Implementation of Ambulatory Blood Pressure Monitoring for Hypertension Diagnosis in Primary Care: A Doctor of Nursing Practice Project

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Author Note

"On my honor, I pledge that I have neither given nor received aid on this assignment."

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Abstract

Hypertension is a significant health concern that affects 45% (108 million) of American adults, with 37 million of them having blood pressures ≥140/90. The two traditional methods of assessing and diagnosing hypertension in the primary care setting are clinic blood pressure measurement (CBPM) and home blood pressure monitoring (HBPM). Unfortunately, these methods have been found to have problematic variability, are time-consuming, and can be costly to the patient. A third method, ambulatory blood pressure monitoring (ABPM), leverages advanced technologies and provides a more accurate representation of the patient's naturally fluctuating blood pressures throughout the day and night, detecting isolated nocturnal hypertension and nocturnal non-dipping patterns, which are stronger predictors of cardiovascular mortality and events. This evidence-based practice project was conducted at a rural family practice clinic that utilized HBPM and CBPM methods in central Virginia. The project demonstrated significant improvements in the diagnosis and management of hypertension in the clinic and has been adopted as an integral clinical practice component in the clinic. Specifically, ABPM found 38% of the participants who presented with hypertension actually did not have hypertension, thereby avoiding potential multiple clinic visits, cost burdens, and unnecessary treatments. The ABPM method also demonstrated significant improvements in the timeliness of assessment and diagnosis, providing critical diagnostic information in two to five days compared to over three weeks with the CBPM and HBPM methods. The ABPM method was well accepted by the clinic staff, with 80% of the staff questioning the accuracy and efficiency of HBPM and CBPM, preferring ABPM over other methods.

keywords: ambulatory blood pressure monitoring (ABPM), clinic blood pressure measurement (CBPM), home blood pressure measurement (HBPM)

Implementation of Ambulatory Blood Pressure Monitoring for Hypertension Diagnosis in Primary Care: A Doctor of Nursing Practice Project

Hypertension is a serious concern due to the complications to target organs that could arise if prolonged. Hypertension is defined as the sustained increase of the resting systolic blood pressure ≥ 130 mmHg and/or a diastolic blood pressure ≥ 80 mmHg (American College of Cardiology [ACC], 2017). If left untreated, hypertension damages the cardiovascular system, brain, and kidneys and can lead to coronary artery disease (CAD), myocardial infarction (MI), heart failure, stroke, renal failure, or death (Bakris, 2019). Healthy People 2020 (2020), reported 92.8% of adults who had their blood pressure measured within the last two years at a primary care visit could verbalize if their blood pressure was within normal range. This was an improvement of 2% from 2008 indicating patient education and awareness of hypertension is increasing, but hypertension continues as an epidemic in the United States with an estimated 108 million adults affected while only 24% of them have it controlled (Center of Disease Control and Prevention [CDC], 2020).

Background and Significance

Per the World Health Organization (2020) 1.13 billion people worldwide have hypertension (HTN), with most of the cases in low- and middle-income countries and affecting 1 in 4 men and 1 in 5 women. In the United States, about 108 million adults have HTN with 37 million having blood pressures ≥140/90 (CDC, 2020). HTN affects non-Hispanic black adults (54%) more than non-Hispanic white adults (46%), and is more prevalent in the southeastern region of the United States (CDC, 2020). The American College of Cardiology (2017) states that normal blood pressure is <120/<80 and elevated blood pressure is 120-129/<80, but hypertension staging begins with readings ≥130/ ≥80 (See Table 1). Out of all the degrees of hypertension,

