PREECLAMPSIA AND INCREASED RISK OF CARDIOVASCULAR DISEASE:

A PRACTICE GUIDE FOR PROVIDERS

by

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ABSTRACT

Cardiovascular disease (CVD) is the leading cause of death among women, however this disease is preventable and treatable. Extant evidence has established that women with a history of preeclampsia are at an increased risk for developing CVD later in life, and yet preeclampsia is under-recognized as a risk factor for CVD. This is due to a knowledge gap amongst healthcare providers, and subsequently providers are not adequately educating their patients with a history of preeclampsia about their CVD risk and reducing this risk. There are no specific guidelines regarding long-term care or screening for CVD in women with a history of preeclampsia, so a guideline needs to be developed to assist providers in caring for this high-risk population. The first aim of this project is to develop a guideline for providers to use in practice while caring for women with a history of preeclampsia, and the second aim is to enhance providers' knowledge of the link between a history of preeclampsia and increased CVD risk later in life so they can provide improved, evidence-based care. This project used a pre-survey, educational content with dissemination of two practice guidelines in different formats and a patient educational handout, and post-survey approach. The project targeted healthcare providers who care for women with a history of preeclampsia at a small rural hospital. Providers who participated in this project did have knowledge of the link between preeclampsia and increased CVD later in life, but were not applying this knowledge to their practice, as they neither took a thorough pregnancy history from their patients in regards to preeclampsia nor provided counseling to women with a history of preeclampsia about their increased risk of CVD. Providers who reviewed the guideline presented in this project found it helpful and had or planned to implement a practice change because of the guideline. The practice guideline developed was an effective tool to help the providers in this project implement evidence-based care into their practice, and the patient handout was an additional resource they could use to educate their patients with a history of preeclampsia.

CHAPTER ONE

INTRODUCTION

Cardiovascular disease (CVD) is the leading cause of death among women in the United States (U.S.) and globally, yet this disease is preventable and treatable (Ahmed et al., 2014; Graves et al., 2019; Lee & Tubby, 2015; Roth et al., 2019). CVD includes coronary artery disease (CAD), stroke, hypertension, peripheral vascular disease, heart failure, and myocardial infarction (MI) and is the number one cause of death in women, making up over 50% of all deaths (Ahmed et al., 2014; Davis & Sanders, 2019; Leslie & Briggs, 2016). In the U.S., deaths from CVD exceed deaths caused by cancer, Alzheimer's, lower respiratory tract disease, and accidents combined (Ahmed et al., 2014; Davis & Sanders, 2019; Leslie & Briggs, 2016).

Additionally, one in five women in the U.S. will have a stroke at some point during their life with primary risk factors being hypertension, atrial fibrillation, diabetes, obesity, smoking, and pregnancy with accompanying gestational diabetes or preeclampsia (Ahmed et al., 2014; Bushnell & McCullough, 2014; Davis & Sanders, 2019). In 1927, a link was identified between preeclampsia during pregnancy and an increased risk of hypertension later in life (Garovic & August, 2013). Extant evidence has now established that women with a history of preeclampsia are also at an increased risk for developing CVD later in life (Ahmed et al., 2014; Amaral et al., 2017; Ananth et al., 2013; Brown et al., 2013; Davis & Sanders, 2019; Gastrich et al., 2019; Grandi et al., 2019; Graves et al., 2019; Leslie & Briggs, 2016; Lui, Jeyaram, & Henry, 2019; Mongraw-Chaffin et al., 2010; Schmidt et al., 2017; Young et al., 2012).

Background

Eclampsia, or seizure during pregnancy, was first introduced to the medical lexicon in 1619 by Varandaeus (Santillan, 2013). In the late 1600 and 1700s, Mauriceau described eclampsia as convulsions due to decreased lochial flow or intrauterine death of the fetus (Santillan, 2013). The treatment at this time was a fluid correction via phlebotomy, and this continued into the 1800s (Santillan, 2013). In 1797, Demanet discovered the connection between edema and eclampsia, and in 1843, Lever noted the link between proteinuria and eclampsia (Santillan, 2013).

By the early 1840s, R Johns also added late preeclamptic symptoms, including headache, blurry vision, abdominal pain, and edema (Santillan, 2013). Then in 1849, Dr. Williams Tyler Smith defined toxemia, which is now known as preeclampsia, as neurologic stimuli, bleeding, environmental changes, irritation of the gastrointestinal or genitourinary tracts, or toxic substances in the body that irritate the central nervous system and cause seizures (Santillan, 2013). Finally in the 1960s, multiple researchers discovered that placental trophoblast cells were not able to invade spiral arteries and use oxygen, resulting in hypoxia, decreased blood flow to the placenta, and preeclampsia (Santillan, 2013).

The American College of Obstetricians and Gynecologists (ACOG) (2020) now defines preeclampsia as a serious blood pressure disorder in pregnant women that typically presents with hypertension and proteinuria after 20 weeks of gestation. Rates of preeclampsia are on the rise in the United States (U.S.); the rate of preeclampsia increased by 25% from 1987 to 2004 (ACOG, 2019; Ananth, et al., 2013). This rise can be attributed to population increases in the U.S., rising

obesity rates, and changes in diagnostic criteria resulting in earlier identification of preeclampsia symptoms (Ananth, Keyes, & Wapner, 2013).

According to the Montana Department of Health and Human Services (DPHHS) office of epidemiology (2020), 3,942 women in Montana had preeclampsia from 2015–2019. This accounted for about 7% of the 55,305 births in Montana from 2015–2019 (DPHHS, 2020), which is consistent with worldwide statistics. Of the mothers with preeclampsia, 54% were under 30 years of age, and 85% of the women with preeclampsia were Caucasian. See Appendix G for more data. Overall, the rate of preeclampsia in Montana is consistent with national and global rates.

In the U.S., women who delivered in 2003 had a 6.7-fold increased risk of severe preeclampsia when compared to women who delivered in 1980 (ACOG, 2019; Ananth, et al., 2013). In 2014, the American Heart Association (AHA) and the American Stroke Association (ASA) suggested preeclampsia be considered a risk factor for stroke and listed this in their prevention guidelines (Davis & Sanders, 2019, p. 51). In response to rising rates of hypertension and stroke in women, the AHA and ASA released the first female-specific stroke prevention guideline (Bushnell & McCullough, 2014). The AHA also stated it is important to obtain an obstetrical history from women when assessing their CVD risk (Lee & Tubby, 2015; Leslie & Briggs, 2016).

Problem Statement

CVD is the primary cause of death in women, and yet preeclampsia is under-recognized as a risk factor for CVD (Ahmed et al., 2014). As preeclampsia rates are increasing in the U.S., this means CVD disease will become an even larger problem among women (Ananth et al.,

2013; Gastrich et al., 2019; Honigberg et al., 2019). Honigberg et al. (2019) estimate that more than 10% of women will experience at least one pregnancy complicated by hypertension. Nonetheless, healthcare providers are not adequately educating their patients with a history of preeclampsia about CVD risk and screening is also inadequate (Bushnell et al., 2014; Davis & Sanders, 2019; Lee & Tubby, 2015; Roth et al., 2019; Young et al., 2012).

This inadequate patient education stems from a knowledge gap providers have in the link between preeclampsia and increased CVD risk later in life, showing there is also a need for better provider education (Bushnell et al., 2014; Davis & Sanders, 2019; Lee & Tubby, 2015; Roth et al., 2019; Young et al., 2012). As there are no specific guidelines regarding when women should be screened for CVD following a pregnancy complicated by preeclampsia, a guideline needs to be developed to assist providers in caring for this high-risk patient population (Davis & Sanders, 2019; Gastrich et al., 2019; Lee & Tubby, 2015; Schmidt et al., 2017; Young et al., 2012).

Additionally, the DNP student has a personal history of preeclampsia with her first pregnancy and has yet to receive information from her providers on the link between preeclampsia and increased CVD later in life. This omission in care is a driving force in the identification of the scholarly project topic presented here. The DNP student feels this is critical information for at-risk women to know, since there are modifiable risk factors that can mitigate or reduce a woman's risk of CVD. The DNP student feels passionate about educating providers on this topic and encouraging them to educate their patients accordingly.

Project Aims

This project has two aims; the first is to develop a guideline for providers to use in practice while caring for women with a history of preeclampsia. Currently, there is no known guideline to address this issue. The second aim of this project is to enhance providers' knowledge of the link between preeclampsia and increased CVD later in life, ultimately leading to an improvement in patient care.

CHAPTER TWO

LITERATURE REVIEW

Literature Selection

The databases searched to find literature related to this topic included Web of Science, CINAHL, PubMed, and Google Scholar. Search terms included preeclampsia, history of preeclampsia, pregnancy-induced hypertension, PIH, hypertensive disorders of pregnancy, cardiovascular disease, cardiovascular disease risk, heart disease, pregnancy and heart disease, stroke, hypertension, high blood pressure, evidence-based practice, practice change, implementing research, evidence-based practice change, and guideline(s). Criteria included articles published in peer-reviewed journals within the last 10 years, with a priority given to articles published in the last 5 years. Many important articles on this topic were published 5-10 years ago, so the timeframe was expanded to include articles within the last 10 years so that these important timeless pieces could be included. Additionally, articles from outside the U.S. were included if published in peer reviewed journals.

One article fell outside of the timeframe guidelines, and this was the article used for the conceptual framework (Model for Evidence-Based Practice Change). The article was published in 1999 by Rosswurm and Larrabee, but the model they propose is an excellent fit for this project so the age of the article was irrelevant. Literature from ACOG and AHA was also included, as these organizations are the experts on preeclampsia and CVD and offer treatment guidelines for these health problems. Articles from these organizations were found in the initial literature

search, and their respective websites were then searched for more literature and information. Overall, 41 articles were reviewed for this project.

Evidence of Literature

Background

Preeclampsia is a multisystem hypertensive disorder mediated by the placenta, and affects 2-8% of pregnancies worldwide (ACOG, 2019; Ahmed et al., 2014; Amaral et al., 2017; Ananth et al., 2013; Brown et al., 2013; Davis & Sanders, 2019; Lee & Tubby, 2015; Leon et al., 2019; Lykke et al., 2009; Schmidt et al., 2017; Wu et al., 2016; Young et al., 2012). According to ACOG (2020, 2019), preeclampsia is defined as a serious blood pressure disorder in pregnant women that can affect all of the organs in the body, with the main features being hypertension and proteinuria that presents after 20 weeks of gestation (Ahemd et al., 2014; Amaral et al., 2017; Brown et al., 2013; Bushnell & McCullough, 2014; Davis & Sanders, 2019; Gastrich et al., 2019; Lee & Tubby, 2015; Leon et al., 2019). Preeclampsia can also occur in the postpartum period after the baby has been delivered (ACOG, 2020). Hypertension is defined as a systolic blood pressure (BP) of 140mm Hg or more or diastolic BP greater of 90mm Hg or more on two separate occasions at least four hours apart, or systolic BP of 160mm Hg or more or diastolic BP of 100mm Hg or more on one occasion (ACOG, 2019; Ahmed et al., 2014; Gastrich et al., 2019). Proteinuria is defined as 300mg of protein or more in the urine in 24 hours (ACOG, 2019; Ahemd et al., 2014; Gastrich et al., 2019).

Pathophysiology

While the exact pathophysiology of preeclampsia is unknown, studies have shown it is caused by the maternal spinal arteries of the placenta failing to remodel, and this causes hypoperfusion to the placenta (Ahmed et al., 2014; Ananth et al., 2013; Davis & Sanders, 2019; Wu et al., 2016). Hypoperfusion causes ischemia, and subsequently inflammatory cytokines and antiangiogenic proteins are released (Ahmed et al., 2024; Amaral et al., 2017). Systemic endothelial dysfunction follows, causing an imbalance of endothelin and thromboxane secretion (Ahmed et al., 2014; Amaral et al., 2017; Davis & Sanders, 2019). Vasoconstriction ensues and results in an increased lumen pressure and ultimately systemic hypertension (Ahmed et al., 2014; Amaral et al. 2017). Unfortunately, the only way to resolve preeclampsia is for the placenta to be delivered (Amaral et al., 2017).

Symptoms

The hallmark symptoms of preeclampsia are hypertension, proteinuria, edema of the face or hands, and headache (ACOG, 2020; Ahmed et al., 2014; Bushnell & McCullough, 2014). Patients may also experience vision changes, pain in their right upper abdomen or right shoulder, nausea and vomiting after 20 weeks, sudden weight gain, and difficulty breathing (ACOG, 2020). Patients must have hypertension and proteinuria per the ACOG (2019) definition to be diagnosed with preeclampsia. If hypertension is present without proteinuria, patients can also be diagnosed with preeclampsia if they have new thrombocytopenia (platelet count less than 100,000), renal insufficiency (serum creatinine concentration greater than 1.1 mg/dL or doubling of serum creatinine), impaired liver function (elevated AST and ALT twice the normal level),

pulmonary edema, or a new headache that is unresponsive to medications and cannot be accounted for by another diagnosis (ACOG, 2013; ACOG, 2019).

