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An Opportunity to Better Address Hypertension in Women: Self-Measured Blood Pressure Monitoring

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Abstract

More than 56 million women in the United States have hypertension, including almost one in five women of reproductive age. The prevalence of hypertensive disorders of pregnancy is on the rise, putting more women at risk for adverse pregnancy-related outcomes and atherosclerotic cardiovascular disease later in life. Hypertension can be better detected and controlled in women throughout their life course by supporting self-measured blood pressure monitoring. In this study, we present some potential strategies for strengthening our nation's ability to address hypertension in women focusing on pregnancy-related considerations for self-measured blood pressure monitoring.

Keywords: self-measured blood pressure monitoring, hypertensive disorders of pregnancy, hypertension, blood pressure, SMBP

Almost 50% of adults in the United States have hypertension, including 56.3 million women.[1] Fewer than one in four of these women (23.3%) have their blood pressure controlled to <130/80 mm Hg,[1] equating to 43.2 million women who are at increased risk of heart attacks, strokes, heart and kidney failure, dementia, and other potential sequelae. While hypertension prevalence in women increases with increasing age,[2] attention to hypertension prevention, detection, and control in women is important early in their lives to stave off potential consequences throughout their life course.

Hypertension in Women of Reproductive Age

Analyses using 2011–March 2020 (prepandemic) National Health and Nutrition Examination Survey (NHANES) data found that 19.3% of women of reproductive age (WRA, defined as 20–44 years) have hypertension (defined as ≥130 mm Hg systolic or ≥80 mm Hg diastolic blood pressure).[3] Hypertension prevalence in WRA varies widely by race and ethnicity, ranging from 14.0% among Hispanic women to 30.9% in non-Hispanic Black women.

Among these WRA with hypertension, more than half (54.5%) were eligible for antihypertensive treatment, yet current use of antihypertensive medication was not optimal and ranged from 42.0% among women of another or multiple non-Hispanic races to 61.8% among non-Hispanic White women. Blood pressure control among all WRA with hypertension was poor, ranging from 5.2% among women of another or multiple non-Hispanic races to 18.6% among Hispanic women. These gaps highlight racial disparities in prevention and control of hypertension among WRA. Detecting hypertension and achieving control in WRA is particularly important so that future morbidity and mortality can be prevented.[3]

Hypertensive Disorders of Pregnancy

Hypertensive disorders of pregnancy (HDP), including chronic hypertension, gestational hypertension, preeclampsia/eclampsia, and preeclampsia superimposed on chronic hypertension, are a leading cause of maternal mortality and are increasing in prevalence.[4–7] Women of racial/ethnic minorities, particularly Black and American Indian/Alaskan Native women, experience a disproportionate burden of morbidity and mortality related to HDP when compared with White women.[4,8,9]

HDP can cause serious maternal complications that may be immediate (heart attack, stroke, and peripartum cardiomyopathy)[10,11] or long-term (hypertension, type 2 diabetes,

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hyperlipidemia, cardiovascular disease, and chronic kidney disease).[12–16] They can also cause serious fetal complications (small for gestational age, stillbirth, preterm delivery, and placental abruption)[10,17] and offspring complications later in life (cardiovascular disease, stroke, and hypertension).[18–21]

As HDP are a leading cause of pregnancy-related deaths, and more than 60% of pregnancy-related deaths are preventable, improved detection and management of HDP remains a key strategy to reducing pregnancy-related mortality and morbidity in the United States.[22] Furthermore, postpartum hypertension and postpartum preeclampsia can cause serious maternal complications (stroke, seizures, and cardiomyopathy) up to 3 months after delivery.[5] Timely detection of these complications can be delayed or even missed because follow-up care for many women is limited to a single visit 4–6 weeks after giving birth.[23]

To reduce preventable pregnancy-related deaths by increasing awareness of serious pregnancy-related complications and their warning signs, CDC's Division for Reproductive Health released the ''Hear Her'' campaign.[24] The goal of ''Hear Her'' is to raise awareness of urgent maternal warning signs of pregnancy-related complications during and after pregnancy and improve communication between patients and their clinical team. Because women are often told by clinicians that their health concerns are unfounded or just a part of normal pregnancy,[25] the campaign encourages anyone who supports pregnant and postpartum women, including partners, friends, family, coworkers, and clinicians, to actively listen to a pregnant or postpartum woman when she says something does not feel right. Data from self-measured blood pressure monitoring (SMBP) could help substantiate women's health concerns by providing quantitative patterns of abnormal blood pressure.