persistent uncontrolled hypertension has the most detrimental degree of organ damage (Mensah, 2016). Hypertension is the most commonly diagnosed condition in the outpatient setting ledding to over 472,000 American deaths in 2017 (US Preventive Service Task Force [USPSTF], 2020). It is a major contributing risk factor for stroke, chronic kidney disease, heart attack, and heart failure (USPSTF, 2020) and it is also one of the leading causes of premature mortality and morbidity globally (Dadlani et al., 2019). People with obstructive sleep apnea; drug, alcohol, or tobacco use; unhealthy diet (excessive salt, high fat diet); decreased physical activity; and obesity are at a higher risk for hypertension (ACC, 2017). On average, healthcare costs associated with hypertension in the United States reached $131 billion each year, with hypertensive individuals paying $2,000 more in annual healthcare cost than non-hypertensive adults (Kirkland et al., 2018). By 2025 the World Health Organization's global target is to reduce the prevalence of hypertension by 25% (World Health Organization [WHO], 2020), but education with efficient and accurate monitoring is needed to achieve this ambitious goal.

There are two main methods to detecting hypertension in the primary care setting: clinic blood pressure measurement (CBPM) and home blood pressure monitoring (HBPM) (Beyhaghi & Viera, 2019). CBPM allows the provider to have direct observation of the patient's blood pressure biweekly in the clinic over a four-to six-week timeframe. CBPM is the more commonly used method to assess hypertension in an individual, but this method has increased variability as clinic-based measurements can produce false positives (white-coat hypertension) or false negatives (masked hypertension). CBPM is time consuming, costly to the patient, and does not allow for an accurate representation of the patient's blood pressure throughout the day (Beyhaghi & Viera, 2019). HBPM requires patients to takes their own blood pressure once or twice per day over a two-week period. HBPM is the second most commonly used HTN detection method, but

this approach relies on user compliance and there may be an increased cost burden for the patient (Beyhaghi & Viera, 2019). Insurance companies usually do not pay for blood pressure machines, so the patients may have out-of-pocket costs to buy one. Accurate and efficient diagnosis and treatment of hypertension with pharmacological and nonpharmacological interventions is imperative to reduce organ damage, improve health outcomes, and decrease costs to the patient.

Ambulatory blood pressure monitoring (ABPM) is an alternate, but underutilized, method of hypertension diagnosis (Muntner et al., 2019). ABPM obtains real-time blood pressure monitoring at the patient's home over a 24-hour period. The ABPM obtains multiple measurements automatically throughout the day allowing for a more accurate monitoring and diagnosis of hypertension than CBPM and HBPM (Aung & Htay, 2019). The patient naturally has diurnal variations of blood pressures throughout the day and the ABPM is able to account for this variability as well as reduce the number of false readings seen with CBPM and HBPM (Dadlani et al., 2019). The ABPM is able to perform assessments on the patient's blood pressure at night to identify isolated nocturnal hypertension (nighttime without daytime hypertension) and nocturnal nondipping patterns (failure of the blood pressure to decrease by at least 10%), which has been found to be a stronger predictor of cardiovascular mortality and events than CBPM or HBPM (Aung & Htay, 2019). Aung and Htay (2019) also found that there was an increase in cardiovascular mortality and all-cause mortality with each increase in ambulatory SBP of one standard deviation (14 mmHg) while an increase in one standard deviation of clinic SBP (19 mmHg) was only associated with all-cause mortality. Beyhaghi and Viera (2019) found that ABPM was more cost effective than CBPM and HBPM, with a cost saving of $77 to $5,013 with higher quality of measurements than both CBPM and HBPM. This method of blood pressure monitoring and diagnosis was not widely used since it was not covered by insurance or

recommended by the ACC/AHA until recently. In 2019 Medicare and Medicaid began covering the cost of ABPM (Center for Medicare and Medicaid Services [CMS], 2019). The American College of Cardiology and The American Heart Association (ACC/AHA) recently approved and recommend the use of ABPM for the measuring of blood pressure outside the clinic for the diagnosis of hypertension (Muntner et al., 2019). The American Academy of Family Physicians (2018) suggests that ABPM is the best out-of-office method, but HBPM may be more practical due to accessibility and cost of ABPM. Additionally, the USPSTF (2020) recommends the use of ABPM as a diagnostic tool for hypertension to prevent misdiagnosis or overtreatment of hypertension.