Preeclampsia results in reduced perfusion that can affect many systems in the body (Ahmed et al., 2014; Bushnell & McCullough, 2014). Patients can have renal dysfunction, which is defined as proteinuria greater than 300mg in 24 hours, creatinine greater than 90 Umol/l, or glomeruloendotheliosis (ACOG, 2019; Ahmed et al., 2014). Patients may also present with hematological dysfunction, including hemolysis, disseminated intravascular coagulation, or thrombocytopenia, hepatic dysfunction characterized by raised transaminases with or without right upper quadrant pain, or neurological dysfunction, including hyperreflexia, visual disturbances, or headache (Ahmed et al., 2014). Thus, many organ systems can be affected by preeclampsia.

Complications

Untreated preeclampsia can lead to severe, life-threatening complications, including Eclampsia (seizure), pulmonary edema, hemorrhagic stroke, renal failure, and death to the mother and/or fetus (Ahmed et al., 2014; Amaral et al., 2017; Gastrich et al., 2019). Eclampsia is a seizure occurring during or after pregnancy as a result of hypertension, and eclampsia can cause death to the mother and/or fetus (ACOG, 2020). Patients with severe preeclampsia can also develop HELLP syndrome, which involves hemolysis, or damage to red blood cells; elevated liver enzymes; and low platelet count (ACOG, 2020). This results in impaired blood clotting, bleeding within the liver, and can lead to maternal death (ACOG, 2020). If not treated, preeclampsia can result in very negative outcomes for both the mother and fetus.

Preeclampsia can also pose risks to the fetus due to the extra stress hypertension puts on the heart and kidneys (ACOG, 2020). These include fetal growth restriction, preterm delivery, placental abruption, and cesarean birth (ACOG, 2020). Placental abruption is a condition where the placenta prematurely detaches from the uterine wall, and this is a medical emergency that requires immediate treatment (ACOG, 2020). Babies who are born prematurely can have serious, lifelong complications and are at increased risk for disease morbidity and mortality (ACOG, 2020).

Classification

Preeclampsia can be classified as mild or severe. Severe preeclampsia may also be referred to as preeclampsia with severe features (ACOG, 2020). A patient with mild preeclampsia will present with symptoms of hypertension and proteinuria, whereas a patient with severe preeclampsia must present with one of the following severe features: systolic BP $\geq$160mm Hg or diastolic BP $\geq$110mm Hg present at least two times in a 6-hour window, proteinuria $\geq$5000mg in 24 hours, oliguria less than 500mL in 24 hours, cerebral or visual disturbances, pulmonary edema, epigastric or right upper quadrant pain, impaired liver function, thrombocytopenia (platelet count less than 100,000/microliter), or intrauterine growth restriction (ACOG, 2013; Ananth et al., 2013).

Preeclampsia Risk Factors

There are many risk factors for preeclampsia, and some of them are modifiable while others are not. Women who are at high risk for preeclampsia include those with a history of preeclampsia in a previous pregnancy, chronic hypertension prior to pregnancy, kidney disease, diabetes mellitus, autoimmune conditions like lupus, or women who are pregnant with more than

one fetus (ACOG, 2020; Davis & Sanders, 2019; Gastrich et al., 2019). Risk factors for women at moderate risk include being pregnant for the first time, obesity or body mass index greater than 30, family history of a mother or sister having preeclampsia, being older than 35, and being African American (ACOG, 2020; Davis & Sanders, 2019; Gastrich et al., 2019; Wu et al., 2016).

Cardiovascular Disease Risk

Ahmed et al. (2014) reports that women with a history of preeclampsia have a 12-fold overall increased risk of CVD when compared to women without a history of preeclampsia. Preeclampsia and CVD share many pathophysiological features (Cirillo & Cohn, 2015; Lee & Tubby, 2015). These include atherosclerosis with endothelial dysfunction, activation of the coagulation cascade, heightened inflammatory response, insulin resistance, an increase in low density lipids, a decrease in high density lipids, and an increase in triglyceride levels (Lee & Tubby, 2015; Leslie & Briggs, 2016; Lykke et al., 2009; Wu et al., 2019). It is unknown if these shared risk factors are the reason women with preeclampsia have a higher risk of CVD, or if the post-pregnancy body is unable to fully recover from the vascular, endothelial, and metabolic damage caused by preeclampsia and results in CVD later in life (ACOG, 2019; Wu et al., 2016; Wu et al., 2019). According to Wu et al. (2016), there is growing evidence that the vascular, endothelial, and metabolic damage caused by preeclampsia manifests later in life with cardiovascular events.

Additionally, women with early-onset preeclampsia requiring preterm delivery are at an even higher risk for CVD (Gastrich et al., 2019; Langlois et al., 2019; Leon et al., 2019; Leslie & Briggs, 2016; Lykke et al., 2009). A study done by Langlois et al. (2019) found that women with a history of preeclampsia requiring preterm delivery had a higher risk of developing CVD later

in life (21.5 per 10,000 person years) than those without preterm delivery (16.0 per 10,000 person years). ACOG (2019) estimated women with a history of recurrent or early-onset preeclampsia or preeclampsia requiring preterm delivery have 4–8 times the risk of developing CVD later in life than those women with normal pregnancies.

When compared, women with a history of preeclampsia have a four-fold increased risk of hypertension later in life than women who were normotensive throughout pregnancy (Bushnell & McCullough, 2014; Davis & Sanders, 2019; Graves et al., 2019; Lykke et al., 2009). Ahmed et al. (2014) found that 52% of women with a history of preeclampsia did have hypertension up to 14 years after delivery. The risk of chronic hypertension was also greater in women with a history of severe preeclampsia versus mild preeclampsia (Ahmed et al., 2014).

Women with a history of preeclampsia also have a two-fold increased risk of stroke when compared to women who were normotensive during their pregnancy (Brown et al., 2018; Bushnell & McCullough, 2014; Bushnell et al., 2014; Davis & Sanders, 2019; Gastrich et al., 2019; Honigberg et al., 2019; Leon et al., 2019; Liu et al., 2019; Wu et al., 2016). Wu et al. (2019) describe a meta-analysis of over 6.4 million women that showed preeclampsia is associated with a two-fold increased risk of stroke, CAD, and death due to CAD or CVD, as well as a four-fold increased risk of heart failure. Because of these increased risks, Bushnell and McCullough (2014) state that preeclampsia needs to be documented in the patient medical history and should be identified as a risk factor for CVD, including hypertension and stroke. The goal of documentation is to help providers recognize these patients and identify them as patients who could benefit from lifestyle changes and early assessment of CVD risk factors (Bushnell & McCullough, 2014; Grandi et al., 2019; Lykke et al., 2009).

Risk Identification

Risk stratification allows for early detection of women at high risk for CVD and enables targeted care to be optimized towards prevention (Wu et al., 2016). Unfortunately, there are currently no CVD risk calculators that specifically incorporate preeclampsia or that can be used for young postpartum women under the age of 40 (Ahmed et al., 2014; Wu et al., 2019). Most established risk scores are targeted at older Caucasian males, so they are not helpful in this population of interest (Wu et al., 2019). The Reynolds risk score does generate a gender-specific score, and this risk tool, the Framingham risk score, and the Systematic Coronary Risk Evaluation (SCORE) have shown an elevated risk when evaluating women with a history of preeclampsia (Ahmed et al., 2014; Wu et al., 2019). The AHA, European Society of Cardiology, ACOG, National Institute for Health and Care Excellence, and Dutch Society of Obstetrics and Gynecology all recommend preeclampsia be included when evaluating women for their CVD risk (Wu et al., 2019). Despite these recommendations, no tool exists to evaluate this (Wu et al., 2019).

Risk Reduction

With the increased risk of CVD disease preeclampsia causes, the question of risk reduction rises (Ahmed et al., 2014). The American Heart Association's (AHA) 2011 guidelines for the prevention of CVD in women did list a history of preeclampsia as a "major risk factor", which places these women "at risk" for CVD (Ahmed et al., 2014, p. 1819). This means women with a history of preeclampsia have a 5.5% annual risk of MI, stroke, or death from a cardiovascular problem, as compared to a 2.2% annual risk amongst women with no risk factors (Ahmed et al., 2014). Fortunately, even modest lifestyle modifications can decrease CVD risk

factors, and lifestyle interventions following preeclampsia can decrease CVD risk by about 4-13% (Graves et al., 2019; Heida et al., 2016).

Ahmed et al. (2014) recommend women with a history of preeclampsia be educated early about their increased risk of CVD. Risk scores should be calculated for each patient, as they may have other factors that contribute to their overall CVD risk, and while there is no preeclampsia-specific tool to calculate this, the Reynolds risk score does generate a gender-specific score and has shown elevated risk when evaluating women with a history of preeclampsia (Ahmed et al., 2014; Wu et al., 2019). Thus the Reynolds risk score is the best risk calculator at this time for providers to use. Patients should also be educated on lifestyle modification and measures they can take to reduce their CVD risk (Ahmed et al., 2014; Bushnell & McCullough, 2014). Measures include healthy diet, regular moderate physical activity of 150 minutes per week, healthy weight and body mass index, breastfeeding, smoking cessation, moderate alcohol intake, early recognition and treatment of diabetes, and maintenance of normal blood pressure, cholesterol levels, and blood glucose (Ahmed et al., 2014; Bushnell & McCullough, 2014; Graves et al., 2019; Leslie & Briggs, 2016).

In terms of diet, a study has shown that patients with high CVD risk who ate a Mediterranean diet had a "dramatic reduction" in rates of MI, stroke, and cardiovascular mortality (Ahmed et al., 2014, p. 1820). A Mediterranean diet includes whole grains, fresh fruits and vegetables, olive oil, nuts, legumes, low-fat meats, and low-fat dairy (Davis & Sanders, 2019). Decreasing sodium intake to less than 2300mg per day can help decrease blood pressure and thus decreased CVD risk (Davis & Sanders, 2019). The AHA recommends the DASH (Dietary Approaches to Stop Hypertension) diet to treat or prevent hypertension, which involves

reducing dietary sodium and eating nutrient-rich foods containing potassium, calcium, and magnesium (Bushnell et al., 2014; Mayo Clinic, 2019). Graves et al. (2019) and Leslie and Briggs (2016) also endorse the DASH diet for women with a history of preeclampsia.

In terms of stroke, hypertension is the most modifiable risk factor for stroke (Bushnell & McCullough, 2014), so all adult women should have hypertension screenings regularly with a blood pressure cuff that fits appropriately (Davis & Sanders, 2019). The woman should have her arm well-supported, be resting quietly, and have her feet comfortably on the ground (Davis & Sanders, 2019). Women who develop hypertension should be treated with prescription medication (Ahmed et al., 2014). Research has not shown one antihypertensive to generally be superior to another, so medication choice should be individualized and based on clinical experience (Davis & Sanders, 2019).

Two additional risk reduction strategies are breastfeeding and Aspirin. Breastfeeding has been shown to reduce a mother's risk of diabetes, hypertension, and heart disease, so breastfeeding is encouraged for as long as possible in women with a history of preeclampsia (Graves et al., 2019). Breastfeeding can also aide in weight loss after delivery, so this can help women with a history of preeclampsia achieve a healthy BMI (Graves et al., 2019). Aspirin is also recommended for at-risk normotensive women over 65 years old, and the dosing is 81mg daily or 100mg every 2 days (Ahmed et al., 2014; Bushnell & McCullough, 2014). Women who are under the age of 65 but have additional stroke risk should also take Aspirin (Ahmed et al., 2014).

Organizational Recommendations

ACOG (2013, 2018) recommends annual monitoring of blood pressure, lipids, fasting glucose, and BMI in women with a history of preeclampsia. The organization recommends healthcare providers counsel these patients on their lifetime risk of CVD and complete a CVD risk assessment with an emphasis on the social determinants of health (ACOG, 2013, 2018). No specific screening tool is recommended for use (ACOG, 2013, 2018). ACOG also recommends providers educate these women on smoking cessation, diet modification, regular aerobic exercise, and the importance of maintaining an ideal body weight (ACOG, 2013, 2018).

The AHA recommends women with a history of preeclampsia have their blood pressure, lipids, fasting glucose, and BMI monitored, but they do not give any interval of time for this monitoring (Bushnell et al., 2014; Mosca et al., 2011). They recommend healthcare providers take a detailed history of pregnancy complications, specifically regarding preeclampsia, preterm birth, gestational diabetes, and small-for-gestational-age infants (Bushnell et al., 2014; Mosca et al., 2011). In women free of CVD, the AHA recommends screening for risk factors like smoking, hypertension, diabetes mellitus, total cholesterol, and high-density lipoprotein every 4–6 years from ages 20–79 in order to calculate a 10-year CVD risk, but this recommendation is not specific to women with a history of preeclampsia (Arnett et al., 2019; Brown et al., 2018; Whelton et al., 2018). Other recommendations by AHA are that providers educate these women on smoking cessation, eating a DASH diet, maintaining regular physical activity, and maintaining a BMI less than 25 kg/m^2 (Arnett et al., 2019; Bushnell et al., 2014; Mosca et al., 2011; Whelton et al., 2018). The DASH diet aims to treat or prevent hypertension and involves reducing dietary sodium and eating nutrient-rich foods containing potassium, calcium, and magnesium (Mayo Clinic, 2019). AHA defines regular physical activity as 150 minutes per week

of moderate exercise, 75 minutes per week of vigorous exercise, or an equivalent combination of the two (Arnett et al., 2019; Mosca et al., 2011).

