduce the risk of gestational diabetes mellitus, preterm birth, excess gestational weight gain, and most relevant to this care plan, gestational hypertensive disorders.[52] Exercise is a well-established preventive strategy for individuals at risk for chronic hypertension and cardiovascular disease outside of pregnancy.[56] It can be posited that the mechanisms of action of exercise in improving cardiovascular health in nonpregnant individuals are also effective in modifying the pathophysiology of preeclampsia. Consequently, there is a breadth of high-level indirect evidence for the effectiveness of exercise as a preventive strategy for preeclampsia from which recommendations can be generated.[53−55]

Rigorous and reproducible evidence shows that prepregnancy exercise and exercise during pregnancy reduce the risk for preeclampsia.[54] Exercise before pregnancy has been observed to reduce the risk of gestational hypertension and preeclampsia in both population and clinical trial settings, likely by reducing prepregnancy risk factors for preeclampsia such as high blood pressure and insulin sensitivity.[53] Exercise during pregnancy to reduce the risk for preeclampsia has also been demonstrated to be effective across several meta-analyses that studied exercise of various intensities, types, and lengths.[39,40] A meta-analysis of 16 RCTs (n=5989) by Danielli et al[54] assessed supervised exercise compared with unsupervised or no exercise. They found a reduction in the pooled cumulative incidence of hypertensive disorders of pregnancy, with an incidence of 3% (95% CI, 3−4) in the supervised cohorts and 5% (95% CI, 5−6) in the unsupervised control cohorts. The pooled odds ratio (OR) when the intervention was compared with the control group was 0.54 (95% CI, 0.40−0.72; $P<.001$). Danielli et al[54] also assessed exercise type among the studies included in the meta-analysis, and found that aerobic exercise combined with strength training compared with aerobic exercise alone was optimally beneficial for preeclampsia prevention (aerobic and strength training together: OR, 0.50; 95% CI, 0.33−0.75; $P=.001$; vs aerobic exercise alone: OR, 0.87; 95% CI, 0.55−1.37; $P=.539$).[54] It should be noted that these studies were all conducted with individuals who were at low risk for adverse pregnancy outcomes. Exercise should be avoided by persons who have preexisting conditions that are a contraindication for exercise. However, for high-risk persons without contraindications, the Work Group recommends exercise as presented.

Recommendations

- Assess for contraindications to exercise.
  - o Ungraded good practice plan.
- Educate about the benefits of exercise during prepregnancy and pregnancy to reduce the incidence of preeclampsia if no contraindications exist.
  - o Moderate-quality evidence
  - o Qualified recommendation
- Three to 4 sessions, 30 to 60 minutes each per week of moderate aerobic and strength training exercise is suggested.
  - o Low-quality evidence
  - o Qualified recommendation

Sleep

Sleep health is characterized by regularity, efficiency, duration, timing, alertness, and satisfaction. Regular sleep of sufficient duration, efficiency, timing,

and quality is related to health and disease. Sleep disorders such as obstructive sleep apnea (OSA) have been shown to be associated with health risks, including hypertension.[62]

Sleep disturbances are commonly reported by persons during pregnancy. Approximately half of pregnant individuals have sleep disturbances, which increase over the course of pregnancy.[63] Sleep disturbances in pregnancy can substantially adversely affect maternal quality of life, and are associated with adverse pregnancy outcomes.[64]

The most consistent data regarding sleep and cardiometabolic health in pregnancy come from studies of OSA. In a recent meta-analysis of 7 studies, OSA was associated with increased risk for gestational hypertension, gestational diabetes mellitus, and preeclampsia ($P<.001$). The pooled adjusted OR values were 1.9 (95% CI, 1.5−2.5), 1.55 (95% CI, 1.5−2.5), and 2.35 (95% CI, 2.1−2.5), respectively.[65] OSA has also been linked to higher rates of preterm birth and fetal growth abnormalities.[66−68] Research has also found that OSA is associated with severe maternal morbidity and mortality.[69] The most widely prescribed treatment for OSA is continuous positive airway pressure (CPAP) during sleep. Outside of pregnancy, the benefit of treatment with CPAP has been consistently demonstrated when excessive daytime sleepiness and sleep quality are used as primary endpoints.[70,71] Although it is generally recommended that persons with a preexisting OSA diagnosis and established treatment should continue treatment during pregnancy, to date, data on the effect of CPAP treatment on pregnancy are limited. Most studies have been small and thus insufficiently powered or limited in the scope of endpoints.[63,72] Larger RCTs of CPAP in pregnancy are currently under way.[73]

Given the paucity of evidence to support benefit, the Working Group currently does not recommend universal screening for OSA in pregnancy. However, it is reasonable to recommend evaluation of pregnant individuals with a known diagnosis of OSA, and those who present to prenatal care with severe OSA-related complaints (eg, severe daytime drowsiness, debilitating fatigue, and irritability). It is presumed that the benefits of improved sleep and daytime functioning and reduction in motor vehicle accidents, which are associated with CPAP treatment in the general population, also apply to pregnant individuals.[74]

There are no specific guidelines that address optimal sleep duration in pregnancy. However, we can extrapolate from a recent Joint Consensus Statement of the American Academy of Sleep Medicine and Sleep Research Society to provide recommendations for all persons during pregnancy, which may be of particular relevance to those at increased risk for preeclampsia.[75]

Recommendations

- Adults should sleep ≥7 hours per night on a regular basis to promote optimal health.
  - o Moderate-quality data
  - o Qualified recommendation
- The Working Group advises that individuals with preexisting OSA diagnosis and established treatment continue treatment during pregnancy.
  - o Ungraded good practice plan

Antenatal care for persons at risk for preeclampsia

A major goal of antenatal care for persons at risk for developing preeclampsia is early detection of signs or symptoms that herald the development of clinical preeclampsia. Baseline laboratory testing, individualized frequency of antenatal visits (particularly in the first and third trimesters), SMBP, prophylactic use of low-dose aspirin, and education for pregnant individuals and healthcare providers are essential components of this care.