Conceptual Model for Evidence Based-Practice

The Iowa Model Revised: Evidence-Based Practice (EBP) to Promote Excellence in Health Care© (Iowa Model) (See Figure 1) is utilized by large organizations and uses a flowchart with feedback loops to direct the EBP process. This model was favored for this EBP project over other models due to the versatility, applicability, and the use of the feedback loops, ensuring the understanding of the process and the decision points. The Iowa Model's initial step begins with assessing for triggering issues/opportunities. With the issue clearly understood, the purpose or question is generated. The first feedback loop assesses if the topic is a priority to the organization. An interdisciplinary team is formed of key personnel that will play an instrumental part in this EBP project. With the team formed, the literature related to the question is then assembled, appraised, and synthesized for quality and consistency. The second feedback loop evaluates if there is a sufficient amount of literature. If insufficient quality or quantity of literature is obtained, the model requires a further evaluation of the literature with broader key terms. With an adequate literature foundation, an EBP project can be designed and piloted.

Implementation and evaluation plans are then created with consideration of the available resources and any constraints. Clinicians are given any prepared materials and adoption of the pilot will be encouraged while collecting baseline data. At the conclusion of the pilot, the data will be evaluated for effectiveness and appropriateness for practice change. This final feedback loop allows for critical assessment of the project and determines if the project is appropriate for integration into the clinic, or if the pilot will need to be redesigned, reevaluated, or reconsidered for priority. Integration into practice is accomplished by identifying key personnel and hardwiring it into the system with monitoring through quality improvement. Finally, the results are disseminated for publication. With a concrete process, robust supporting literature, and a thorough implementation process, this model fully encompasses all aspects of the evidence-based practice model, making it an exceptional model for this project. Permission was granted (Appendix A) to use the Iowa Model by the University of Iowa Hospital and Clinics.

Identifying Triggers/Opportunities

In Virginia 32.4% of the residents have hypertension and it is the 13th leading cause of death, ranking Virginia 26th in 2019 for the prevalence of hypertension (America's Health Rankings, 2019). The USPSTF (2020) recommends that adults 18 years and older should be screened for high blood pressure and that blood pressure measurements should be obtained outside the clinic setting to confirm the need for treatment. In a rural family practice setting in central Virginia that manages over 1,400 patients per month with one family practice medical doctor, two nurse practitioners (NP), two physician assistants (PA), it is the providers' duty and responsibility to address, manage, and intervene in individuals with suspected hypertension. The clinic is in the most optimal location for the community and patients, but due to the rural nature of the area, the closest hospital, cardiologist, or specialist may be more than an hour away for the

patients. This family practice clinic also provides medical care to the transient population of cross-country transportation truck drivers and is a certified facility for the Department of Transportation (DOT) physicals. This practice utilized the CBPM and HBPM method of blood pressure assessment, but due to the rural area, transient nature of the truck drivers, and high patient volume in the clinic, close blood pressure monitoring was challenging at times. A more efficient and accurate blood pressure monitoring system would be useful in the diagnosis of hypertension given this clinic's unique population.

Purpose and Clinical Question

The purpose of this project was to assess, appraise, and synthesize the current literature and to implement an evidence-based practice project for the use of ambulatory blood pressure monitor units as diagnostic tools for hypertension in the primary care setting. The recommendation of the ACC/AHA and USPSTF to use ABPM for the diagnosis of hypertension outside the clinic provided an opportunity for further evaluation of the literature and practice change. As shown by the prevalence of hypertension, this topic was a priority for further investigation. This project was guided by the question: ***In adults ages 21 to 85 years old, seen in a primary care setting, how does the use of ambulatory blood pressure monitoring in the diagnosis of hypertension compare to the current practice of home blood pressure monitoring in more accurately diagnosing hypertension over a three months period?***