Several other organizations have given follow-up recommendations for women with a history of preeclampsia. The European Society of Cardiology recommends women with a history of preeclampsia receive periodic screening for hypertension but give no further guidance (Piepoli et al., 2016). The National Institute for Health and Care Excellence recommends providers educate patients with a history of preeclampsia on their increased risk of hypertension and the complications this can cause later in life (Visintin et al., 2010). They also recommend women with a history of preeclampsia maintain their BMI between 18 and 24.9 kg/m^2, maintain a healthy diet, and exercise regularly (Visintin et al., 2010).

Finally, the Dutch Society of Obstetrics and Gynecology recommends women with a history of preeclampsia have a CVD risk profile at age 50 (Heida et al., 2016). They also state women with preeclampsia should be counseled postpartum about their increased CVD risk and be encouraged to optimize modifiable risk factors (Heida et al., 2016). Overall, there is strong consensus that women with preeclampsia need to be educated after delivery about their increased risk of CVD, but there is no consensus on when and how often these women should receive follow-up and screening moving forward. Thus, development of a guideline is merited so that providers know when and how often patients should be seen, screened, and the specific patient education that needs to be shared with at-risk women.

Other Recommendations

Wu et al. (2016) completed a systematic review and meta-analysis that included over 6.4

million women and over 258,000 women with preeclampsia. Based on their findings, they concluded that women with a history of preeclampsia should receive lifelong monitoring of CVD risk factors (Wu et al., 2016). Graves et al. (2019) recommend women with a history of preeclampsia be seen at 6 weeks postpartum per standard recommendations and then again at 6 months postpartum for blood pressure measurement, BMI measurement, and testing of a lipid panel and urine albumin-to-creatinine ratio. They also state this visit presents the opportunity to educate women on their increased CVD risk, discuss how to optimize their health for future pregnancies, and to recommend lifestyle and pharmacological interventions as needed (Graves et al., 2019).

Graves et al. (2019) then recommend these women be seen at 12 months postpartum to remeasure blood pressure, BMI, and a lipid panel if the panel at the 6-month visit was abnormal. This visit again provides an opportunity for providers to reinforce a healthy lifestyle, including regular physical activity and healthy diet, and refer patients to a cardiologist or dietician if needed (Graves et al., 2019). After 12 months, these women should have their blood pressure monitored by a provider every 6–12 months (Graves et al., 2019). Leslie and Briggs (2016) also recommend annual monitoring of women with a history of preeclampsia and preterm birth at less than 37 weeks' gestation or a history of recurrent preeclampsia. This monitoring should include assessment of blood pressure, lipids, fasting glucose, and BMI (Leslie & Briggs, 2016).

Provider Knowledge Deficit

Research has demonstrated that providers, including PCPs and OB/GYNs, have limited knowledge about the link between preeclampsia and future CVD risk (Bushnell et al., 2014; Davis & Sanders, 2019; Graves et al., 2019; Lee & Tubby, 2015; Leslie & Briggs, 2016; Roth et

al., 2019; Young et al., 2012). Obstetricians have been shown to have the most knowledge about this link, while family physicians, internal medicine specialists, and midwives have been shown to have the least knowledge (Roth et al., 2019; Leslie & Briggs, 2016). A study done by Young et al. (2012) showed that 38% of OB/GYNs were educating their patients with a history of preeclampsia on cardiovascular risk reduction, but only 9% of internists were providing this education.

The knowledge gap providers have about the link between preeclampsia and increased CVD risk later in life shows there is a need for better provider education (Bushnell et al., 2014; Davis & Sanders, 2019; Lee & Tubby, 2015; Roth et al., 2019; Young et al., 2012). As there are no specific guidelines regarding when women should be screened for CVD following a pregnancy complicated by preeclampsia, a guideline needs to be developed to assist providers in caring for this high-risk patient population (Davis & Sanders, 2019; Gastrich et al., 2019; Lee & Tubby, 2015; Schmidt et al., 2017).

Patient Knowledge Deficit

While many providers routinely offer preventive counseling regarding CVD risk, they generally do not discuss the implications of this and a history of preeclampsia (Davis & Sanders, 2019; Young et al., 2012). A study done by Roth et al. (2019) showed that women with a history of preeclampsia had little to no knowledge about the link between preeclampsia and increased CVD risk later in life. The women either received no information from their healthcare provider about this link or feel like the information they received was inadequate (Roth et al., 2019). Additionally, many women who did have knowledge on this topic obtained this knowledge through informal internet searches (Roth et al., 2019).

Research has demonstrated that general awareness of CVD risk in high-risk women is linked to the initiation of preventative actions, and women with a history of preeclampsia have been shown to be highly motivated to lower their risk of CVD risk (Graves et al., 2019). According to Leslie and Briggs (2016), women with a history of preeclampsia need to understand their risks and the rationale behind risk-reduction strategies to be advocates of their own health and achieve optimal health status.

Provider Education

Overall, there is a need for better provider education so that patients can receive important information regarding their history of preeclampsia and subsequent increased CVD risk (Bushnell et al., 2014; Lee & Tubby, 2015; Leslie & Briggs, 2016; Roth et al., 2019). Providers may be hesitant to make changes to their current practice, arguing that they already question their patients about a history of preeclampsia and educate them on CVD risk. Nonetheless, providers need to understand the importance of discussing and evaluating these two issues together due to the significant risk a history of preeclampsia poses for future CVD.

Graves et al. (2019) note that family practice physicians are well-positioned to identify and counsel women who are at an increased risk for CVD (p. 884). Unfortunately, there are no specific guidelines regarding when women should be screened for CVD following a pregnancy complicated by preeclampsia, even though routine screening is recommended (Davis & Sanders, 2019; Gastrich et al., 2019; Lee & Tubby, 2015; Schmidt et al., 2017). What is known is that obtaining a thorough obstetrical history from women is very important when assessing their CVD risk (Brown et al., 2018; Lee & Tubby, 2015; Roth et al., 2019; Young et al., 2012). The American College of Cardiology, ACOG, and AHA all recommend obtaining a thorough

medical history, including a detailed pregnancy history, in order to thoroughly assess a woman's CVD risk (Leslie & Briggs, 2016).

Patient Education

Obesity, physical inactivity, metabolic syndrome, and diabetes are considered high-risk factors for stroke independent of a woman's history of preeclampsia (Bushnell & McCullough, 2014; Davis & Sanders, 2019). Therefore, patients with these conditions in addition to a history of preeclampsia particularly need to be educated about eating a healthy diet, getting regular moderate physical activity, maintaining a healthy weight and body mass index, and maintaining normal cholesterol and blood glucose levels (Bushnell & McCullough, 2014; Davis & Sanders, 2019).

Women who develop preeclampsia should receive education from their provider at their postpartum visit about their future risk of CVD and stroke (Davis & Sanders, 2019; Wu et al., 2016), and yet research indicates that women are not receiving this education (Roth et al., 2019). Preeclampsia should remain on the patient's problem list and never be removed from the medical history, even if a woman is past her reproductive years, and women with a history of preeclampsia should be encouraged to tell all of their healthcare providers about this history (Bushnell et al., 2014; Davis & Sanders, 2019; Leslie & Briggs, 2016). Patients should receive education at every visit from there on out with their primary care provider (PCP) or OB/GYN about CVD risk reduction (Davis & Sanders, 2019).

Patients should receive both verbal and written education on risks. The provider should discuss this with the patient during the appointment, and risk reduction strategies should be identified together by the provider and the patient. Then the patient should receive written

information in the discharge summary about the link between preeclampsia and increased CVD risk, as well as written information on any risk reduction strategies they identified with their provider. If appropriate, patients should be referred to specialists, such as cardiology or dietetics, to assist in reducing their CVD risk.

Conceptual Framework

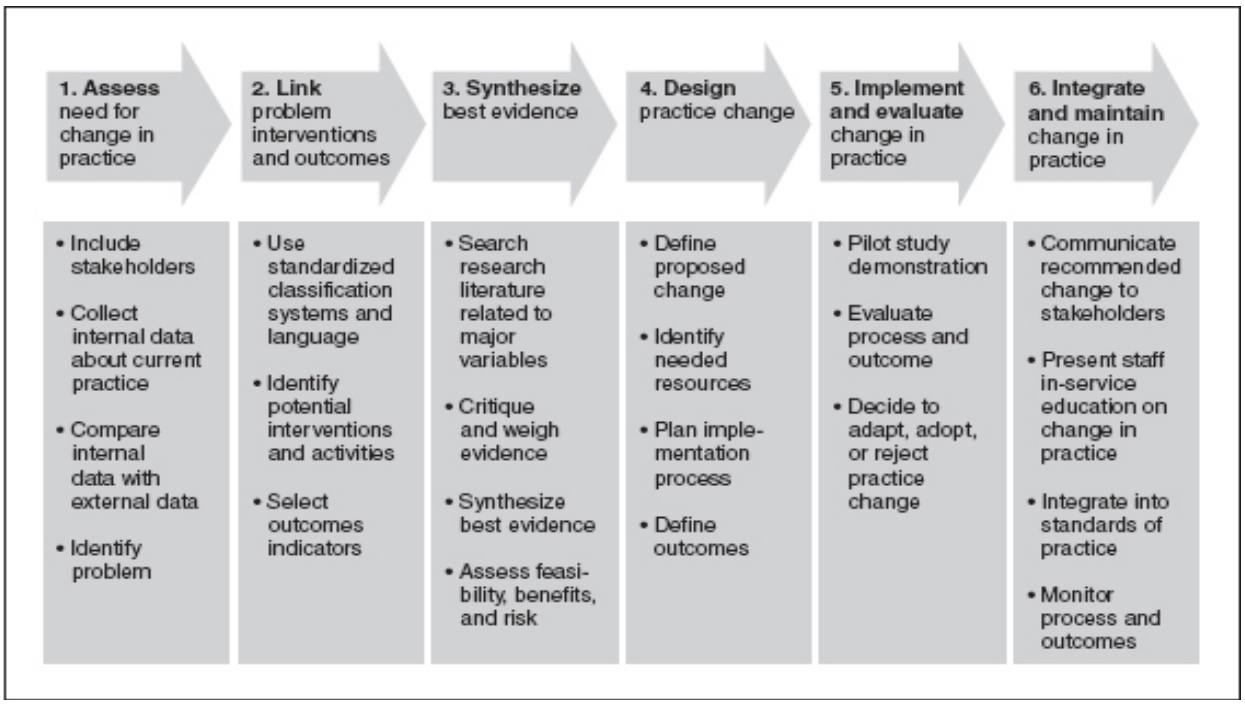
Rosswurm and Larrabee's Model for Evidence-Based Practice Change has been selected as the framework for this project (Rosswurm & Larrabee, 1999). In this age of healthcare, providers cannot just rely on clinical experience, opinion-based processes, and pathophysiologic rationale anymore (Rosswurm & Larrabee, 1999, p. 317).) The increase in clinical research and the accessibility to these findings has created a "paradigm shift from traditional and intuition-driven practice to evidence-based practice" (Rosswurm and Larrabee, 1999, p. 317). Evidence-based practice is defined as "the integration of individual clinical expertise with the best available external clinical evidence from systematic research" (Rosswurm & Larrabee, 1999, p. 317). Rosswurm and Larrabee (1999) challenge practitioners to question their current practices and find better, evidence-based alternatives.

Although several models have been created to help providers utilize research, providers still have trouble synthesizing contextual and empirical evidence as well as integrating evidence-based changes into their practice (Rosswurm & Larrabee, 1999). For this reason, Rosswurm and Larrabee (1999) created their evidence-based model. This model stems from theoretical and research literature on evidence-based practice, research utilization, and change theory, and the model guides providers through the process of implementing evidence-based practice (Rosswurm & Larrabee, 1999). Rosswurm and Larrabee (1999) tested the model with nurses at a

regional medical center, and the nurses successfully applied the model and implemented evidence-based practice. Rosswurm and Larrabee (1999) stated the model was successful with nurses and may also be useful for other providers desiring to implement evidence-based practice.

The model includes six steps that guide providers through the process of converting to evidence-based practice (Rosswurm & Larrabee, 1999). These steps are: assess the need for a chance in practice, link problem interventions and outcomes, synthesize best evidence, design practice change, implement and evaluate the change in practice, and then integrate and maintain the change within practice (Rosswurm & Larrabee, 1999). See Figure 1 below for a graphic of this process (Rosswurm & Larrabee, 1999). This model will be used as a guide and framework to implement evidence-based change within a group of providers caring for women with a history of preeclampsia.