Baseline evaluation

There are currently no universal recommendations for baseline laboratory assessment in early pregnancy for persons who screen as at-risk for preeclampsia. Individuals at risk for preeclampsia because of an underlying chronic condition (eg, chronic hypertension) should have laboratory assessments that are standard of care for evaluation of the underlying disorder. The Preeclampsia Foundation and their medical board suggest acquiring baseline information relevant to the later development of preeclampsia for comparison in persons who are identified as at-risk for preeclampsia.[76] These baseline assessments allow the clinician to identify laboratory values that may be outside the range of normal at the time of the initial assessment and thereby subsequently complicate or make the diagnosis of preeclampsia unclear later in the pregnancy. Specifically, evaluation of renal function (creatinine, uric acid, and urinary protein [protein/creatinine ratio]), liver function (ie, aspartate transaminase [AST], alanine aminotransaminase [ALT]), and platelet count is recommended early in pregnancy for persons who are identified as at-risk for preeclampsia. The Working Group supports this recommendation.

Patients with metabolic syndrome are also at increased risk for preeclampsia. Although lipid evaluation is important,[77] the Working Group recommends deferring this assessment until 6 months postpartum unless there is family or personal history of specific lipid abnormalities during pregnancy.

Individuals who develop preeclampsia are at increased risk for cardiovascular disease, both in pregnancy and later in life. Cardiovascular disease during pregnancy is a leading cause of maternal death in the United States.[78] More than 20% of all pregnancy-related deaths are because of known or unknown cardiovascular causes, with an increased rate in those with preeclampsia.[79] An algorithm to screen for cardiovascular disease in all pregnant persons supported by ACOG is presented in the Figure. Using risk factors alone, persons who have a combination of advanced maternal age, obesity, chronic hypertension, diabetes mellitus, or other factors that increase the risk for preeclampsia and therefore cardiovascular disease will benefit from baseline cardiac evaluation including electrocardiography and echocardiography.[78,80] The Working Group supports the recommendation of cardiovascular clinical risk assessment to determine the need for cardiovascular evaluation as especially pertinent for persons at risk for preeclampsia.

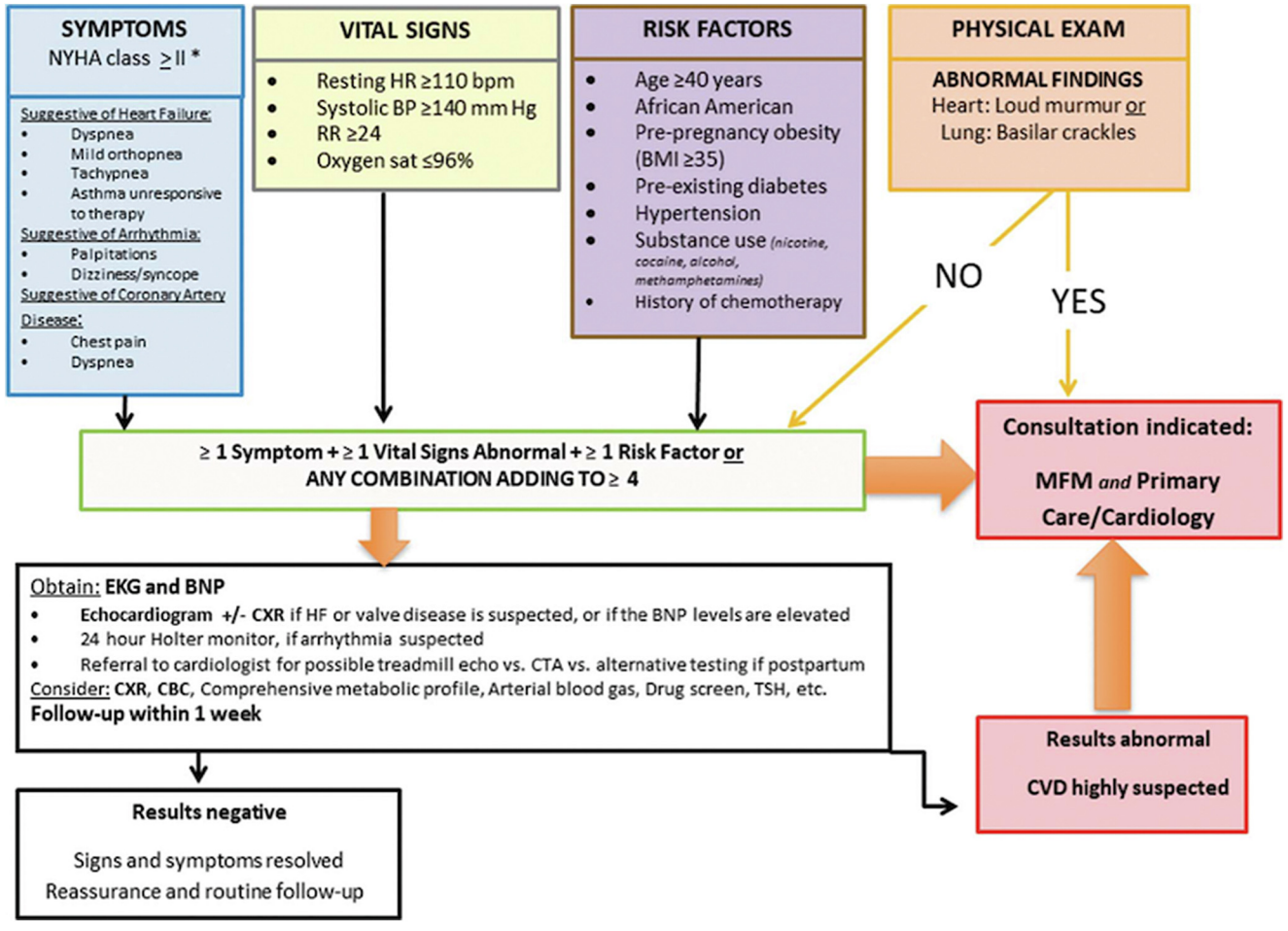
Recommendations

- Assess for relevant changes of preexisting medical conditions at initial antenatal visit.
  - o Ungraded good practice plan
- The Working Group believes that baseline assessment in early pregnancy of renal function (urinary protein, creatinine, uric acid), hepatic function (AST, ALT), and platelet count provides useful information for the later assessment of persons at risk for developing preeclampsia.
  - o Ungraded good practice plan
- The Working Group suggests, as recommended by ACOG, screening individuals with clinical indications for cardiovascular disease (Figure).
  - o Moderate-quality evidence
  - o Qualified recommendation

Frequency of antenatal care visits

Although antenatal care in the United States has traditionally consisted of 8 to 12 in-person visits, the optimum frequency of clinical visits has not been determined. Protocols for fewer in-person visits combined with telehealth and self-monitoring are increasingly being evaluated and implemented.[81] All pregnant individuals should receive a

FIGURE
Cardiovascular disease assessment in pregnant and postpartum women



These are recommendations from the American College of Obstetricians and Gynecologists for clinical findings to guide more extensive assessment of cardiovascular health.