Form a Team

The project was conducted in a family practice setting in central Virginia. This clinic consisted of one family practice medical doctor, two nurse practitioners, two physician assistants (PA) and four medical assistants (MA) who were all part of this team. This practice is also a clinical teaching site for nurse practitioner, medical, and PA students. The family practice doctor

was the owner, stakeholder, and practice mentor. Permission was obtained from the physician owner to perform an EBP project in the clinic. Advisor and project mentor Dr. Terri Yost guided this EBP project to fruition, ensuring a well-designed project that positively impacted the clinic and patient outcomes. Expert consultation by Dan Wilson, medical librarian, and Ivora Hinton, UVA data analysist and statistician, was obtained throughout the project.

Assemble, Appraise, and Synthesize Body of Evidence

Assemble the Relevant Literature

A systematic literature review was conducted to examine the effect of ambulatory blood pressure monitoring in the diagnosis of hypertension among adults ages 21 to 85 in the primary care setting using PubMed, Cumulative Index to Nursing and Allied Health Literature (CINAHL), Web of Science, and Cochrane (See Figure 2, PRISMA Flow Diagram). The PICOT format was used to guide this literature search

Population: adults ages 21 to 85 years old, seen in a primary care setting

Intervention: the use of ambulatory blood pressure monitoring to diagnosis hypertension

Comparison: the current practice of home blood pressure monitoring and clinic blood pressure monitoring

Outcome: more accurately diagnosing hypertension

Time: over a three-month period

The search termed utilized in all databases were "*ambulatory blood pressure monitoring," "24 hour blood pressure monitoring," "24 hour ambulatory blood pressure monitoring," "hypertension," "high blood pressure," and "diagnosis"*. Year of publication for all searches were restricted to the past 10 years (2010 – present). The search was also restricted to English language and full text. A grey literature search using Google Scholar showed no

evidence of publication bias and findings were consistent with findings in the systematic review. Practice guidelines about ambulatory blood pressure monitoring and hypertension were reviewed from Professional organizations and national bodies such as American College of Cardiology and American Heart Association. Articles with any level of evidence that pertained to the use, accuracy, and effectiveness of ambulatory blood pressure were initially included.

To ensure all pertinent articles were included, literature search strategy consultation was obtained from the university's medical librarian. The comprehensive literature search generated a high number of articles that did not meet inclusion criteria. To ensure that pertinent articles were not excluded, a hand review of the articles was performed. A total of 776 articles were generated from the comprehensive literature search and after removing 164 duplicates, 612 articles remained. The article titles were screened for PICOT question relevance and meeting inclusion criteria. The inclusion criteria included any articles that compared, discussed, or evaluated the ambulatory blood pressure monitors in adults ages 21 – 85. This evaluation excluded 562 articles leaving 50 articles for full-text assessment. Further evaluation of the remaining articles found that 40 articles did not address PICOT question. Eleven articles were included in the qualitative synthesis. Figure 2 depicts the PRISMA format and process.

Out of the 11 articles included in the qualitative synthesis, one article was removed for it lacked quality of evidence and results using the Johns Hopkins Nursing Evidence-Based Practice (JHNEBP) standards. An additional article was found that referenced the PICOT questions and was added to the articles for quality synthesis. Four articles were systematic reviews with three performing meta-analyses. Four articles were cohort studies, with one of the four being a quasi-experimental study. Two articles were cross-sectional study. A total of 10 articles remained for literature review, appraisal and synthesis.

Appraisal and Synthesis

Level of Evidence

A thorough evaluation of the ten articles was performed using the Johns Hopkins Nursing Evidence-Based Practice (JHNEBP) worksheets to assess the level of evidence and applicability to the topic as described in Table 3. Overall, the quality of evidence ranged from level II-A to level III-B. As previously discussed, an article was removed after evaluating it to be level III-C: The survey tool used to gather the providers response was created by the author and was not validated or checked for reliability. Further, findings were significantly influenced by recall bias due to the methods used for data collection.