Several major federal initiatives have prioritized blood pressure control, including through widespread use of SMBP, in WRA and pregnant and postpartum women as a strategy for improving maternal health (Table 1).[26–31] Our objective in this study is to present some potential strategies for strengthening our nation's ability to address hypertension in women focusing on pregnancy-related considerations for SMBP. Most of the scientific literature and other publications cited in this study focus on women; however, we acknowledge the importance of hypertension and risk of atherosclerotic cardiovascular disease among transgender, intersex, and nonbinary people as well.

Self-Measured Blood Pressure Monitoring

SMBP is the measurement of blood pressure by a person outside of an office setting, ideally using a validated automatic upper arm device. SMBP is an evidence-based strategy for lowering blood pressure and improving control among people with hypertension.[32–36] It has been included in numerous clinical guidelines and taskforce recommendations for its role in the diagnosis and management of hypertension and was highlighted by the Surgeon General as a strategy for both controlling hypertension and improving maternal health.[28,37–40] Similar to blood glucose monitoring, SMBP can be used to provide vital information on a person's patterns of blood pressure. These data can then be shared with the person's clinical team to be incorporated into her hypertension care plan (*e.g.*, medication titration or addition) and used by the patient as an indicator for needed lifestyle changes (*e.g.*, increase physical activity or consume less sodium).

Despite the established utility and value of SMBP among adult populations including WRA, more research on effectiveness of SMBP use for blood pressure control in pregnant or postpartum women is needed. Results from individual trials and systematic reviews in this population have been mixed due to heterogeneity in populations studied, differences in measurement protocols and procedures, outcomes assessed, and inconsistent use of SMBP devices that have been clinically validated in pregnant populations.[41–46] Studies are also needed to assess SMBP's role in supporting prenatal care for women with barriers to care such as limited access to health care and transportation, copayments, and the inability to take time off from work. In the absence of robust evidence in this specific population, given the evidence for its use in the general population, SMBP use in pregnant and postpartum women is a reasonable tool to include in the HDP clinical ''toolbox.''

Several issues must be addressed to achieve widespread implementation of SMBP during and after pregnancy. These include SMBP device validation, availability, and coverage/reimbursement; better identification of pregnant women with

Table 1. Federal Initiatives to Address Blood Pressure Control in Women

Date	*Federal initiative*
February 2019	Health Resources and Services Administration challenge to identify and spotlight experts in remote health monitoring, including SMBP during and after pregnancy.[26]
December 2020	Department of HHS *Healthy Women, Healthy Pregnancies, Healthy Futures: Action Plan to Improve Maternal Health in America* was released; one of its three main targets is to achieve blood pressure control in 80% of WRA with hypertension in 5 years.[27]
December 2020	Surgeon General's *Call to Action to Improve Maternal Health* was released; acknowledges that hypertension and other conditions are risk factors for poor maternal health outcomes.[28]
October 2021	HHS Office of Women's Health annual National Women's Blood Pressure Awareness Week was launched.[29]
October 2021	HHS Office of Women's Health SMBP Partnership Program was announced to accelerate the uptake of SMBP among women.[30]
January 2022	Million Hearts® included a focus on SMBP use in pregnant and postpartum women with hypertension for 2022–2026.[31]

HHS, Health and Human Services; SMBP, self-measured blood pressure monitoring; WRA, women of reproductive age.

hypertension who could benefit from SMBP; and development of clinical quality measures that focus on management of HDP and use SMBP readings.