Asterisk denotes The NYHA Functional Classification is available at http://www.heart.org/HEARTORG/Conditions/HeartFailure/AboutHeartFailure/Classes-of-Heart-Failure_UCM_306328_ Article.jsp.

Modified from California Department of Public Health, 2017; supported by Title V funds. Developed in partnership with California Maternal Quality Care Collaborative, Cardiovascular Disease in Pregnancy and Postpartum Taskforce. Visit www.CMQCC.org for details. Reprinted with permission from CMQCC (with permission).

BMI, body mass index; *BNP*, brain natriuretic peptide; *BP*, blood pressure; *CBC*, complete blood count; *CTA*, computed tomographic angiography; *CVD*, cardiovascular disease; *CXR*, chest x-ray; *EKG*, electrocardiogram; *HR*, heart rate; *MFM*, maternal-fetal medicine; *TSH*, thyroid-stimulating hormone; *NYHA*, New York Heart Association; *RR*, respiratory rate.

Roberts. A care plan for individuals at risk for preeclampsia. Am J Obstet Gynecol 2023.

minimum of 4 in-person visits, including an initial comprehensive evaluation that includes blood pressure measurement at 6 to 10 weeks' gestation or as soon as the person presents for prenatal care. Persons at risk for preeclampsia as identified by this care plan should be seen more frequently via either in-person visits or telehealth contact. Telehealth contact in combination with SMBP has been shown to be a safe substitute for in-person visits for persons at risk for hypertensive disorders of pregnancy.[82,83]

Consideration should be given to SDOH inequities, transportation barriers, distance from health care, individual risk factors, and individual history of adverse pregnancy outcomes with associated emotional trauma (ie, trauma-informed care) to create a customized antenatal visit schedule, incorporating virtual visits, as appropriate. For example, persons with history of preeclampsia may have posttraumatic stress related to experiences during the previous pregnancy.[84] This should be evaluated. Trauma-informed care is likely to be particularly beneficial for this population.

Recommendations

- Customize antenatal visit schedule to individual needs and circumstances.
  - o Ungraded good practice plan
- Evaluate and, if necessary, obtain care for posttraumatic stress in women with previous preeclampsia.
  - o Ungraded good practice plan

Blood pressure monitoring

Pregnant individuals at risk for preeclampsia should have blood pressure monitoring at all clinical visits.[85] The measurements, obtained during the first half of pregnancy, establish the individual's baseline values. For individuals at risk for preeclampsia, it is likely that more frequent measurement of blood pressure would increase early recognition of preeclampsia and facilitate interventions to reverse or mitigate adverse outcomes. Although optimal frequency of blood pressure monitoring for this population has not been evaluated, the Working Group recommends that persons at risk for preeclampsia have blood pressure monitored every 2 weeks until 20 weeks, and weekly thereafter, with more frequent determinations if warranted by the clinical condition. There are suggestions for individualization based on the level of early blood pressure or blood pressure trajectory; however, the Working Group does not consider these ready for determining a clinical care recommendation.

Self-monitoring of blood pressure

SMBP is recommended to facilitate the recommended increased frequency of monitoring. SMBP has been shown to be feasible, acceptable, and accurate.[86,87] Two recent RCTs compared outcomes in persons at high risk for preeclampsia conducting SMBP vs receiving clinician monitoring during antenatal care visits.[88,89] Neither study found differences in systolic blood pressure measurements, timing of diagnosis of preeclampsia, or adverse perinatal outcomes between the 2 methods of blood pressure monitoring.[88,89] However, a substantial proportion of those in the usual-care groups also participated in SMBP, which may have diluted any difference in results between the study and usual-care groups. In addition, although relevant pregnancy outcomes were evaluated, the studies did not document clinician response to reports of elevated blood pressure by persons in the intervention arms of the study. The results may also have been confounded by the fact that some individuals diagnosed as hypertensive in the office never achieved diagnostic blood pressure elevation on SMBP. Previous systematic reviews of studies that have evaluated SMBP have differing results. Stergiou and Bliziotis[83] found that SMBP was associated with reduced odds of developing preeclampsia in a general population (OR, 0.50; 95% CI, 0.31−0.81; n=725), whereas Yeh et al[90] did not find SMBP to be associated with improvements in clinical outcomes when used by persons diagnosed with a hypertensive disorder of pregnancy.

Although current research has not yet definitively shown that SMBP improves clinical outcomes of preeclampsia specifically, SMBP has other benefits that make it a critical component of care for this population. SMBP is safe, easy to perform, a mandatory component of obstetrical telemedicine, and associated with improved outcomes in nonpregnant persons with hypertension.[83,91] In addition, SMBP can diagnose masked hypertension and white-coat hypertension, thereby avoiding under- or overtreatment.[92] In addition, SMBP allows individuals to be actively engaged in their health care, and has thus been shown to increase self-empowerment and lower anxiety.[90] Another study concluded, "Lastly, in a study addressing racial disparities in postpartum blood pressures and the impact of social determinants of health, SMBP was shown to virtually eliminate disparities in attainment of postpartum blood pressure, improving postpartum blood pressure surveillance."[93]

Two critical components for implementing SMBP are: (1) patient education that includes instructions for obtaining an accurate blood pressure reading and recognition of signs and symptoms of preeclampsia, and (2) healthcare provider response to reports of abnormal blood pressure readings and contacts from individuals reporting symptoms. Table 2 provides an overview of the technique for obtaining an accurate blood pressure reading.[82,94−96] Multiple online resources offer written and video instructions for SMBP, which can be helpful. Key components of education include using a validated instrument,[94] correct size and placement of cuff, subject position when obtaining a reading, timing of blood pressure measurements, and when to report findings to healthcare personnel.

It is important that the cuff be validated both during pregnancy and for individuals with preeclampsia (Table 3). Machines suitable for nonpregnant persons may not be accurate given the cardiovascular changes that occur during pregnancy and preeclampsia. The Working Group also does not recommend obtaining blood pressure measurements from public settings such as drug stores. These blood pressure instruments may not be validated or calibrated, and should not be used for monitoring during pregnancy.