Five articles were categorized as II-A, two of which were systematic reviews with meta-analysis. Each of the meta-analyses had a robust, comprehensive search strategy and rigorous appraisal methods. Hodgkinson et al. (2011) searched seven databases for articles over the past 30 years and had two independent reviewers evaluating and critiquing the articles. Piper et al. (2014) conducted a systematic review to assist in updating the hypertension recommendations for the U.S Prevention Service Task Force (USPSTF). They searched over 11 databases and also had two independent reviewers evaluating over 19,000 titles and abstract. O'Flynn et al. (2016) conduced a prospective cohort study with over 931 participants and even though a limitation to this study was selection bias, they had a standardized method of obtaining the blood pressure data and the results were consistent with the impact ABPM on diagnosis and management. Schwartz et al. (2016) performed a robust quasi-experimental time series design study with over 1,000 participants. A limitation to this article was the use of non-probability convenience sampling to obtain participants, but the robust sample size of 1,011 created a homogenous sample with appropriate power, providing stronger results. Sheppard et al. (2018) performed a

prospective observational cohort study with almost 900 participants. A purposeful limitation by the research team was not using the same blood pressure monitoring device through all participating sites because they wanted to simulate true clinic readings.

There were two articles with evidence level of II-B due to the studies limitations. Reino-Gonzalez et al. (2017) performed a systematic review generating over 230 articles from the past 60 years and had two independent reviewers evaluating the articles, but a notable limitation was that the search was performed only using the Cochrane and Medline databases. Albasri et al. (2017) also conducted a systematic review which generated over 3,500 studies from three separate databases, but there was inconsistent methodology which affected the interpretation of the mean blood pressure differences.

There were two articles with level III-A and one article with evidence level III-B due to study design and limitations. Kairo (2014) conducted a retrospective cohort study with over 450 participants. Due to the large number of participants and the evidence showing consistent results, this study was categorized as level III-A. Ringrose et al. (2018) also conducted a strong level III-A retrospective cross-sectional study with 96 participants. Their data were consistent and aligned with practice standards. Finally, Kronish et al. (2017) conducted a level III-B cross sectional study with 42 participants. This study discussed the barriers to the use of ABPM, but convenience sampling was used and the study was conducted using a survey for which the validity was not discussed.

Sensitivity of Ambulatory Blood Pressure Monitoring

Increased accuracy with ABPM over clinic and home blood pressure monitoring was resonant throughout almost every article. Each article described the fact that ABMP was more sensitive and more specific than other blood pressure measurements and was able to distinguish

white-coat hypertension and masked hypertension. O'Flynn et al. (2016) found that ABPM had a sensitivity of 70% and a specificity of 76%, while the office blood pressure had a sensitivity of 56% and a specificity of 74%. Reino-Gonzalez et al. (2017) echoed these results with an ABPM sensitivity of 55-91%, while clinic blood pressures had a sensitivity of 25-61%.

The individual taking the blood pressure measurements should be taken into consideration as well as the sensitivity and validity of the office blood pressure machine. Reino-Gonzalez et al. (2017) mentioned that, depending on who was taking the blood pressure, the sensitivity would decrease or increase. They found that the sensitivity of blood pressure measurements would decrease when performed by a physician and would increase when taken by a nurse (Reino-Gonzalez et al., 2017).