Figure 1. Model for Evidence-Based Practice Change.



(Rosswurm & Larrabee, 1999)

CHAPTER THREE

METHODS

This project used a pre-survey, educational content that included two guidelines for providers to choose from and an educational handout for patients, and post-survey approach. The project targeted healthcare providers who care for women with a history of preeclampsia and aimed to increase their knowledge of the link between a history of preeclampsia and increased CVD risk later in life so that they can provide improved, evidence-based patient care.

Ethical Issues

The DNP student spoke with Dr. Mark Quinn, chair of the Institutional Review Board (IRB), at Montana State University on 01/30/2020. Dr. Quinn confirmed that this project qualified for exempt IRB status. The IRB application was submitted on 06/10/2020, and IRB approval was received that same day. See Appendix A for IRB Approval Letter.

Sample and Setting

The sample population for this project included all (n = 41) of the family practice and OB/GYN providers at a rural hospital near the DNP student. The hospital is located in southwestern Montana and is an 83-bed hospital with both inpatient and outpatient services.

Instruments

Two online surveys developed through Qualtrics® were used for this project with

the focus being provider knowledge of preeclampsia and increased risk of CVD. The surveys were blinded and anonymous so that data quality was protected. Survey A was adapted from an existing instrument developed by Young et al. (2012), and Survey B was created by the DNP student based on the literature review and in alignment with the project aims. Primary care providers and OB/GYN providers, including medical doctors (MDs), doctors of osteopathy (DOs), physician's assistants (PAs), advanced practice registered nurses (APRNs), including nurse practitioners (NPs), and midwives were surveyed. The DNP student worked with the Director of Compliance/Compliance Officer at the healthcare organization where she is employed to get approval to complete the surveys and to identify providers that met the survey criteria. The DNP student then directly emailed the survey to identified providers at the hospital.

Survey A (see Appendix B) consisted of 22 questions and contained five demographic questions, 10 questions about clinical practice, five questions about knowledge regarding preeclampsia and increased CVD risk, and two questions about the guideline the DNP student is presenting. The demographic questions included queries about practice specialty, years of practice experience, provider age, gender identity, and personal or relative history of preeclampsia. The clinical practice questions included information on the most common age range of patients seen in practice; average number of women >50 years old in practice; research or special practice interest in preeclampsia; direct care of patients with preeclampsia; counseling patients >50 years old about cardiovascular risk; history taking regarding preeclampsia, severity of preeclampsia, and preterm delivery; education provided to women with preeclampsia on increased risk of CVD later in life; and the type of education provided to patients regarding history of preeclampsia and increased risk of CVD later in life.

Preeclampsia and CVD knowledge was incorporated into multiple-answer questions about preeclampsia and other related health problems, preeclampsia and its link to shorter life expectancy, familiarity with the AHA-identified link between preeclampsia and increased cardiovascular disease risk later in life, the ASA-identified link between preeclampsia and stroke, and familiarity with ACOG's practice bulletin that addresses preeclampsia and CVD risk. The guideline questions asked if the provider would find a written guideline about caring for women with a history of preeclampsia helpful and whether they would be open to making a practice change if they learned something new from the guideline.

Survey B (see Appendix C) consisted of 12 questions about the practice guidelines and patient educational handout that were sent to the providers. The first question asked if the provider read the guideline, and if they answered no, the survey skipped to question 11. Question 11 asked the provider to briefly explain why they were not able to read the guideline they were sent with a free-text box for their response. The survey then finished with question 12, which asked what suggestions the provider had for capturing older patients that may not have had a formal "preeclampsia" diagnosis during pregnancy but had hypertension in pregnancy and subsequent increased CVD risk with a free-text box for their response.

If the provider answered yes to question 1, they were asked if they found the guideline helpful or learned anything new from it and how easy the guideline was to read and understand. Then there was a question about practice changes made since reading the guideline with a free-text box for what changes were made and a question about practice changes they intended to make since reading the guideline with a free-text box for intended changes. The next question asked for provider input on needed changes/modifications to the practice guideline with a free-

text box for their response. The next two questions asked if the provider found the patient educational handout useful and what changes they would recommend making to this handout with a free-text response box. Finally, their survey also finished with question 12, which asked what suggestions the provider had for capturing older patients that may not have had a formal "preeclampsia" diagnosis during pregnancy, but had hypertension in pregnancy and subsequent increased CVD risk with a free-text box for their response.

Procedures

The providers were reached through their hospital email. The Marketing and Communications Director at the chosen organization helped to identify all the family practice and OB/GYN providers (n = 41) there that needed to be sent the survey, and she provided email information for these providers. An email was then sent to the providers with information about the project aim, the upcoming surveys, and the guideline that would be sent out. The Qualtrics® URL link for Survey A was embedded in the initial email for providers. This allowed the providers to immediately click on the link and access the survey.

Respondent information remained anonymous to the DNP student. Survey A remained open for 10 days, and the DNP student sent emails out regarding Survey A the day that it opened and then four, seven, and eight days after the survey opened. It took participants about 5 minutes to complete Survey A.

Once Survey A closed, an educational Power Point® (PPT) presentation with voiceover, PDF printable guidelines, and a PDF printable patient educational handout developed by the DNP student were sent to all of the providers, including those that did not take Survey A. The PPT explained the rationale for the needed guideline and practice change, and the guidelines

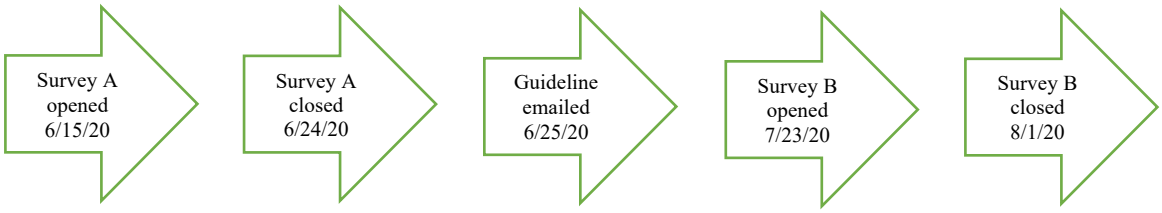
provided recommendations from the AHA, ACOG, and other research studies regarding monitoring frequency, monitoring tests, and lifestyle modification education patients should receive. There were two guidelines that the providers could choose from; one was presented in a table format with checkboxes, and the other was presented in an algorithm format. Both guidelines contained the same information, so the providers could choose whichever format they preferred to use. The patient educational handout could then be printed by providers and given to their patients after their appointment. The PPT presentation information can be found in Appendix D, the practice guidelines can be found in Appendix E, and the patient educational handout can be found in Appendix F.

Four weeks after the PPT, guidelines, and patient educational handout were distributed, all of the providers were emailed the Qualtrics® link to Survey B, which inquired about their use or intended use of the guideline and patient educational handout. Survey B was also open for 10 days, and the DNP student sent emails out regarding Survey B the day that it opened and after it had been open for four, seven, and eight days.

Rosswurm and Larrabee's Model for Evidence-Based Practice Change is the framework for this project. Survey A assessed the need for a practice change, which is the first step in Rosswurm and Larrabee's model (Rosswurm & Larrabee, 1999). The practice guideline and educational presentation that were emailed to the providers after Survey A closed completed steps three through five in the model, which are to synthesize best evidence, design the practice change, and implement and evaluate the change in practice (Rosswurm & Larrabee, 1999). Survey B also helped to complete step five in the model by evaluating the practice change (Rosswurm & Larrabee, 1999).

The DNP student opened Survey A to providers from June 15th to June 24th, 2020. The PPT, practice guidelines, and patient educational handout were sent via email by the DNP student to all of the providers identified, including those that did not take Survey A, on June 25nd, 2020. Four weeks later, Survey B opened from July 23th to August 1st, 2020. Providers who did not take Survey A were still emailed Survey B, as some providers who did not take the initial survey might have still used the guideline or patient educational handout and had feedback on these. See Figure 2 for project timeline.

Figure 2. Project Timeline.



CHAPTER FOUR

DATA ANALYSIS

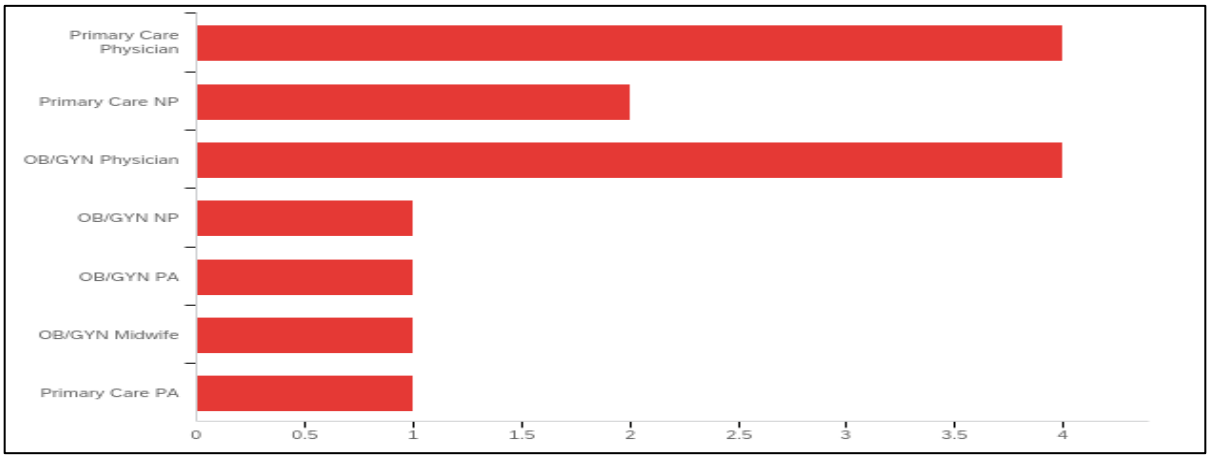
Survey A

Survey A was emailed to 41 providers through Qualtrics®, and 14 providers responded to the survey. Some providers only responded to select survey questions, but most providers responded to all 22 questions. Survey A opened on June 15, 2020, and reminder emails were sent to complete the survey four, seven, and eight days after the survey opened. The survey then closed on June 24, 2020.

Survey A Results

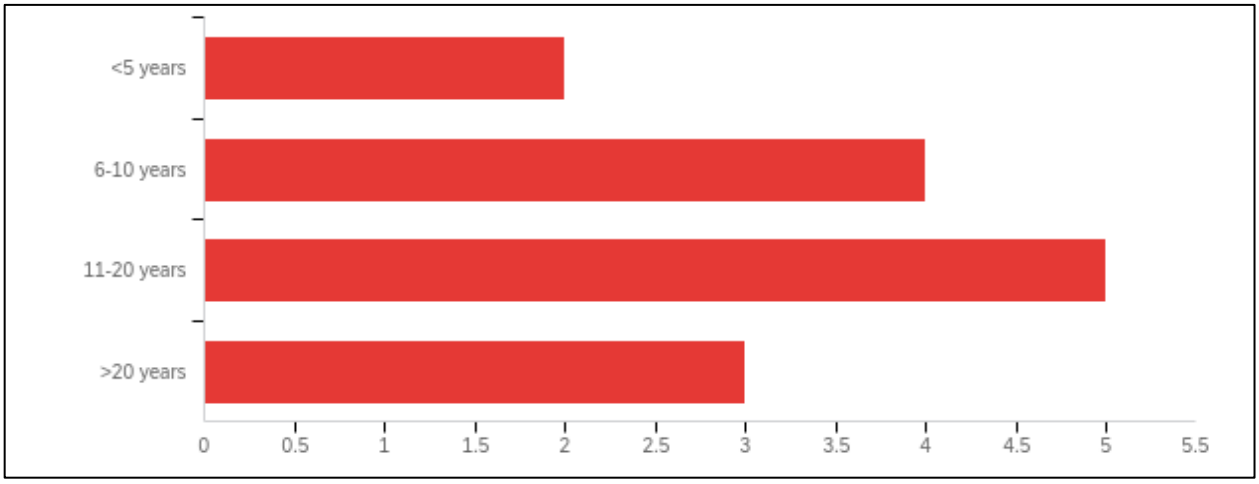
Question 1 asked about the provider's specialty. Eight different options were given, and at least one provider from every specialty was represented by the survey respondents. Most of the respondents were either primary care physicians, accounting for 29%, or OB/GYN physicians, accounting for an additional 29%. See Figure 3 for provider specialty breakdowns.

Figure 3. Question 1.