TABLE 2
Self-monitoring of blood pressure

Steps for blood pressure measurement	Instructions
Home blood pressure monitoring device	Choose a blood pressure cuff that is validated for use in pregnancy (Table 3). Take the blood pressure cuff to your provider's office to calibrate your cuff against their sphygmomanometer. Use a cuff that is the right size for your arm: the length of the bladder is 80% of your arm circumference and width is 40% of arm circumference.[a] Take your blood pressure at approximately the same time each day.
Before obtaining blood pressure	Do not measure blood pressure within 30 min of eating, drinking caffeinated beverages, use of tobacco, taking medication, or exercise. Have an empty bladder when measuring blood pressure. Rest for 3–5 min sitting upright in a chair with wide arms or next to a table where you can rest your arm. Wear loose clothing with a short-sleeved shirt or sleeves that can be pushed up to your shoulder easily.
Sit correctly	Rest for 3–5 min sitting upright next to a table where you can rest your arm or in a chair with wide arms. Sit with your back straight and supported (sit on a dining chair, rather than a sofa). Place your arm on the table or chair arm so your arm is approximately the same level with your heart. Place your feet flat on the floor, and your legs should not be crossed.
Placement of blood pressure cuff	Always measure blood pressure in the same arm. Make sure the bottom of the cuff is placed directly above the bend of the elbow. Check your monitor's instructions for an illustration, or have your healthcare provider show you how if needed. Do not place the cuff over clothing. Do not talk or have a conversation while measuring blood pressure.
Take multiple readings and record results	Each time you measure, take 2 or 3 readings 1 min apart and record the results. If your monitor has built-in memory to store your readings, take it with you to your appointments. Some monitors may also allow you to upload your readings to a secure website after you register your profile.

Muntner et al[96] (Appendix 1 contains detailed instructions).

[a] Appropriate size for length of arm circumference (AC) that is measured at the middle of upper arm:
- Small adult-size cuff for AC=$8\frac{1}{2}$ to $10\frac{1}{4}$ inches (22–26 cm). This cuff is $4\frac{3}{4}$ inches wide and $8\frac{2}{3}$ inches long (12×22 cm);
- Adult-size cuff for AC=$10\frac{1}{4}$ to $13\frac{1}{2}$ inches (27–34 cm). This cuff is $6\frac{1}{4}$ inches wide and $11\frac{3}{4}$ inches long (16×30 cm);
- Large adult-size cuff for AC=$13\frac{3}{4}$ to $17\frac{1}{3}$ inches (35–44 cm). This cuff is $6\frac{1}{4}$ inches wide and $14\frac{1}{4}$ inches long (16×36 cm);
- Adult thigh-size cuff for AC=$17\frac{1}{3}$ to $20\frac{1}{2}$ inches (45–52 cm). This cuff is $6\frac{1}{4}$ inches wide and $16\frac{1}{2}$ inches long (16×42 cm).

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Clinical support systems must be in place to assure that persons reporting abnormal SMBP values are appropriately evaluated. To this end, we recommend that all healthcare providers and adjunct personnel who interact with persons at risk for preeclampsia be educated about how to respond to reports of blood pressure readings.

In short, SMBP is **strongly recommended** for pregnant individuals at risk for preeclampsia. Funding for blood pressure cuffs that can be provided to individuals who cannot afford the equipment is cost-effective given that the alternative is more frequent clinician visits.

Recommendations

- Frequent antenatal visits are recommended to monitor blood pressure and detect symptoms early. These visits can be accomplished by in-person or telemedicine visits.
  - o Ungraded good practice plan
- SMBP is recommended.
  - o Moderate-quality evidence
  - o Strong recommendation
- The Working Group suggests that blood pressure be measured and reported every 2 weeks until 20 weeks' gestation, and weekly thereafter (more frequently if necessary).
  - o Ungraded good practice plan

Other home testing

The Working Group does not consider that other home monitoring strategies should be part of the usual antenatal care plan for persons at risk for preeclampsia. Specifically, home testing of urine is not recommended[8,97] because proteinuria is not required for the diagnosis of preeclampsia and does not correlate well with maternal or fetal outcomes.[8,97,98]

Recommendations

- Home urine testing for proteinuria is not recommended.
  - o Moderate-quality evidence
  - o Strong recommendation

Fetal antepartum assessment in the absence of known or suspected preeclampsia

There is currently insufficient evidence to support additional fetal antenatal assessment based solely on a person being at risk for preeclampsia. Ultrasound assessment for fetal growth evaluation and antenatal testing (eg, nonstress testing, biophysical profile) should be used for persons with standard obstetrical indications for these tests.

Nevertheless, many of the medical and obstetrical comorbidities that are associated with elevated risk of preeclampsia (eg, chronic hypertension, gestational diabetes mellitus) are indications for serial ultrasound assessment of fetal growth and for initiation of antenatal testing in the third trimester.

Recommendations

- Increased risk for preeclampsia without additional comorbidities is not an indication for additional fetal assessments such as serial ultrasounds or biophysical testing. These tests should be recommended for persons with usual indications for such testing.
  - o Ungraded good practice plan

Intrapartum care for persons at risk for preeclampsia

In the absence of diagnostic criteria for preeclampsia or other comorbidities, there is no evidence to recommend interventions in addition to the usual intrapartum management for both maternal and fetal care. This standard care includes the option for an out-of-hospital birth, attended by a licensed healthcare provider if the individual meets low-risk criteria for giving birth in that setting.[99,100]

Individuals who have a comorbidity such as chronic hypertension or diabetes mellitus should receive the standard monitoring for that comorbid condition. Individuals at risk for preeclampsia who remain normotensive throughout the pregnancy can be monitored in the intrapartum period with the same frequency and intensity used to monitor persons not at risk for preeclampsia. In line with ACOG guidance,[101] vital signs should be obtained every 4 hours unless a change in clinical status requires more frequent evaluation of vital signs. Similarly, persons at risk for preeclampsia who remain normotensive through pregnancy and who do not have fetal growth restriction or other evidence of fetal compromise can receive routine assessment of the fetal heart rate during labor, including the option for intermittent fetal heart rate monitoring in centers that have the staffing to support this option.