Hodgkinson et el. (2011) found that all studies they evaluated showed the same decreased sensitivity and specificity of clinic and home blood pressure monitoring and expressed concern and hesitation in diagnosing and treating people with these measurements alone. Kario (2014) found that 60% of participants with home systolic blood pressure measurements <135 mmHg actually had ABPM that was >130 mmHg, which indicated the presence of masked hypertension. Masked hypertension is difficult to diagnose since the clinic blood pressure may be normal, while the ABPM will be elevated, indicating a need for these types of patients to have this type of monitoring. Both Schwartz et al. (2016) and O'Flynn et al. (2016) found that about 14% of the participants had masked hypertension and white coat hypertension was seen in 1-14% of participants. Piper et al. (2014) also found a wide range of studies with reported white-coat hypertension ranging between 5-65%. The presence of this white-coat hypertension brings the question if there was a sensitivity error in the clinic testing or if it was a true false-positive.

Schwartz et al. (2016) reported that there was a common misconception that clinic blood pressure was higher than ABPM, but they found that ABPM exceeded clinic blood pressure measurements by 10 mmHg in 35% of the participants. Ringrose et al. (2018) found results similar to Schwartz, that ABPM was higher than clinic blood pressure by almost 5 mmHg. This demonstrates the accuracy and sensitivity of the ABPM. Many of the other articles report similar findings, indicating that the sensitivity of ABPM is more accurate in depicting the true mean blood pressure throughout a 24-hour period, than a one-time clinic measurement. Ringrose et al. (2018) highlighted the variability of the person's blood pressure throughout a 24-hour period and that capturing one event of the patient's blood pressure in the clinic setting is insufficient to determine the mean blood pressure or diagnose a patient with hypertension. There was a general consensus that blood pressures >135mmHg in clinic will typically have a higher ABPM reading of >135 mmHg and will increase the likelihood of a diagnosis of hypertension.

ABPM and Diagnostic Threshold

The topic of the ABPM threshold was consistently referenced and was a topic of discussion throughout all articles. Most articles used a range for ABPM reading of 135/85 mmHg and 140/90 in clinic to indicate hypertension. Hodgkinson et al. (2011) explained that the threshold for the European Society of Hypertension practice guidelines for 24-hour blood pressure monitoring was >130/80 mmHg and for daytime blood pressure >135/85, but some of the studies had different thresholds for ABPM hypertension making it difficult to evaluate the data thoroughly. The ACC/AHA utilizes the same threshold as the European Society of Hypertension of a 24-hour ABPM of 130/80 mmHg, daytime ABPM reading of 135/85, and nighttime ABPM reading as 120/80 (American College of Cardiology/American Heart Association [ACC/AHA], 2017). Hodgkinson's finding are concerning with how others are

categorizing hypertension and what is the appropriate range. Even though the blood pressure threshold was set at 135/85 mmHg in most studies, there are limitations of making this range a rigid standard because of the individuality of each patient/participant and they should be observed separately (O'Flynn et al., 2016). Kario (2014) used the same blood pressure range of 135/85 mmHg and found that 66% of the participants with borderline blood pressure (home blood pressure measurement between 125-135 mmHg) had ABPM SBP >135 mmHg. These findings question the standards set by the European Society of Hypertension since their range is higher and these borderline patients would have been overlooked, but further investigation is needed. Piper et al. (2014) explained that the closer the patient's blood pressure comes to the threshold, the more likely misdiagnoses will occur. The ambiguity of where the threshold rests for further evaluation of a patient's blood pressure creates a predicament, but Sheppard et al. (2018) developed an algorithm to triage patients and classify them into three groups: normal blood pressure, definitively hypertensive, and needing further investigation. They were able to correctly triage and classify 801 out of 887 participants with 97% sensitivity and 76% specificity using three clinic blood pressure measurements, age, sex, body mass index (BMI), previous hypertension and treatment, and the presence of cardiovascular disease. This effective triaging can assist with diagnostic, treatment, and management of hypertension, but major organizations and practice guidelines would have to reevaluate their diagnosis and assessment process to incorporate a more complex way to identify who needs further evaluation and the respective blood pressure ranges.