More SMBP Devices Specifically Validated in Pregnant Populations

The accuracy of BP devices is a critical consideration in the implementation of SMBP. Automatic upper arm devices are preferred over wrist cuffs due to associated user error with the latter.[47] In recent years, the importance of using independently validated devices has been highlighted.[48,49] The American Medical Association partnered with the National Opinion Research Center at the University of Chicago (NORC) to launch the U.S. Blood Pressure Validated Device Listing (VDL™) to provide a list of blood pressure measurement devices that have been clinically validated by independent parties.[50] Although this resource includes a variety of blood pressure measurement devices, including SMBP devices, as of July 2022, the VDL does not denote whether devices were validated in pregnant populations, which is particularly important given that blood volume increases by 40%–50% during pregnancy. Nevertheless, a few devices have been validated among pregnant populations[51–54]; these could be options for use in clinical practice and future research.

Properly Sized Blood Pressure Cuffs

Using a properly sized cuff is crucial to obtaining accurate blood pressure readings. When implementing SMBP, it is important to measure arm circumference. Using too small a cuff can produce falsely elevated readings and vice versa, contributing to over- and underdiagnosis of hypertension.[55] According to 2007–2010 data from NHANES, 38.0% of women with hypertension (excluding pregnant women) need a large or extra-large blood pressure cuff (*i.e.*, a cuff that accommodates arm circumferences of >34 to ≤44 cm and >44 cm, respectively). In all women aged 20–39 years during that same period, 26.3% had an arm circumference that called for a size large or extra-large cuff.[56] Comparable analyses have not been conducted specifically for pregnant women.

Weight gain is appropriate and typical during pregnancy. Depending on prepregnancy body mass index, women are recommended to gain 5–18 kg during pregnancy to allow for proper fetal development.[57] Data suggest that 47% of women gain more than the recommended amount of weight during pregnancy.[58] Therefore, as a woman progresses through pregnancy, it may be necessary to remeasure her arm circumference to ensure a properly sized cuff is used for blood pressure measurement—both in-office measurement and for SMBP. Because this phenomenon of arm circumference in pregnant women has not been well studied, it may play a role in the results from SMBP-related trials; blood pressure measured with a smaller-than-recommended cuff may result in higher blood pressure readings, on average, by 4.8 mm Hg.[55]

SMBP Coverage and Reimbursement

Cost, in both time and dollars, is a well-documented barrier to SMBP implementation.[59–61] Coverage for SMBP devices and separate cuffs varies widely by payer.[62,63] Although billing codes exist to support reimbursement for clinician time to train patients on SMBP and receive, interpret, and incorporate patient-generated readings into their care plan, these codes are not yet widely used.[49]

Medicaid is the largest payer for maternity care in the United States. In 2020, Medicaid was the source of payment for 42.0% of all births including 64.7% of births by non-Hispanic Black women and 58.6% of births by Hispanic women.[64] As of February 2022, 37 states provide some level of Medicaid coverage for SMBP devices, although the range in level of coverage varies greatly (ranging from $8.66 in Arkansas to $159.44 in New Hampshire; mean/median $62.84/$49.36).[62] As of May 2022, SMBP devices on the VDL cost between $30 and $499 (mean/median $103.29/$83.00), and those with an extra-large cuff cost $100 or more.[65] Yet Alaska, New Hampshire, Washington, DC, and Utah are the only states that provide Medicaid coverage of SMBP devices of $100 or more. When compared with SMBP device coverage, fewer states reimburse for clinician time to educate and train patients on SMBP ($n=22$) or incorporate patient SMBP readings into their care plan ($n=19$).[62] Expanding and optimizing existing SMBP-related Medicaid coverage/reimbursement are strategies that can be used to overcome barriers, particularly in racial/ethnic minority pregnant women.

In addition, coverage and reimbursement related to SMBP outside of Medicaid varies greatly. In a 2019 coverage analysis of 20 private insurers with the highest numbers of covered lives, SMBP-related coverage was suboptimal; two plans covered SMBP devices to confirm a diagnosis of hypertension and four covered SMBP devices with special stipulations (*e.g.*, prior authorization, enrollment in a disease management program for high-risk beneficiaries, or for home dialysis). Four plans reimbursed for related clinical services, although only for high-risk beneficiaries.[63] Improving coverage and reimbursement may enhance access to and use of SMBP among women, including those with HDP, and may help women avoid largely preventable cardiovascular disease and events throughout their life course.