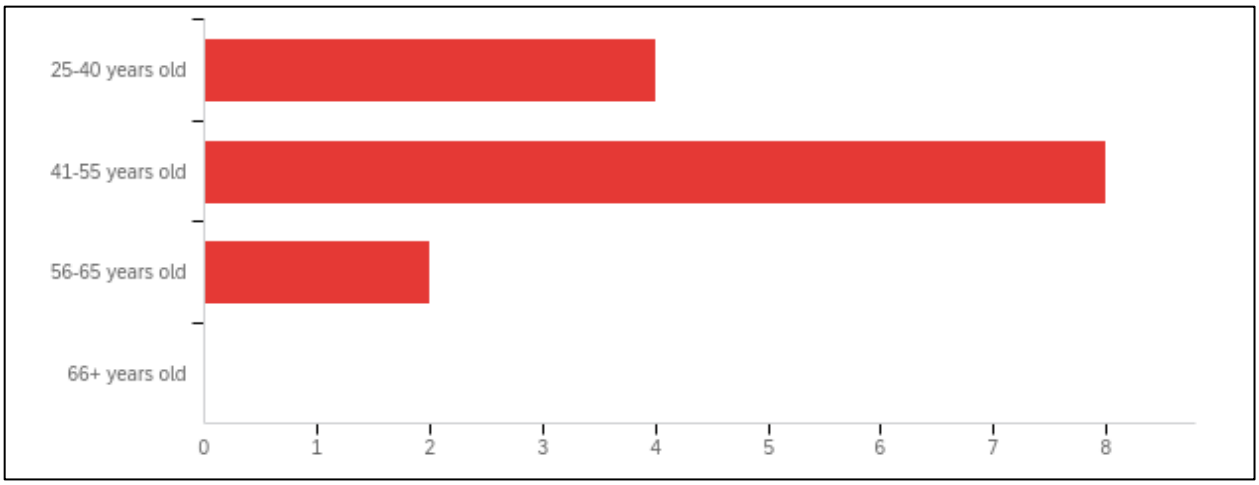
Question 2 asked the provider about the number of years of clinical experience. The majority of the respondents (n = 5) had 11–20 years of experience, which accounted for 36% of the respondents. See Figure 4 for provider experience specifics.

Figure 4. Question 2.



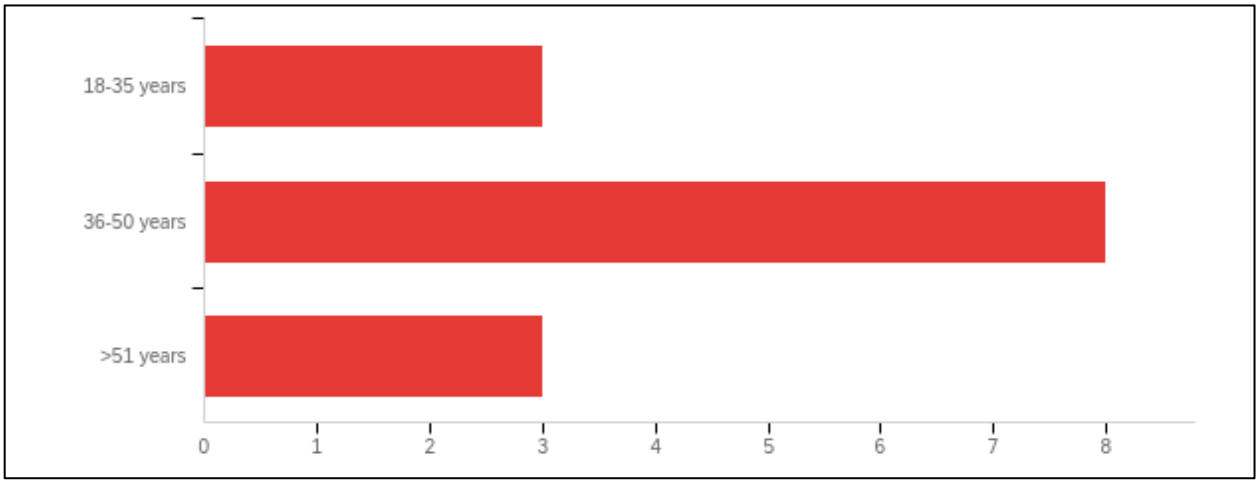
Question 3 asked about the age of the provider, and the majority of respondents (n = 8), or 57%, were 41–55 years old. See Figure 5 for provider age breakdown.

Figure 5. Question 3.



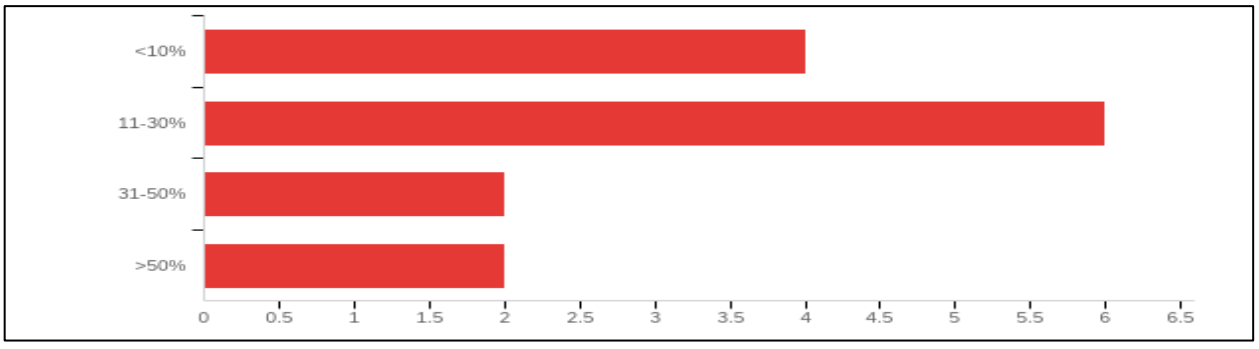
Question 4 asked about gender identity. Thirteen of the 14 respondents identified as female, which accounted for 93%, and only one of the respondents was male. Question 5 then asked the age range of patients most frequently seen by the providers. Most of the providers (n = 8), or 57%, reported caring for patients age 36–50. See Figure 6 for age breakdown.

Figure 6. Question 5



Question 6 asked the providers what percentage of women in their practice are over the age of 50. The majority of providers (n = 6) responded that 11–30% of their practice was made up of women over the age of 50. See Figure 7 for all provider responses.

Figure 7. Question 6.



Question 7 asked whether the provider has a first degree relative with a history of preeclampsia. Four providers, or 29%, did have a first degree relative with a history of preeclampsia, and 10 providers, or 71%, did not have a first degree relative with preeclampsia. Question 8 asked if the provider had a research or specific practice interest in preeclampsia. Only two providers, or 14%, answered “yes”, and 12 providers, or 86%, answered “no”. Question 9 then asked if the provider cares directly for women with preeclampsia. Five providers, or 36%, responded “yes”, and nine providers, or 64%, responded “no”.

Question 10 was a multiple response question that asked whether women with a history of preeclampsia are at an increased risk for developing other various health problems later in life, including malignancy, HTN, ischemic heart disease, stroke, renal disease, and liver disease. See Table 1 for provider answers and see Chapter 5 for interpretation of these results.

Table 1. Question 10.

#	Question	Yes		No		Unsure		Total
1	Malignancy	0.00%	0	42.86%	6	57.14%	8	14
2	Hypertension	100.00%	14	0.00%	0	0.00%	0	14
3	Ischemic Heart Disease	85.71%	12	0.00%	0	14.29%	2	14
4	Stroke	92.86%	13	0.00%	0	7.14%	1	14
5	Renal Disease	78.57%	11	0.00%	0	21.43%	3	14
6	Liver Disease	28.57%	4	28.57%	4	42.86%	6	14

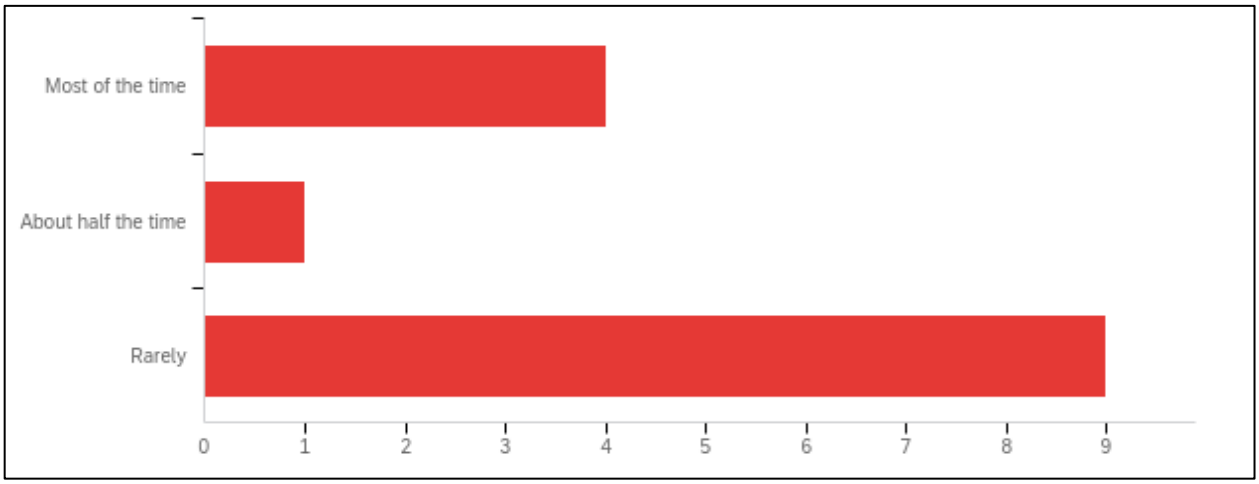
Question 11 asked providers whether or not women with a history of preeclampsia have a shorter life expectancy. Thirteen providers, or 93%, responded “yes”, and one provider

responded “no”. Question 12 then asked if the American Heart Association has identified a link between preeclampsia and increased cardiovascular disease risk later in life. Twelve providers responded to this question, and 100% of the respondents answered “yes”. Question 13 asked if the American Stroke Association identified a link between preeclampsia and stroke. Only 10 providers responded to this question, and 100% of the respondents answered “yes”.

Question 14 asked the providers if they are familiar with the American College of Obstetricians and Gynecologists’ practice bulletin that addresses strategies for prevention of CVD in women with a history of preeclampsia. All 14 providers responded to this question. Six providers, or 43%, were familiar with the practice bulletin, and eight providers, or 57%, were not familiar with this practice bulletin.

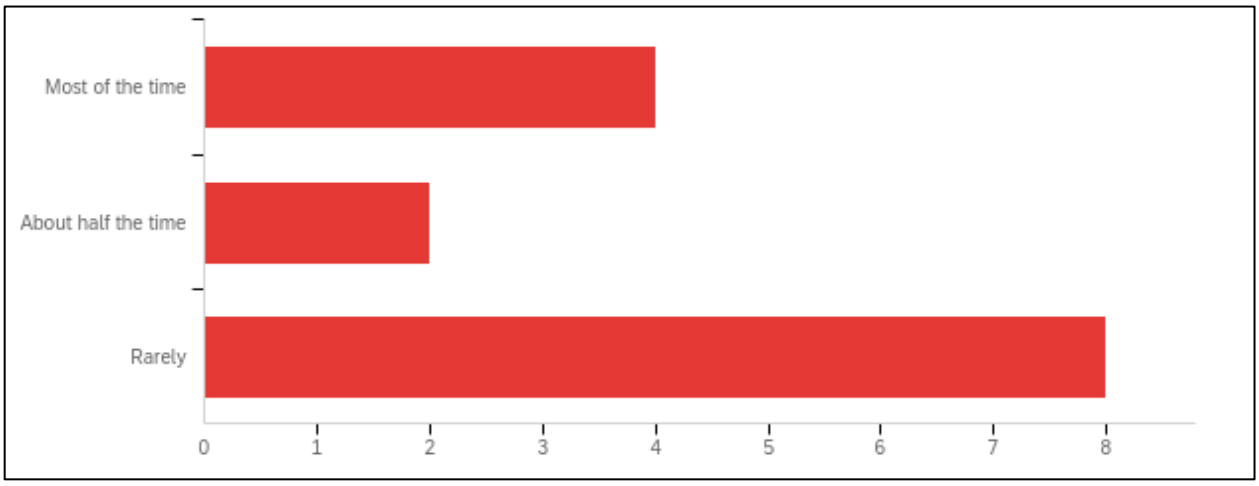
Question 15 asked if the provider regularly counsels their patients >50 years old about reducing their CVD risk. Thirteen providers, or 93%, answered “yes”, and one provider, or 7%, answered “no”. Question 16 asked if, when the provider takes a history from a nonpregnant woman, they ask about a history of preeclampsia. A majority of the providers, or 64%, answered “rarely”. See Figure 8 for all provider responses.

Figure 8. Question 16.