TABLE 3
Examples of blood pressure measuring instruments validated for pregnancy and preeclampsia[a]

Type of blood pressure device	Validated devices	
	Company	Product number
Portable devices used for self-monitoring of blood pressure	Andon	iHealth Track
	OMRON	BP760N (HEM-7320-Z) EVOLV (HEM-7600T-E) HEM-9210T M6 Comfort (HEM-7321-E or HEM-7360-E) M3 Comfort (HEM-7155-ALRU or HEM-7155-E) M4 Intelli IT (HEM-7155T-ALRU or HEM-7155T-EBK) M400 Comfort (HEM-7155-D) M400 Intelli IT (HEM-7155T-D) M500 Intelli IT (HEM-7361T-D) M7 (HEM-780-E) M7 Intelli IT (HEM-7361T-EBK or HEM-7322T-E or HEM-7361T-ALRU) MIT MIT Elite X3 Comfort (HEM-7155-EO) X4 Smart (HEM-7155-ESL) X6 Comfort (HEM-7360-EO) X7 Smart (HEM-7361T-ESL)
	Microlife	BP 3BTO-A WatchBP Home
	Withings	BPM Connect or Connect Pro
Devices used in clinic or office settings for blood pressure measurement	Microlife	3AS1-2 3BTO-A VSA (BP 3GP1-IL) WatchBP Home, or Home A, or Home A BT, or Home S
	Dinamap	ProCare 400
	Welch Allyn	Vital Signs

Adapted from Hurrell et al.[94] STRIDE BP—validated devices for office/clinic blood pressure measurement; list generated on October 4, 2022.

[a] An updated and more complete list of blood pressure cuffs validated for pregnancy and preeclampsia is maintained on the web site for STRIDE BP at: https://stridebp.org/bp-monitors/37-pdfs/734-home?format=pdf&tmpl=component&box=pregnancy.

Roberts. A care plan for individuals at risk for preeclampsia. Am J Obstet Gynecol 2023.

Recommendations

- Maternal and fetal assessment during the intrapartum period is not increased but should be guided by clinical condition and findings.
  - o Ungraded good practice plan

Postpartum care for persons at risk for preeclampsia

It remains imperative to continue to evaluate blood pressure in the postpartum period given that the prevalence of new-onset postpartum hypertension has been reported to be between 0.3% and 7.5%.[102] Furthermore, unresolved hypertension following preeclampsia persists in 39% of cases (Stage 1).[103] Currently, there is no algorithm to define or identify individuals who have an elevated risk for postpartum hypertension, but it is likely that women at risk for preeclampsia would continue having this risk in the postpartum period.

If an individual remains normotensive throughout their pregnancy and in the intrapartum period, there are no data to

suggest that routine in-hospital or birthing suite postpartum care, including frequency of vital sign assessment, should be different from the care provided to persons not at risk for preeclampsia. In accordance with ACOG guidance, standard vital sign assessments in the postpartum period include assessment of blood pressure and pulse every 15 minutes in the first 2 hours after birth, but more frequently and for longer duration if there are complications during the labor or birth.[101]

The optimal frequency for follow-up of pregnant individuals in the postpartum period after discharge from the clinical setting is unclear according to available evidence. ACOG recommends a clinical encounter (in-person or by phone) with a healthcare provider within the first 3 weeks postpartum to address acute issues, with ongoing care as needed and a comprehensive postpartum visit at no later than 12 weeks after birth.[104] In the absence of data specifically related to persons at risk for preeclampsia but who have remained normotensive, there is no evidence to suggest the need for more frequent visits postpartum. However, there is a role for SMBP in the early postpartum period. Hauspurg et al[105] demonstrated feasibility, good patient satisfaction, and high compliance and retention in a study that assessed the effects of remote home blood pressure monitoring in persons with hypertensive disorders of pregnancy. In their study, the participants measured their blood pressure once a day for 5 days during the first week postpartum. For those who remained in the study and were not using antihypertensive medication, the frequency of blood pressure checks was decreased to 3 days per week for the next 5 weeks. This study only enrolled persons with hypertensive disorders, but in the absence of data specifically on individuals who were at risk for preeclampsia, this study does demonstrate the feasibility of at-home SMBP for postpartum surveillance.[105] Thus, it seems reasonable to consider postpartum daily home SMBP for women at risk for preeclampsia. Clear instruction should be provided to call the provider if the blood pressure is found to be ≥140/90 mm Hg or at another value that the healthcare provider deems appropriate for the individual. It is reasonable to consider having these individuals perform daily blood pressure checks until their initial postpartum follow-up with a healthcare provider at least 3 weeks after birth or pregnancy cessation.

Recommendations

- Standard follow-up in the immediate postpartum period is appropriate for persons at risk for preeclampsia who remained normotensive prenatally and during the intrapartum period.
  - o Low-quality evidence
  - o Qualified recommendation
- Daily postpartum blood pressure checks with SMBP after discharge from clinical setting is advised until the individual is seen by healthcare provider (3 weeks).
  - o Ungraded good practice plan
- Notify healthcare provider of blood pressure ≥140/90 mm Hg or at another value defined by the healthcare provider.
  - o Ungraded good practice plan

Longer-term cardiovascular follow-up

The factors that place individuals at risk for preeclampsia also place them at risk for cardiovascular disease later in life. The Working Group thus recommends that these individuals be followed as recommended for persons with previous preeclampsia.[106] Because cardiovascular disease is one of the leading causes of death in the first 6 months after pregnancy,[107] these persons should have a cardiovascular assessment within the first 3 to 6 months postpartum. The evaluation may be performed by a primary care provider, obstetrician-gynecologist, maternal–fetal medicine specialist, or cardiologist. The recommendations of the American Heart Association and ACOG[78] have been merged by the Health After Preeclampsia Patient and Provider Engagement Network (HAPPEN),[77] a diverse group of clinicians, preeclampsia experts, patients, and patient advocates. Although these evaluation strategies are evolving and their effectiveness for reducing the incidence of cardiovascular disease is under study, the Working Group supports the recommendations of the HAPPEN group. These include encouragement of a healthy lifestyle, no smoking, increased physical activity, weight management, and a healthy diet. They also advocate yearly follow-up, which can be provided by the primary care provider, and includes assessment of blood pressure, weight, height (for body mass index [BMI] calculation), fasting glucose or HbA1C, and lipids.

Recommendations

- Cardiovascular evaluation should be performed in the first 3 to 6 months postpartum.
  - o Moderate-quality evidence
  - o Qualified recommendation
- Yearly follow-up to assess for cardiovascular disorders is advised. Evaluation consists of blood pressure, weight, height (for BMI calculation), fasting glucose or HbA1C, and lipids.
  - o Moderate-quality evidence
  - o Qualified recommendation
- Encourage healthy lifestyle (no smoking, increased activity, weight management, and a healthy diet).
  - o Ungraded good practice plan

Education for persons at risk for preeclampsia and providers

One of the most important parts of this care plan is education for both the individual at risk for preeclampsia, support person(s), and healthcare providers. For individuals, this education should ideally have occurred before pregnancy, but should otherwise commence in early pregnancy. Healthcare providers include obstetricians, primary care providers, midwives, nurse practitioners, physician assistants, nurses, doulas, childbirth educators, and other allied healthcare workers such as social workers, nutritionists, and scheduling staff who interact with this population in differing ways. All healthcare workers who interact with pregnant individuals should receive education about preeclampsia and be aware of appropriate care plans and responses to patient contact. This is also important for urgent care, emergency department triage staff, and

providers seeing persons who are in the first weeks postpartum.