ABPM diagnosis as a Predictor of Cardiovascular Risk

Risk for cardiovascular event and end organ damage is one of the most concerning aspects of hypertension. The United Kingdom recommends ABPM as the gold standard for

evaluation of hypertension because it has been shown to be a more sensitive measurement of future cardiovascular events for the patient than the clinic measurement (Albasri et al., 2017). Both Hodgkinson et al. (2011) and Sheppard et al. (2018) reiterate this same fact by explaining that the ABPM takes multiple measurements throughout the day which is a better representation of the true mean blood pressure and indicating future stroke and cardiovascular mortality. They also recommend the use of a home blood pressure monitor in the absence of ABPM, but ABPM is the gold standard. Piper et al. (2014) found that 11 studies showed that the use of a 24-hour blood pressure monitoring (especially with night-time values) predicted stroke, other fatal and nonfatal cardiovascular events, and long-term cardiovascular outcomes independently over clinic blood pressure monitoring. Masked hypertension can be particularly dangerous since the clinic blood pressure is typically normal, but the patient has sustained hypertension throughout the day resulting in the same cardiovascular risk as those with true sustained hypertension, but these patients are undertreated and underrecognized (Reino-Gonzalez et al., 2017). Schwartz et al. (2016) found that studies over the past 30 years agree that there is an increased cardiovascular morbidity, mortality, and end organ damage with sustained hypertension. Patients with white-coat syndrome are at a disadvantage since their clinic blood pressure is elevated, but they are normotensive according to the ABPM reading, and they are more likely to be misdiagnosed and overtreated, while others that need treatment are being underrecognized (Piper et al., 2014).

Discussion

The use of ABPM is very applicable and generalizable to the public since 45% of the United States adult population has hypertension and 11 million United States adults continue to have underdiagnosed hypertension (CDC, 2020). The articles evaluated expressed the need for further blood pressure evaluation to prevent over and underdiagnosis. The use of ABPM would

be best in the outpatient setting with sufficient support staff and appropriate monitoring. Some barriers to the use of ABPM expressed by providers interviewed by Kronish et al. (2017) were the cost to both the patients and clinic, time needed to train staff and patients, lack of resources, and willingness of patient to complete testing. There was also a significant knowledge deficit by the providers about the reliability and sensitivity of the ABPM, since they perceived that it was not as reliable as clinic measurements. Hodgkinson et al. (2011), also acknowledged these barriers and suggested that home blood pressure monitoring may be more widely accepted due to the ease of use and availability.

The overall strength of evidence was robust and points toward practices incorporating the use of ABPM for patients with questionable, borderline, and high blood pressures. The use of ABPM could prevent over/under medication and the recognition of hypertension potentially mitigates the effects of sustained uncontrolled hypertension. Practices should invest more time and resources in this method of assessment because it has the ability to positively affect millions of patients.

Based on the evidence reviewed, the use of ABPM is a more accurate representation of the patient's blood pressure throughout the day and has been shown to assist in a more precise diagnosis of hypertension than clinic or home blood pressure monitoring. The potential clinical practice implications of ABPM use are centered around the ability to accurately diagnose hypertension and avoid misdiagnosis. ABPM has been shown to provide more sensitive and specific blood pressure measurements than clinic and home blood pressure measurements since it is able to accurately capture the patient's mean blood pressure throughout the day. The efficiency, accuracy, and sensitivity of ABPM distinguishes it as the gold standard for out-of-clinic blood pressure measurement for the United Kingdom and the European Society of

Hypertension. The USPSTF, ACC, and the AAFP all recommend the use of ABPM for diagnostic purposes outside the clinic setting. There is minimal risk to the patient and providers should consider adding the use of ABPM to their hypertension diagnosis criteria. Some limitations noted in this review included the need for a better understanding of the barriers to the use of ABPM. An article by Kronish et al. (2017) was included in the review; however, this was only one research study and further research is needed to fully understand the reasoning ABPM is not widely used in the United States. Studies evaluating the cost for the patients and facility should be included as well as who would manage the data from these devices. Even though some articles mentioned that ABPM costs were lower for the patients, no dollar value was ever discussed. Finally, a more targeted search limited to studied only from the United States is needed since many of these articles were from other countries. Overall, there was a robust collection of research supporting the use of ambulatory blood pressure monitoring as a diagnostic tool for accurately assessing hypertension. It is the duty of the providers to recognize risk factors and abnormal or borderline blood pressure readings, as well as to appropriately streamline accurate and efficient blood pressure evaluation.