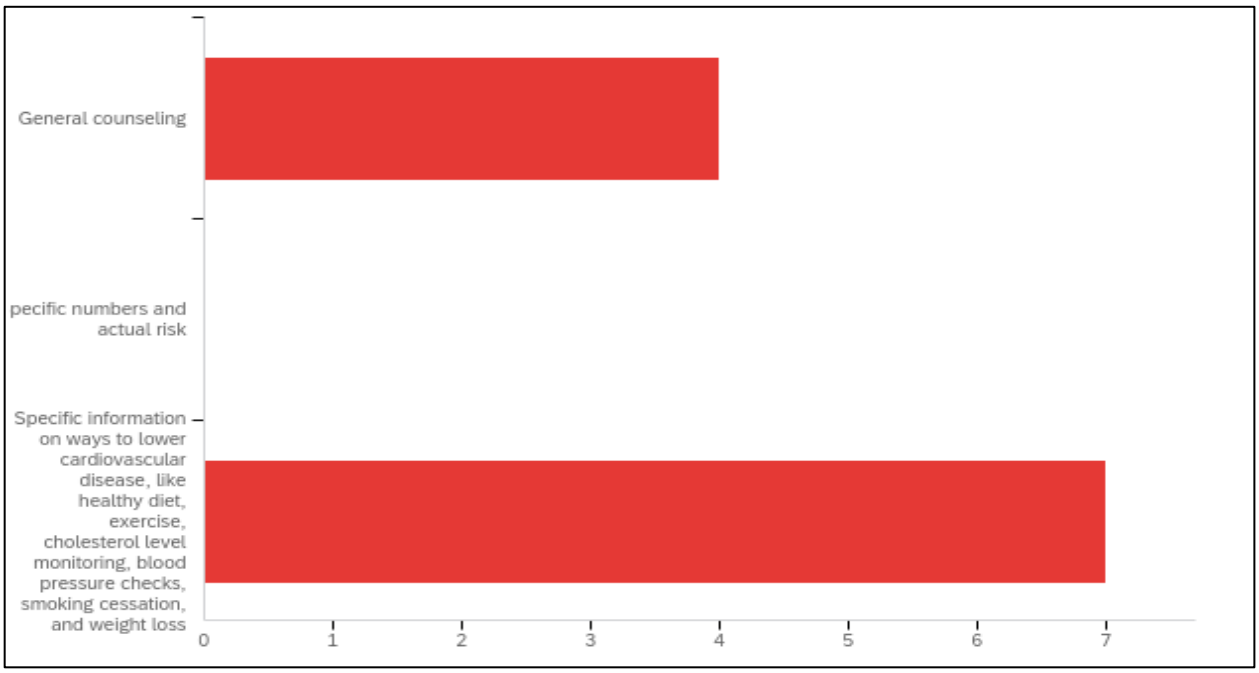
Question 17 asked the providers if they ask women with a history of preeclampsia about the severity of preeclampsia they experienced. Most providers (n = 8), or 57%, answered "rarely". See Figure 9 for all provider responses.

Figure 9. Question 17.



Question 18 asked the providers if they ask women with a history of preeclampsia about preterm delivery. Eight providers, or 57%, answered “most of the time”, and six providers, or 43%, answered “rarely”. No providers chose the answer “about half the time”. Question 19 asked providers if they counsel women with a history of preeclampsia about their risk of CVD later in life. Seven providers, or 50%, answered “most of the time”, and the other seven providers answered “rarely”. Again, no providers chose the answer “about half the time”. Then question 20 asked the providers who do counsel women with a history of preeclampsia about their CVD risk what kind of counseling they are providing. The majority of the respondents (n = 7), or 64%, said they offer specific information/counseling versus general counseling. See Figure 10 for details.

Figure 10. Question 20.



Finally, questions 21 and 22 asked if the providers would find a written guideline about caring for women with a history of preeclampsia helpful and whether they would be open to changing their practice if they learned something new from this guideline. Ten providers, or 71%, responded that a written guideline would be helpful, and four providers, or 29%, responded that a written guideline would "maybe" be helpful. Thirteen providers, or 93%, said they would be open to making a practice change if the guideline taught them something new, and only one provider said they would "maybe" be willing to make a practice change. None of the respondents to questions 21 or 22 answered "no".

Intervention

On June 25, 2020, the educational PowerPoint, provider practice guidelines, and patient educational handout were emailed to all 41 providers from the DNP student's personal email. The providers were asked to review the information and use the provider guideline and patient educational handout in practice. They were advised that a secondary survey would be emailed to them in four weeks and were asked to watch for this email to complete the survey.

Survey B

Survey B was then emailed to all 41 providers through Qualtrics®, and six providers responded. Survey B opened on July 23, 2020, and reminder emails were sent to complete the survey four, seven, and eight days after the survey opened. The survey then closed on August 1, 2020.

Survey B Results

Four of the six respondents did read the practice guideline, and two of the respondents did not read the guideline. The two that did not read the guideline attributed this to a lack of time. Of the four providers that read the practice guideline, three providers found the practice guideline helpful or learned something new from it, and the other three providers did not respond to this survey question. Three of the providers felt the guideline was “extremely easy” to read and understand, and the other one provider felt it was “neither easy nor difficult” to read and understand.

None of the four providers that had read the practice guideline reported making any practice changes since reading it, and none of them elaborated in question 5 about why they had not made a change. However, two providers did respond that they intended to make a practice change in the future after reading the guideline. One provider plans to “discuss pregnancy complications with new patients”, and the other provider responded, “Possibly it is in review”. The other two providers did not intend to make any future practice changes. When asked what changes the providers would recommend making to the practice guideline handout, one said none, one said to make it shorter with bullet points, and the other said, “Maternal-fetal medicine is deciding”.

Four providers found the patient educational handout useful, and no changes were recommended for this handout. Finally, the providers were asked what suggestions they have for capturing older patients that may not have had a formal “preeclampsia” diagnosis during pregnancy but had hypertension in pregnancy and subsequent increased CVD risk. Four providers responded to this question with only two offering suggestions. The first provider

recommended “adding a screening question”, and the other provider recommended “ask as part of the standard medical history ‘Did you have elevated BP in pregnancy?’”.

CHAPTER FIVE

OUTCOMES AND RESULTS

Overall, most of the respondents had 11–20 years of experience and were 41–55 years old. Thirteen of the providers were female, and only one was male, so there was strong female representation amongst the respondents. The male respondent is an OB/GYN provider, so there was no male representation from the primary care providers. Most providers did not have a first degree relative with a history of preeclampsia nor a research or specific practice interest in preeclampsia, so there was not significant personal preeclampsia knowledge amongst this group of providers.

In terms of practice specifics, half of the survey respondents were primary care providers, and the other half of the providers practiced in an OB/GYN office. Most providers reported 11–30% of their patient population being females over the age of 50. The most common patient age range reported was 36–50 years old, and most of the providers do not directly care for women with preeclampsia in their practice.

In regards to provider knowledge of preeclampsia and its long term effects, 100% of the providers knew preeclampsia is associated with an increased risk of hypertension later in life. The majority of the providers also knew there is an association between preeclampsia and stroke or ischemic heart disease later in life. While hypertension, ischemic heart disease, and stroke later in life are all known to be associated with a history of preeclampsia, malignancy, renal disease, and liver disease later in life have not been associated with a history of preeclampsia (Ahmed et al., 2014; Amaral et al., 2017; Ananth et al., 2013; Brown et al., 2013; Davis & Sanders, 2019; Gastrich et al., 2019; Grandi et al., 2019; Graves et al., 2019; Leslie & Briggs,

2016; Lui, Jeyaram, & Henry, 2019; Mongraw-Chaffin et al., 2010; Schmidt et al., 2017; Young et al., 2012).

The providers in this project had variable knowledge about links between a history of preeclampsia and renal disease, liver disease, and malignancy. Most providers incorrectly identified renal disease to be an increased risk later in life for women with a history of preeclampsia. While renal problems can occur during the acute presentation of preeclampsia, no long-term association has been found between a history of preeclampsia and development of renal disease later in life (ACOG, 2019; Ahmed et al., 2014). Some providers also thought there was a link between preeclampsia and liver disease later in life while others were unsure, and some providers knew correctly that there is no link. For malignancy, most providers were unsure if there is a link between this and a history of preeclampsia, while other providers knew there is no link. No providers responded that there is a link between malignancy and preeclampsia, which is correct. Almost all of the providers responded that women with a history of preeclampsia have a shorter life expectancy, which can be true depending on the CVD they develop later in life.

In terms of organizational findings, 100% of the providers that responded to question 12 (n = 12) knew that the AHA has identified a link between preeclampsia and increased risk of CVD later in life. All of the providers that responded to question 13 (n = 10) also knew that the ASA has identified a link between preeclampsia and stroke. A little more than half of the providers (n = 8) were familiar with the American College of Obstetricians and Gynecologists' practice bulletin that addresses strategies for prevention of CVD in women with a history of preeclampsia.

In practice, most providers regularly counsel their patients >50 years old about reducing their CVD risk, but few providers ask their nonpregnant patients about a history of preeclampsia when gathering their medical history. Additionally, few providers reported asking women with a history of preeclampsia about how severe their preeclampsia was. Conversely, most providers do ask their patients with a history of preeclampsia about preterm delivery. Only half of the providers reported regularly counseling women with a history of preeclampsia about their increased risk of CVD later in life, and they reported giving specific counseling about how to lower CVD disease risk (see Figure 10 above). In the end, most of the providers did respond that they would find a written guideline about caring for women with a history of preeclampsia helpful and would be open to changing how they practice if they learned something new from this guideline.

Even though Survey B had many fewer respondents than Survey A, all of the providers who read the DNP student's guideline and patient educational handout found them helpful or learned something new from them. Overall, they found the practice guideline easy to use, but only one provider reported making a practice change since reading the guideline. They did not report what this change was. Two additional providers reported they planned to make a practice change in the future because of the guideline.

The only recommendation given to change the practice guideline was to make it shorter with bullet points, even though the first guideline format already has bullet points, and no recommendations were given for changing the patient educational handout. The final question in Survey B asked what ideas the providers had for capturing older patients that may not have had a formal "preeclampsia" diagnosis during pregnancy but had hypertension in pregnancy and

subsequent increased CVD risk. The two suggestions given were to add a screening question, and the other provider suggested asking as part of the standard medical history, “Did you have elevated BP in pregnancy?”. All in all, the results from Survey B showed that the practice guideline and patient educational handout developed for this project are helpful to providers and can assist them in implementing evidence-based care into their practice.

CHAPTER SIX

DISCUSSION

The first aim of this project was to develop a guideline for providers to use in practice while caring for women with a history of preeclampsia. This was done after completing an extensive review of the literature, and the guidelines can be found in Appendix E. While not an initial aim of the project, a patient educational handout was also created as a resource for providers to give to their patients. This handout can be found in Appendix F.

The second aim of the project was to enhance providers' knowledge of the link between a history of preeclampsia and increased CVD risk later in life so that they can provide improved, evidence-based patient care. Most of the providers in this project did not have personal preeclampsia knowledge, nor did they report caring for women with preeclampsia in their practice. Additionally, a majority of the providers participating in this project knew that there is a link between a history of preeclampsia and CVD later in life, but they incorrectly identified other health problems as being linked to a history of preeclampsia.

Despite this knowledge of the link between preeclampsia and CVD risk, most of the providers do not ask their nonpregnant patients about a history of preeclampsia when gathering their medical history nor do they ask women with a history of preeclampsia about how severe their preeclampsia was. Most providers did report asking their patients with a history of preeclampsia about preterm delivery, however. All in all, this data shows that this group of providers do have knowledge of the link between preeclampsia and increased CVD later in life, but they are not fully applying this knowledge to their practice. According to the American College of Cardiology, ACOG, and AHA, obtaining a thorough medical history to assess for

CVD risk includes taking a detailed pregnancy history (Leslie & Briggs, 2016), and this group of providers is not doing that.

Additionally, most of the providers reported regularly counseling their patients >50 years old about reducing their CVD risk, but only half of the providers reported regularly counseling women with a history of preeclampsia about their increased risk of CVD later in life. This shows that the providers in this survey likely do not recognize the importance of the link between a history of preeclampsia and increased CVD risk later in life. They are missing the opportunity to educate their patients with a history of preeclampsia about this risk and thus missing an opportunity to help decrease the incidence of CVD in women in the U.S.

In recognition of this gap, most of the providers who responded to survey B did respond that they would find a written guideline about caring for women with a history of preeclampsia helpful and would be open to changing how they practice if they learned something new from the guideline. Then the results from Survey B showed that the providers who reviewed the guideline found it helpful and had already or planned to implement a practice change because of guideline. They also liked the patient educational handout and found it useful. Overall, the guideline was an effective tool to help the providers in this project implement evidence-based care into their practice, and the patient handout was an additional resource they could use to educate their patients with a history of preeclampsia. This completed aim two of the project.

Additionally, the providers who responded to Survey B helped suggest a way to further identify women within their practice who have a history of preeclampsia and are at an increased risk of CVD. Older women who had preeclampsia during pregnancy may not have a formal diagnosis of “preeclampsia” listed in their medical history, so the providers in Survey B

suggested adding a screening question to the standard medical history that asks, “Did you have elevated blood pressure in pregnancy?”. This additional question could help to effectively capture older female patients who did not have a formal “preeclampsia” diagnosis during pregnancy but are at increased risk for CVD. Ultimately, adding this screening question to the standard medical history providers take could help to identify many more women with a history of preeclampsia who could then be educated to help decrease their risk of CVD.