Pregnant Women with Hypertension Are Hiding in Plain Sight

Using SMBP to improve blood pressure control is a moot strategy if patients with hypertension are not being diagnosed and managed. In clinical settings, it is not uncommon for adults to have multiple abnormal blood pressure readings without a diagnosis of hypertension.[66–71] We have dubbed this phenomenon of potentially undiagnosed hypertension ''hiding in plain sight'' and have proposed a four-step process for addressing this phenomenon using electronic health record (EHR) data.[66] Several clinical settings have undertaken this kind of EHR data exploration to find patients with potentially undiagnosed hypertension, diagnose as appropriate, and bring them under control.[67–71]

Researchers from Kaiser Permanente applied a similar framework to identify pregnant women with hypertension through blood pressure values, diagnosis codes, and medication fills captured in EHRs. They found that searching solely for elevated blood pressures, in absence of a diagnosis code, helped identify many more pregnant women with hypertension.[72] These kinds of population health management approaches may facilitate care teams' efforts in identifying

and managing pregnant and postpartum women with potential HDP. Such patients could then be counseled and equipped to use SMBP.

Leveraging Clinical Quality Measures

Because ''what gets measured gets done,'' a good way to signal the importance of managing HDP could be through clinical quality measurement. SMBP readings can currently be used in existing clinical quality measures that address controlling high blood pressure in the nonpregnant population; examples include National Quality Forum (NQF) 0018 and Centers for Medicare and Medicaid Services (CMS) 165.[73,74] However, currently, there are no measures endorsed by NQF that address hypertension management during the pregnancy or postpartum periods. This gap represents an opportunity not yet realized to assess and drive performance in hypertension control in this important population.

Perinatal quality collaboratives (PQCs) implement evidence-based quality improvement initiatives, such as safety bundles, in health care systems to improve the quality of care for pregnant women and babies.[75] The Alliance for Innovation on Maternal Health (AIM) has a maternal safety bundle to improve inpatient management of severe hypertension in pregnancy,[76] but little formal quality improvement work exists focused on outpatient management of chronic hypertension during pregnancy, gestational hypertension, or preeclampsia prevention. CMS oversees the Quality Payment Program (QPP) Merit-Based Incentive Payment System (MIPS) to reward high-value high-quality care with payment increases while simultaneously reducing payments for care that does not meet performance standards.[77] To make quality reporting easier, MIPS has developed specialty measure sets. The Obstetrics/Gynecology specialty measure group includes CMS22, *Screening for High Blood Pressure and Follow-Up Documented*, which assesses whether blood pressure is measured in all patients (regardless of pregnancy status) and whether a recommended follow-up plan is documented if warranted by blood pressure readings. It also includes the aforementioned CMS165, *Controlling High Blood Pressure*, but, as previously stated, this measure excludes pregnant women. An opportunity to strengthen this measure group and improve pregnancy-related outcomes is to add a measure that assesses blood pressure control among pregnant women with HDP. Formal clinical quality measures, which allow for the inclusion of SMBP readings for assessing blood pressure control in HDP, could be beneficial.

Conclusion

Hypertension is common in women and increasingly common during and after pregnancy. Undetected and uncontrolled hypertension puts lives at risk, for both mothers and infants, from largely preventable harm. Advancing the use of SMBP, equipping care teams to better detect women with HDP and postpartum preeclampsia, and improving related measures of care, could help women live longer healthier lives.

Authors' Contributions

Conceptualization (lead), writing—original draft (lead), and writing—review and editing (equal) by H.K.W. Writing—original draft (supporting) and writing—review and editing (supporting) by T.E.S. Conceptualization (supporting), writing—original draft (supporting), and writing—review and editing (equal) by J.S.W.

Disclaimer

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