What pregnant persons and healthcare providers need to know

Awareness of the signs and symptoms of preeclampsia

Delays in seeking care and lack of knowledge about the signs and symptoms of preeclampsia are a leading contributor to maternal mortality and morbidity from hypertensive disorders of pregnancy. For this reason, persons at risk for preeclampsia should be informed of what preeclampsia and HELLP (hemolysis, elevated liver enzymes, low platelet count) syndrome are (Appendix 1) and educated early in their pregnancy about important but sometimes subtle symptoms and signs. Although the obstetrical care provider is usually an individual's primary source of information, communication and shared decision-making can be supported by additional patient education materials such as those found on the Preeclampsia Foundation website. Table 4 summarizes the content of education that should be shared with persons at risk for preeclampsia. Essential components of this education include a review of the risk factors, signs and symptoms of preeclampsia and HELLP syndrome, and education about the importance of reporting signs and symptoms to a healthcare provider. It is also essential that healthcare providers recognize the importance of signs and symptoms reported to them and practice active and respectful listening to their patients.

The importance of daily use of low-dose aspirin during pregnancy

Because low-dose aspirin is available over the counter, the recommendation to initiate low-dose aspirin therapy does not necessitate a prescription, and as a result, may create confusion around the dosage and timing. In addition, the lack of a formal prescription may minimize the apparent importance of the treatment. It is important that individuals are provided sufficient information and guidance on taking low-dose aspirin.

TABLE 4
Educational content for persons at risk for preeclampsia

Topic	Content
Prenatal and early postpartum signs and symptoms	Headache that will not go away Visual disturbances (seeing spots or auras) Epigastric pain (upper right quadrant) Nausea/vomiting (second half of pregnancy) Sudden weight gain (≥5 lb per wk) Breathlessness (difficulty breathing) Swelling of the face or hands "Just not feeling right" or unexplained "anxiety"
Antenatal care	Home self-monitoring of BP Take aspirin daily
Postpartum care	Preeclampsia can occur during the first wk postpartum and is most likely within the first wk. SMBP should be continued for the first wk postpartum until seen by a healthcare provider. Report any BP ≥140/90 mm Hg to a healthcare provider.
Lifetime care	Cardiovascular evaluation should be performed in the first 3–6 mo postpartum. Yearly follow-up to assess for cardiovascular disorders is recommended. Evaluation consists of BP, weight, height (for BMI calculation), fasting glucose or HbA1C, and lipids. Encouragement of healthy lifestyle (no smoking, increased activity, weight management, and a healthy diet).

BMI, body mass index; *BP*, blood pressure; *HbA1C*, hemoglobin A1C; *SMBP*, self-monitoring of blood pressure.

Roberts. A care plan for individuals at risk for preeclampsia. Am J Obstet Gynecol 2023.

Addressing preexisting conditions that increase the risk for preeclampsia

Identification and addressing the spectrum of risk factors, including modifiable and nonmodifiable conditions, can help attenuate risk for developing preeclampsia.

Postpartum risk of preeclampsia

Pregnant individuals should be informed that preeclampsia can also first occur in the postpartum period. Given that increased risk of antepartum preeclampsia has been identified in this cohort, postpartum risk also seems more likely, further underscoring the importance of education, self-advocacy, access to SMBP, and clinical protocols for healthcare response to patient contact when using SMBP.

Lifetime risk of cardiovascular disease after preeclampsia

Persons at risk for preeclampsia are also at risk for cardiovascular disease in later life. Using electronic records to record preeclampsia on a lifelong problem list may help prompt primary care providers to encourage yearly blood pressure and cardiovascular risk evaluation of persons affected by hypertensive disorders in pregnancy.

There is a growing body of literature demonstrating that individuals at risk are not being screened or identified as having a higher risk of cardiovascular disease in their primary care setting.[108] Providing patient education materials[109] and tools such as the Beyond Pregnancy tool,[76] endorsed by the International Society for the Study of Hypertension in Pregnancy and the Preeclampsia Foundation, may help engage the individual in understanding and acting on their long-term risks, as well as initiating conversations with their healthcare providers.

Specific guidance for how individuals can best communicate concerns with providers

Similar to the use of TeamSTEPPS[110] for communication among healthcare providers working within established hierarchies, persons at risk for preeclampsia can be encouraged to use **CUS** words to

advocate for themselves: "I am Concerned," "I am Uncomfortable," "I do not feel Safe."

Another tool to facilitate patient communication with providers is to encourage the individual to use the mnemonic "BRAIN" when evaluating new health information and recommendations: (1) Benefits—"What are the benefits to this intervention?"; (2) Risks—"What are the risks?"; (3) Alternatives—"What are the alternatives?"; (4) Intuition—"What does my intuition tell me?"; and (5) Nothing—"What if I do nothing?"

Guidance for healthcare provider communication

Healthcare providers have many opportunities to share information about the signs and symptoms of preeclampsia in a variety of settings and at various touchpoints that may occur before pregnancy and during pregnancy and the postpartum period. Socioeconomic and SDOH inequities, including but not limited to access to healthcare and education, race and ethnicity, and neighborhood and built environment, are associated with increased risk of preeclampsia and eclampsia, which enforces the need to educate at every opportunity.[111] The Agency for Healthcare Research and Quality and others have identified 7 key strategies for effective patient education[112,113]: (1) use nonmedical plain language, 2) organize information into 2 or 3 components ("chunk and check"), (3) use "teach back" to confirm understanding with open-ended questions, (4) do not assume an individual's literacy level or understanding by appearance or educational achievement level, (5) use proven tools that support consistent message, (6) messages must be repeated to be remembered, and (7) use multiple teaching strategies to accommodate different learning styles.