Limitations

This project did have limitations. The first is that it was completed at only one healthcare facility at a small rural hospital. Expanding it to multiple organizations and larger healthcare facilities would have helped to capture more data and more thoroughly assess provider knowledge and practice patterns. Second, the surveys used in this project were not validated, so this could have limited the results. Finally, the project was completed during the novel COVID-19 pandemic, which put significant strain on healthcare organizations around the world. This likely impacted the ability of the healthcare providers included in this project to complete the surveys and read the information emailed to them. It would be interesting to repeat this intervention once the COVID-19 pandemic has stabilized and see if the results are different or if more providers respond.

Provider Engagement

To engage more providers in this project, an incentive for survey participation could have been used. This could have been a gift card, money, or a getaway night at a local venue. This may have encouraged participation and increased the number of survey respondents. The DNP

student could also have gone to the clinics of the surveyed providers and made face-to-face interactions with them. This would have presented an opportunity for providers to ask questions or give feedback and would have reminded them to complete the surveys.

Implications for Practice

The findings of this project show that the practice guideline developed may be an effective tool to help providers care for women with a history of preeclampsia. It guides them to the evidence-based monitoring, screening, and education they should be providing to their patients with a history of preeclampsia. The practice guideline should be made readily available to providers at the healthcare organization of interest for day-to-day use, and further work should be done to facilitate publication of this guideline and its availability to healthcare providers throughout the U.S.

The patient educational handout developed during this project is an additional resource for providers to use with their patients, and the providers who took part in this project found it to be a helpful tool. The handout is something that providers should have printed out and available in their offices to give to patients after their visit or in the office waiting rooms for patients to read. Further work should also be done to publish this educational handout and make it available to healthcare providers throughout the U.S.

The project also helped to identify that a screening question should be added to the standard medical history that asks, “Did you have elevated blood pressure in pregnancy?”. This question could help to effectively capture female patients, especially older patients, who did not have a formal “preeclampsia” diagnosis during pregnancy but are at increased risk for CVD. Further work should be done add this question to the standard medical history form in the

primary care and OB/GYN offices at the healthcare organization of interest. Additionally, further research should be done after adding this question to the standard medical history to see if more women with a history of preeclampsia are identified and thus able to be monitored, screened, and educated about their increased risk of CVD later in life.

DNP Essentials

The eight core DNP essentials are listed below with a description of how this project met each essential.

Scientific Underpinnings for Practice

Rosswurm and Larrabee's Model for Evidence-Based Practice Change was used as the framework for this project (Rosswurm & Larrabee, 1999). This model stems from theoretical and research literature on evidence-based practice, research utilization, and change theory, and the model guides providers through the process of implementing evidence-based practice (Rosswurm & Larrabee, 1999). See Figure 1 above for the six steps included in this model, which were completed in this project.

Organizational and Systems Leadership for Quality Improvement

The DNP student led this project to improve the quality of care provided within the organization at which the DNP student is employed. The DNP student successfully developed an evidence-based practice guideline for providers to use while caring for patients with a history of preeclampsia and inspired the providers who took part in this project to make practice changes

after reading through the guideline. This will improve the quality of care the patients at this organization receive and hopefully improve their health outcomes, especially in regard to CVD.

Clinical Scholarship and Analytical Methods for Evidence-Based Practice

The DNP student successfully analyzed the literature available on this topic in order to create an evidence-based practice guideline for providers to use while caring for patients with a history of preeclampsia. Additionally, the DNP student created an evidence-based patient educational handout for providers to use and give to their patients.

Information Systems/Technology for the Improvement and Transformations of Health Care

The DNP student utilized multiple technological platforms to complete this project. First, the Montana State University library was accessed through the internet to complete a thorough review of the literature. Then the DNP student utilized Qualtrics® to develop and disseminate the surveys for this project. A narrated, educational presentation was prepared using PowerPoint®, and this was disseminated along with the practice guidelines and patient educational handout to the providers through email.

Health Care Policy for Advocacy in Health Care

Through this project, the DNP student was able to identify problems in the healthcare delivery system, which is a lack of providers educating their patients with a history of preeclampsia about their increased risk of CVD later in life. Identifying this gap allowed the DNP to help address the problem by providing a practice guideline and patient educational handouts to the providers in this project to be used in their practice. Hopefully these tools can be

used organization-wide and eventually be published nationally to be available to providers across the U.S.

Interprofessional Collaboration for Improving Patient and Population Health Outcomes

The DNP student collaborated with primary care providers and OB/GYN providers throughout this project. Their feedback was sought, especially in Survey B, to improve the provider practice guideline and patient educational handout. Their suggestions for capturing more women, especially older women, with no formal preeclampsia diagnosis was also sought.

Clinical Prevention and Population Health for Improving the Nation's Health

The DNP student was able to analyze a healthcare system's delivery of care for women with a history of preeclampsia and identify the gaps and weaknesses within this system. This provided an opportunity to close gaps, especially in regard to patient education, and thus improve the health of women within this organization. While improvement in health was not directly measured in this project, the implementation of evidence-based care into practice will result in improved health for women who seek care at this organization.

Advanced Nursing Practice

Through an extensive literature review, the DNP student determined that there was a lack of and need for a practice guideline for providers to use while caring for women with a history of preeclampsia to help identify and decrease the incidence of CVD disease amongst this high-risk population. The DNP student effectively developed a guideline for providers to use, as evidenced

by the survey responses from this project. All in all, this project has practical implications for the nursing profession and can be implemented directly into practice.

CHAPTER SEVEN

CONCLUSION

CVD is the leading cause of death among women in the U.S. and globally, yet this disease is preventable and treatable (Ahmed et al., 2014; Graves et al., 2019; Lee & Tubby, 2015; Roth et al., 2019). Extant evidence has established that women with a history of preeclampsia are at an increased risk for developing CVD later in life, but no guideline has been developed to help providers care for this high-risk population (Ahmed et al., 2014; Amaral et al., 2017; Ananth et al., 2013; Brown et al., 2013; Davis & Sanders, 2019; Gastrich et al., 2019; Grandi et al., 2019; Graves et al., 2019; Leslie & Briggs, 2016; Lui, Jeyaram, & Henry, 2019; Mongraw-Chaffin et al., 2010; Schmidt et al., 2017; Young et al., 2012). To address this need for a guideline to be developed, the DNP student sought to develop an appropriate guideline and provide evidence-based practice recommendations for providers caring for women with a history of preeclampsia.

The first aim of this project was to develop a guideline for providers to use in practice while caring for women with a history of preeclampsia, and this was completed. The second aim of this project was to enhance providers' knowledge of the link between a history of preeclampsia and increased CVD risk later in life so they can provide improved, evidence-based care. While the knowledge of this link already existed amongst the providers who took part in this project, they were not applying this knowledge to their practice as evidenced by the lack of taking a thorough pregnancy history from their patients and lack of counseling to women with a history of preeclampsia about their increased risk of CVD later in life. Providers who reviewed the guideline presented in this project found it helpful and had already or intended to implement

a practice change because of the guideline, which resulted in successful completion of the second project aim.

In the end, the practice guideline developed in this project was an effective tool to help the participating providers implement evidence-based care into their practice, and the patient handout was an additional resource they could use to educate their patients with a history of preeclampsia. The DNP student was able to successfully implement evidence-based care into practice and complete the eight DNP essentials through this work. Further research needs to be done to continue advancing the care for women with a history of preeclampsia, nonetheless a small change was created through this project. Women with a history of preeclampsia are at increased risk for adverse outcomes related to CVD. Healthcare providers need to be educated on how to effectively monitor, screen, and educate this population to decrease their risk of CVD later in life and subsequently decrease the incidence of CVD amongst women in the U.S.

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APPENDICES

APPENDIX A

IRB APPROVAL LETTER

INSTITUTIONAL REVIEW BOARD
For the Protection of Human Subjects
FWA 00000165

MONTANA STATE UNIVERSITY

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MEMORANDUM

TO: Brielle Toole and Sandra Benavides-Vaello

FROM: Mark Quinn Mark Quinn CH
Chair, Institutional Review Board for the Protection of Human Subjects

DATE: June 10, 2020

RE: *"Preeclampsia and Increased Cardiovascular Disease Risk: A Practice Guide for Providers" [BT061020-EX]*

The above research, described in your submission of June 10, 2020, is exempt from the requirement of review by the Institutional Review Board in accordance with the Code of Federal regulations, Part 46, section 101. The specific paragraph which applies to your research is:

____ (b) (1) Research conducted in established or commonly accepted educational settings, involving normal educational practices such as (i) research on regular and special education instructional strategies, or (ii) research on the effectiveness of or the comparison among instructional techniques, curricula, or classroom management methods.

_X_ (b) (2) Research involving the use of educational tests (cognitive, diagnostic, aptitude, achievement), survey procedures, interview procedures or observation of public behavior, unless: (i) information obtained is recorded in such a manner that human subjects can be identified, directly or through identifiers linked to the subjects; and (ii) any disclosure of the human subjects' responses outside the research could reasonably place the subjects at risk of criminal or civil liability, or be damaging to the subjects' financial standing, employability, or reputation; and (iii) the information obtained is recorded by the investigator in such a manner that the identity of the human subjects can readily be ascertained, directly or through identifiers linked to the subjects, and an IRB conducts a limited IRB review to make the determination required by section 16.111(a)(7).

____ (b) (3) Research involving the use of educational tests (cognitive, diagnostic, aptitude, achievement), survey procedures, interview procedures, or observation of public behavior that is not exempt under paragraph (b)(2) of this section, if: (i) the human subjects are elected or appointed public officials or candidates for public office; or (ii) federal statute(s) without exception that the confidentiality of the personally identifiable information will be maintained throughout the research and thereafter.

____ (b) (4) Research involving the collection or study of existing data, documents, records, pathological specimens, or diagnostic specimens, if these sources are publicly available, or if the information is recorded by the investigator in such a manner that the subjects cannot be identified, directly or through identifiers linked to the subjects.

____ (b) (5) Research and demonstration projects, which are conducted by or subject to the approval of department or agency heads, and which are designed to study, evaluate, or otherwise examine: (i) public benefit or service programs; (ii) procedures for obtaining benefits or services under those programs; (iii) possible changes in or alternatives to those programs or procedures; or (iv) possible changes in methods or levels of payment for benefits or services under those programs.

____ (b) (6) Taste and food quality evaluation and consumer acceptance studies, (i) if wholesome foods without additives are consumed, or (ii) if a food is consumed that contains a food ingredient at or below the level and for a use found to be safe, or agricultural chemical or environmental contaminant at or below the level found to be safe, by the FDA, or approved by the EPA, or the Food Safety and Inspection Service of the USDA.

Although review by the Institutional Review Board is not required for the above research, the Committee will be glad to review it. If you wish a review and committee approval, please submit 3 copies of the usual application form and it will be processed by expedited review.

APPENDIX B

SURVEY A

Note: Survey A adapted from an existing instrument developed by Young et al. (2012).

1. What is your specialty?
    a. Primary Care Physician
    b. Primary Care APRN/NP
    c. Primary Care PA
    d. OB/GYN Physician
    e. OB/GYN APRN/NP
    f. OB/GYN PA
    g. OB/GYN Midwife

2. How many years of experience do you have?
    a. <5 years
    b. 6-10 years
    c. 11-20 years
    d. >20 years

3. How old are you?
    a. 25-40 years old
    b. 41-55 years old
    c. 56-65 years old
    d. 66+ years old

4. What gender do you identify with?
    a. Male
    b. Female
    c. Other

5. What is the age range of the patients that you most frequently take care of?
    a. 18-35 years
    b. 36-50 years
    c. >50 years

6. What is the average number of women in your practice who are >50 years old?
    a. <10%
    b. 11-30%
    c. 31-50%
    d. >50%

7. Do you or a first degree relative have a history of preeclampsia?
    a. Yes
    b. No

8. Do you have a research or specific practice interest in preeclampsia?

a. Yes
b. No

9. Do you directly care for patients who have preeclampsia?
    a. Yes
    b. No

10. Do women with a history of preeclampsia have an increased risk of developing these problems later in life? (Options are yes, no, or unsure)
    a. Malignancy
    b. Hypertension
    c. Ischemic Heart Disease
    d. Stroke
    e. Renal Disease
    f. Liver Disease

11. Do women with a history of preeclampsia have a shorter life expectancy?
    a. Yes
    b. No

12. Has the American Heart Association identified a link between preeclampsia and increased cardiovascular disease risk later in life?
    a. Yes
    b. No
    c. I don't know

13. Has the American Stroke Association identified a link between preeclampsia and stroke?
    a. Yes
    b. No
    c. I don't know

14. Are you familiar with the American College of Obstetricians and Gynecologists' practice bulletin that addresses strategies for prevention of cardiovascular disease in women with a history of preeclampsia?
    a. Yes
    b. No
    c. I don't know

15. Do you regularly counsel your patients >50 years old about reducing their cardiovascular risk?
    a. Yes
    b. No

16. When you take a history from a nonpregnant woman, do you ask about a history of preeclampsia?
    a. Most of the time
    b. About half of the time
    c. Rarely

17. Do you ask women with a history of preeclampsia about the severity of preeclampsia they had?
    a. Most of the time
    b. About half of the time
    c. Rarely

18. Do you ask women with a history of preeclampsia if they delivered prematurely?
    a. Most of the time
    b. About half of the time
    c. Rarely

19. Do you counsel women with a history of preeclampsia about their risk of cardiovascular disease later in life?
    a. Most of the time
    b. About half of the time
    c. Rarely

20. If you do counsel women with a history of preeclampsia about their cardiovascular disease risk, what kind of counseling are you providing?
    a. General counseling
    b. Specific numbers and actual risk
    c. Specific information on ways to lower cardiovascular disease, like healthy diet, exercise, cholesterol level monitoring, blood pressure checks, smoking cessation, and weight loss

21. Would you find a written guideline about caring for women with a history of preeclampsia helpful?
    a. Yes
    b. Maybe
    c. No

22. Would you be open to changing how you practice if you learned something new from the above guideline?
    a. Yes
    b. Maybe
    c. No

APPENDIX C

SURVEY B

1. Did you read the guideline emailed to you about preeclampsia and cardiovascular disease?
    a. Yes
    b. No (If the answer is no, the survey moves to question 11.)

2. Did you find the guideline helpful or learn anything new from it?
    a. Yes
    b. No

3. How easy did you find the guideline to read and understand?
    a. Extremely easy
    b. Somewhat easy
    c. Neither easy nor difficult
    d. Somewhat difficult
    e. Extremely difficult

4. Have you made any practice changes since reading through the guideline?
    a. Yes
    b. No

5. If yes, what changes have you made?
    Free text response box

6. Do you plan to make any practice changes in the future after reading through the guideline?
    a. Yes
    b. No

7. If yes, what changes do you plan to make?
    Free text response box

8. What changes, if any, would you recommend making to the guideline?
    Free text response box

9. Did you find the patient educational handout useful?
    a. Yes
    b. No

10. What changes would you recommend making to the patient educational handout, including ideas for information dissemination?
    Free text response box

11. Please briefly explain why you were not able to read the guideline emailed to you about preeclampsia and cardiovascular disease? (ex. due to COVID-19, time constraints, etc.)
    Free text response box

12. What suggestions do you have for capturing older patients that may not have had a formal "preeclampsia" diagnosis during pregnancy but had hypertension in pregnancy and subsequent increased CVD risk?

    Free test response box

APPENDIX D

POWERPOINT PRESENTATION SLIDES

Preeclampsia and Increased Cardiovascular Disease Risk: A Practice Guide for Providers

Brielle Toole, RN

DNP Student at MSU

Background

- Cardiovascular disease (CVD) is the leading cause of death among women in the U.S. and globally, yet this disease is preventable and treatable. Death from CVD makes up over 50% of all female deaths.
- One in five women in the U.S. will have a stroke at some point during their life.
- In the 1960's, a link was identified between preeclampsia during pregnancy and an increased risk of hypertension later in life. Extant evidence has now established that women with a history of preeclampsia are also at an increased risk for developing CVD later in life.

Preeclampsia on the Rise

- Rates of preeclampsia are on the rise in the United States (U.S.); the rate of preeclampsia increased by 25% from 1987 to 2004.
- Preeclampsia is a multisystem hypertensive disorder mediated by the placenta and affects 2-8% of pregnancies worldwide. From 2015-2019, 3,942 women in Montana had preeclampsia, and this was 7% of the 55,305 births reported to the Montana Department of Health and Human Services.
- In 2014, the American Heart Association (AHA) and the American Stroke Association (ASA) suggested preeclampsia be considered a risk factor for stroke and listed this in their prevention guidelines. The AHA also stated it is important to obtain an obstetrical history from women when assessing their CVD risk.

Cardiovascular Disease Risk

- Ahmed et al. (2014) report that women with a history of preeclampsia have a 12-fold overall increased risk of CVD when compared to women without a history of preeclampsia.
- Preeclampsia and CVD share many pathophysiological features.
- When compared, women with a history of preeclampsia have a four-fold increased risk of hypertension and two-fold increased risk of stroke later in life than women who were normotensive throughout pregnancy.

Preterm Delivery

- Women with history of preeclampsia requiring preterm delivery had a higher risk of developing CVD later in life (21.5 per 10,000 person years) than those without preterm delivery (16.0 per 10,000 person years).
- ACOG estimated women with a history of recurrent or early-onset preeclampsia or preeclampsia requiring preterm delivery have 4-8 times the risk of developing CVD later in life than those women with normal pregnancies.

Provider Role

- Providers have limited knowledge about the link between preeclampsia and future CVD risk. While many providers routinely offer preventive counseling regarding CVD risk, they generally do not discuss the implications of this and a history of preeclampsia.
- There is a need for better provider education so that patients can receive important information regarding their history of preeclampsia and subsequent increased CVD risk.
- General awareness of CVD risk in high-risk women is linked to the initiation of preventative actions, and women with a history of preeclampsia have been shown to be highly motivated to lower their risk of CVD.

Practice Guideline

*** All monitoring, screening, and education should be done on an **ANNUAL** basis ***

Monitoring	Screening	Education
Blood Pressure	Anxiety (ex: GAD-7)	Smoking Cessation
Lipids	Depression (ex: PHQ-9)	DASH Diet
Fasting Glucose	Reynold's Risk Score*	Regular Physical Activity**
BMI	Detailed pregnancy history at first visit only and documented	BMI less than 25 kg/m^2

* Visit http://www.reynoldsriskscore.org/ for more information
** Physical activity is defined as 150 minutes per week of moderate exercise, 75 minutes per week of vigorous exercise, or an equivalent combination of the two

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APPENDIX E

PRACTICE GUIDELINES

Practice Guideline for Patients with a *History of Preeclampsia*

*** All monitoring, screening, and education should be done on an **ANNUAL** basis ***

Monitoring	Screening	Education
☐ Blood Pressure	☐ Anxiety (ex: GAD-7)	☐ Smoking Cessation
☐ Lipids	☐ Depression (ex: PHQ-9)	☐ DASH Diet
☐ Fasting Glucose	☐ Reynold's Risk Score*	☐ Regular Physical Activity**
☐ BMI	☐ Detailed Pregnancy History at first visit only	☐ BMI less than 25 kg/m^2

* Visit http://www.reynoldsriskscore.org/ for more information

** Physical activity: 150 min/week of moderate exercise, 75 min/week of vigorous exercise, or an equivalent combo of the two

Refer patients to a specialist if indicated (ex: cardiology, endocrinology, dietetics, etc.)

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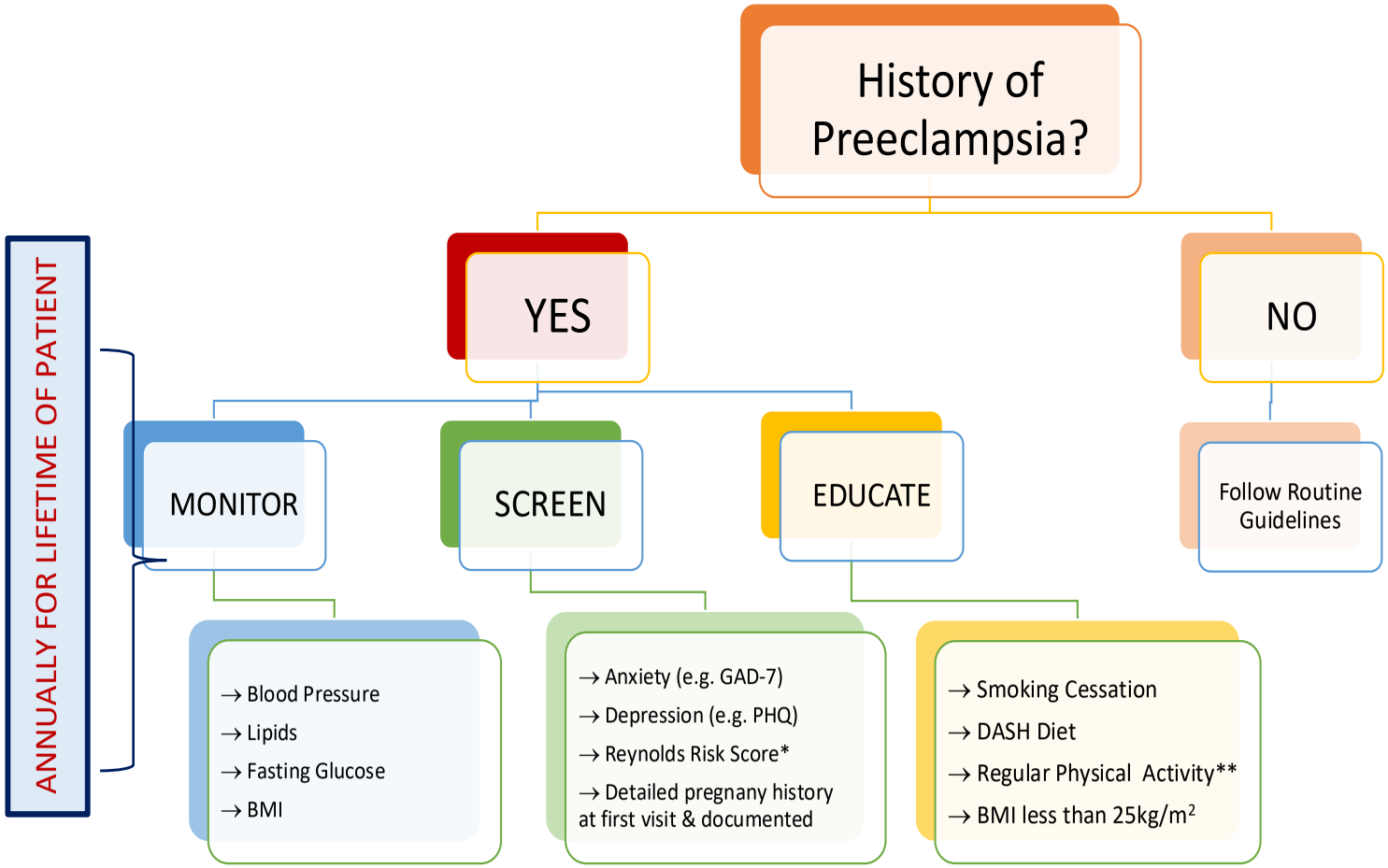

⇒ *Visit http://www.reynoldsriskscore.org/ for more information

⇒ ** Physical activity is defined as 150 minutes per week of moderate exercise, 75 minutes per week of vigorous exercise, or an equivalent combination of the two

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APPENDIX F

PATIENT INFORMATIONAL HANDOUT

Patient Information

PREECLAMPSIA
Increases Your Lifetime Risk for Cardiovascular Disease (CVD)

Know Your Facts -- Every Visit, Every Time

Did you know that preeclampsia increases your lifetime risk of CVD? CVD includes coronary artery disease, stroke, peripheral vascular disease, heart failure, and heart attack and is the number one cause of death in women. Women with a history of preeclampsia have 4 times the risk of high blood pressure and 2 times the risk of stroke later in life when compared to women without preeclampsia. Fortunately, even simple lifestyle changes can decrease your risk of CVD.

If you had preeclampsia with ANY pregnancy, you should have the following tests done at your provider's office **EVERY YEAR** for the rest of your life.


BLOOD PRESSURE

FASTING GLUCOSE

LIPIDS

BODY MASS INDEX (BMI)

CVD RISK SCORE

WHAT CAN YOU DO TO REDUCE YOUR CVD RISK?

- √ **STOP SMOKING:** If you don't smoke, don't start. If you do smoke, talk to your provider about getting support to quit.
- √ **REGULAR PHYSICAL ACTIVITY**: Aim for 150 minutes per week of moderate physical activity.
- √ **Body Mass Index (BMI):** Keep your BMI under 25 kg/m^2.
- √ **Balanced Diet:** A balanced diet is key to reducing CVD risk. Ask your provider about the **DASH** diet.
- √ **Depression or Anxiety:** If you are experiencing depression or anxiety, talk to you provider about getting treatment. Mental health is important to your heart health.

APPENDIX G

MONTANA PREECLAMPSIA DATA

Prevalence of Preeclampsia and Eclampsia by Age and Race among Births to MT Residents, 2015-2019

Age and Race		Preeclampsia		Eclampsia	
		Yes	No or Unknown	Yes	No or Unknown
Under 30	White	1760	27038	62	28736
	AI/AN	329	4684	8	5005
	Other	39	635	†	672
30 or Older	White	1583	20631	52	22162
	AI/AN	177	1753	13	1917
	Other	54	564	0	618

† = 1-4 Occurrences
Suppression Policy: https://dphhs.mt.gov/Portals/85/publichealth/documents/Epidemiology/GuidelinesReportingPHI.pdf

Data Provided by the Office of Epidemiology and Scientific Support, MT DPHHS