Recommendations

- All individuals at risk for preeclampsia and all healthcare providers involved in the care of these individuals must be aware of the signs and symptoms of preeclampsia, the importance of low-dose aspirin to reduce the rate of preeclampsia, preexisting conditions that are risks factors for preeclampsia, the risk of preeclampsia occurring postpartum, and the lifetime risk for cardiovascular disease in those who have had or are at risk for preeclampsia.
  - o Ungraded good practice plan
- Pregnant persons should be instructed in signs and symptoms that should be communicated to healthcare providers.
  - o Ungraded good practice plan
- Pregnant persons should be instructed in communication strategies that promote communication with healthcare providers such as CUS and BRAIN.
  - o Ungraded good practice plan
- Healthcare providers should use communication strategies that facilitate communication such as those developed by the Agency for Healthcare Research and Quality.
  - o Ungraded good practice plan

Cost-benefit considerations

When developing a care plan, it is important to consider whether the recommendations are financially feasible. Most of the recommendations of the Working Group in this care plan introduce minimal cost. In fact, most are already standard of care. An important exception to the standard-of-care guidelines, is the availability of home SMBP. Although covered by most public and private payers, this is not universal. The use of this approach is widely supported.[114,115] Furthermore, it is mandatory for the increased frequency of blood pressure measurements recommended by the Working Group, and clearly involves less financial burden compared with in-person clinical visits. SMBP also has the aforementioned additional advantages such as increased involvement and engagement in care. The Working Group strongly advocates that payers of healthcare services cover the modest expense of home blood pressure determination including equipment and training. Further, the Working Group asserts that, given the likely improvements in outcomes, the cost will have a positive return on investment in many cases.[116] At-home SMBP will likely prevent adverse outcomes, costly adverse events, and perhaps readmissions for complications. These benefits will also likely extend beyond perinatal outcomes to include patient satisfaction, particularly if SMBP is able to replace frequent in-person office visits for high-risk individuals. The laboratory testing and follow-up visits are also a vital part of effective lifetime women's care, and are recommended by ACOG[104] and supported by the Working Group as a worthwhile payer expense.[116]

Limitations and future directions

It is important to provide guidance for the perinatal care of persons at risk of developing preeclampsia. This care plan is based on a review of current research evidence, expertise, and personal experience. The care plan was developed by a group of experts with diverse expertise in a variety of disciplines. We included stakeholders from several relevant organizations who have supported these recommendations. There are limitations to this care plan, which the Working Group hopes will be addressed by further studies. Firstly, few recommendations are supported by strong evidence. We have addressed this by GRADE staging of recommendations, which clearly indicates that truly "strong recommendations" almost invariably demand strong or moderate evidence. However, the recommendations of the Working Group are the agreed opinions of the group, often supported by indirect data. These recommendations were guided by considerations of safety, physiological rationale, and cost-effectiveness. Secondly, the addition of new predictive tests and new treatments in the future may require reassessing the risk group and recommendations. This care plan identifies individuals at increased risk sufficient to meet the clinical, biochemical, and biophysical criteria currently judged sufficient to justify low-dose aspirin therapy. This identifies a high-risk group for treatment with a very safe drug. We hope that in the future, the limitations we address can be targets of directed research.

Education of both care providers and individuals at risk is perhaps the most important and challenging part of this care plan. A major difficulty is informing healthcare providers, who are not primarily involved in the care of pregnant persons, of the special considerations for specific signs and symptoms of preeclampsia during pregnancy and the early postpartum period. We hope that our acknowledgment of this issue will stimulate addition of this information to the training of such healthcare providers and allied healthcare personnel who interact with pregnant persons. Obviously, education of the individual and their investment in the care plan is crucial to its success. The involvement of patient advocacy agencies is vital in this context.

Conclusion

The Care Plan for Individuals at Risk for Preeclampsia provides guidelines that are safe, cost-effective, and minimally intrusive. We recommend that the care plan be revised as necessary as more and better information becomes available. In the future, use of this care plan will be greatly increased by its incorporation into societal guidelines/recommendations and electronic medical records' care pathways. ■

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APPENDIX A
At Risk

APPENDIX A:

Guidelines for Persons At-Risk for *Preeclampsia*

If you are at risk for getting preeclampsia, this handout can help you learn what you and your health care provider can do to keep you healthy. The back page of this handout has instructions for how to take your blood pressure and additional resources to learn about preeclampsia.

To discuss with my healthcare provider

- **Ask your healthcare provider:**
  - If you can take low-dose aspirin and when to start during this pregnancy
  - If exercise is safe for you during this pregnancy
  - To provide counseling (ideally by a registered dietician)
  - If you are concerned you are sleeping too little or too much
  - If your blood pressure is too high, how can it be better controlled with medications that are safe to take during pregnancy
  - Ask what blood pressure value you should report to your health care provider immediately
  - Discuss local resources that can help you address social challenges that may affect your health care (for example, reliable transportation)

- **Use your "BRAIN" when evaluating new health information and recommendations:**
  - ***B***enefits – What are the benefits to this intervention?
  - ***R***isks – What are the risks?
  - ***A***lternatives – What are the alternatives?
  - ***I***ntuition – What does my intuition tell me?
  - ***N***othing – What if I do nothing?

Use "CUS" words to speak up for yourself:

- I am ***C***oncerned
- I am ***U***ncomfortable
- I don't feel I am ***S***afe

To do on my own

- **Check for signs of preeclampsia and know when and how to report them to your provider:**
  - Headache that won't go away
  - Seeing spots or auras
  - Pain in your upper right abdomen
  - Nausea/vomiting (2nd half of pregnancy)
  - Fast weight gain (≥ 5 pounds in a week)
  - Hard time breathing
  - Swelling of your face or hands
  - "Just not feeling right"
  - Unexplained "anxiety"

- **Take low-dose aspirin** every day (81 mg) starting between 12-16 weeks of pregnancy and continued daily until you give birth

- **Take your blood pressure at home:** Use a validated blood pressure cuff to measure your blood pressure one time every 2 weeks until 20 weeks of your pregnancy, then one time every week. Record the results to share with your provider. Immediately report any result of 140/90 mmHg or higher or other value provided by your care provider

- **Eat a healthy diet:** Obtain advice (ideally from a registered dietitian) to learn how to eat to help prevent preeclampsia (including eating a Mediterranean-style diet) and follow the Dietary Guidelines for pregnancy. Have calcium in your diet assessed

- **Take Vitamin D** (600 – 2000) IU (including amount in your prenatal vitamins).

- If diet assessment determines you have a low calcium intake (< 800 mg./day) consult with your diet counselor to increase calcium intake to 1000 mg./day. If this is not possible, take a calcium supplement of 500 mg/day.

- **Exercise:** 3-4 sessions between 30-60 minutes each week of moderate aerobic and strength-training exercise if your doctor or midwife tells you it's safe

- **Sleep:** Sleep 7 or more hours per night

(continued)

APPENDIX A
(*Continued*)

Instructions for *Monitoring Blood Pressure* at Home

Choose an at-home blood pressure monitoring device

- **Choose a blood pressure cuff** that is approved for use in pregnancy (**see list below*)
- **Make sure that the cuff fits your arm size correctly**
- **Tip:** Have your healthcare provider check your BP cuff to ensure it is sized correctly and takes accurate readings

Before taking your blood pressure...

- **Make sure you:**
  - don't eat, have caffeine, use tobacco, take medicines, or exercise **within 30 minutes** of measuring your blood pressure
  - have an **empty bladder**
  - **wear loose clothing** with a sleeve **that can be pushed up to your shoulder easily**

Sit correctly

- **Rest** for 3-5 minutes while:
  - **sitting with your back straight** and supported (on a dining chair, rather than a sofa)
  - your **arms are open** and not crossed
  - your **feet should be flat on the floor** and your legs should not be crossed

Position your arm and cuff

- **Arm: Your arm should be supported on a flat surface (like a table) with the upper arm at heart level. Always use the same arm.**
- **Cuff:**
  - Place the bottom of the cuff right above the bend of the elbow. Check your monitor's instructions for a picture or ask your healthcare provider to show you.
  - Do not place the cuff over clothing.

Take 2 or 3 measurements and write down results

- **Do not talk** when you are measuring your blood pressure
- Take your blood pressure at **about the same time each day**
- Each time you measure, **take 2 to 3 readings** 1 minute apart and write the numbers down
- If your monitor has built-in memory to store your readings, **take it with you to your appointments**

**Omron M7, MIT, MIT Elite, HEM-9210T, BP760N; Mircolife WatchBP Home A, BP 3BTO-A, BP 3AS1-2, Watch BP Home A BT, WatchBP Home S, CRADLE VSA; Andon iHealth Track. A continuously updated list of validated blood pressure cuffs can be found at the website for STRIDE BP.*

Additional Resources:

Overview of Preeclampsia, Background, Indication, and Dosing of Aspirin Use During Pregnancy, Monitoring Your Blood Pressure at Home, Blood Pressure Tracking Log, Making Sense of Preeclampsia Tests, Beyond Pregnancy: Make a Health Plan that Works for You

APPENDIX B
Provider

APPENDIX B

Health Care Provider Guidelines for Care of Individuals at Risk for *Preeclampsia*

The Care Plan for ***Individuals at Risk for Preeclampsia*** is for pregnant persons considered at risk for preeclampsia at least sufficient to recommend prophylactic aspirin therapy during pregnancy. The following checklist summarizes the Care Plan's recommendations for health care providers.

Antenatal Care

- ❑ Identify individual as at-risk for preeclampsia
- ❑ Evaluate individuals with prior preeclampsia for post-traumatic stress disorder and provide resources and/or refer for counseling if necessary
- ❑ Customize care plan recommendations relative to social determinants of health and individual needs
- ❑ Manage pre-existing disorder(s) that increase the risk for preeclampsia
- ❑ COVID-19 vaccination or booster is recommended for individuals who are not fully vaccinated
- ❑ Recommend self-monitoring of blood pressure at home every 2 weeks until 20 weeks, then weekly until birth or more frequently if indicated
- ❑ Provide self-monitoring blood pressure education, cuff size assessment, and access to appropriately-sized, validated cuff

Pharmacologic recommendations

- ❑ Initiate low-dose aspirin therapy (81 mg/day) between 12 and 28 weeks' gestation (optimally before 16 weeks weeks. There is reasonable data to support that aspirin doses >100mg may be acceptable alternatives to 81mg.)
- ❑ Continue low-dose aspirin therapy until birth or pregnancy cessation
- ❑ Provide education and guidance that will support adherence to low-dose aspirin therapy
- ❑ For persons with chronic hypertension: administer antihypertensive therapy for BP ≥ 140/90 mmHg

Behavioral recommendations

- ❑ **Diet:** Provide counseling and education tailored to individual and caloric needs (registered dietician or nutritionist if available) including an estimate of calcium intake
- ❑ **Diet:** Refer to WIC (when applicable)
- ❑ **Diet:** Recommend Mediterranean-style diet
- ❑ **Diet:** Recommend 600-2000IU/day vitamin D (including Vitamin D in prenatal vitamins)
- ❑ **Diet:** Recommend diet counseling for calcium deficient individuals (person who consumes <800mg./day) to increase calcium intake to 1000 mg./day. If this is not possible, supplement with 500mg./day.
- ❑ **Exercise:** Assess contraindications for exercise
- ❑ **Exercise:** When safe, recommend 3-4 sessions per week, 30-60 minutes each of moderate aerobic and strength training exercise
- ❑ **Sleep:** Recommend at least 7 hours of sleep
- ❑ **Sleep:** For persons with obstructive sleep apnea, continue treatment
- ❑ **Discontinue smoking and support smoking cessation**

(continued)

APPENDIX B
(*Continued*)

Antenatal Care (continued)

Screening

- ❑ Assess for pre-existing conditions
- ❑ Order baseline assessment of renal and hepatic function (urinary protein, creatinine, uric acid, AST, ALT) and platelet count
- ❑ Screen individuals with clinical indications for cardiovascular disease

Education

- ❑ Educate individuals about the signs and symptoms of preeclampsia and HELLP Syndrome
- ❑ Educate individuals about the dosage and frequency of low-dose aspirin therapy; offer strategies that encourage adherence
- ❑ Educate individuals about home blood pressure values requiring immediate attention
- ❑ Educate individuals with chronic hypertension about the benefits of tight control of blood pressure
- ❑ Educate individuals about postpartum risk of preeclampsia and future risk for cardiovascular disease

Intrapartum Care

- ❑ Maternal and fetal assessment during the intrapartum period is not increased but should be guided by clinical condition and findings

Postpartum Care

- ❑ Recommend daily assessment and reporting of blood pressure by self-monitoring blood pressure for 3 weeks postpartum, with guidance about blood pressure values that require health care provider notification
- ❑ Refer for cardiovascular evaluation in the first 3-6 months postpartum
- ❑ Recommend yearly follow-up to assess for cardiovascular disorders including evaluation of blood pressure, weight, height (for BMI calculation), fasting glucose, or HbA1C, and lipids
- ❑ Encourage a healthy lifestyle (no smoking, increased activity, weight management and a healthy diet)