This literature review supports the accuracy and use of ABPM for the diagnosis of hypertension; additionally, the USPSTF, ACC, and the AAFP all recommend the use of ABPM for diagnostic purposes outside the clinic setting. This overwhelming body of evidence prompts the need for the translation and integration of evidence into practice. Based on this evaluation, there was an appropriate amount of evidence to pilot a practice change in the family practice setting.

Design and Pilot the Practice Change

Setting and Sample

An evidence-based practice pilot project was conducted at a rural family practice clinic with full support from the practice owner, providers, and clinic staff. The use of ambulatory blood pressure monitors was low risk, supported by clinical research, and its use was recommended by major stakeholder organizations including the ACC/AHA to enhance the diagnostic process. Prior to implementation, this evidence-based pilot project was submitted to the UVA Social and Behavioral Science IRB (#22566) for review and was given the determination: Not Human Subjects Research.

Two SunTech Oscar 2 Ambulatory Blood Pressure Monitors and supporting software and educational materials were purchased for this pilot. The required SunTech ABPM computer software was initially downloaded on two medical assistants' computers for unit programing and patient BP evaluation. For increased adoption, the SunTech ABPM computer software was downloaded on four additional medical assistant's computers four weeks into the pilot. Clinic staff and patient educational pamphlets about hypertension, the pilot program, and the ABPM units were created by the project lead. These educational pamphlets were created using published literature from the American Heart Association and American College of Cardiology about hypertension and the ABPM units. A staff script (Appendix C) for educating the participants about the pilot program, as well as care and use of the device, was created based on the SunTech information and demo (SunTech Medical, 2020). A staff pre- and post-survey and a patient pre- and post-survey were all created by the project lead using the Agency for Healthcare Research and Quality ([AHRQ], 2007) workflow and patient safety assessment worksheets as a guide. All created surveys were assessed for face validity by the academic advisor and multiple UVA DNP professors. Staff surveys assessed the clinic workflow, hypertension diagnosis process, and the staff's perception of those processes. Patient surveys assessed the patient's basic knowledge of

hypertension, if they had ever previously checked their blood pressure, their satisfaction with the evaluation process, and their overall opinion of the ABPM unit. The goal was to effectively implement an ABPM evidence-based practice pilot program for this rural family practice clinic in a manner that would foster adoption of the ACC/AHA recommended practice.

Any patient who presented for a wellness or follow up visit and met the inclusion criteria were eligible for further diagnostic assessment. The providers and nursing staff evaluated the patients based on the set criteria for enrollment into the ABPM unit evaluation. The criteria included: meeting the blood pressure threshold set by the ACC/AHA, age 21-85 years old, and they were scheduled for a wellness/follow up visit. Additionally, the patient could not have signs/symptoms of an acute illness when arriving to the appointment (i.e., cough, fever, upper respiratory infection, abdominal pain, etc.). Exclusion criteria included: a previous diagnosis of hypertension, currently on antihypertensive medications or medications that could artificially manipulate the blood pressure, and a previous diagnosis of chronic pain. Utilizing the ACC/AHA guidelines, patients with a blood pressure of ≥130 - 159 / ≥80 – 99 mmHg were eligible for further assessment for hypertension using the 24-hr ABPM device (Muntner & Shimbo, 2018).

Measures

The Ambulatory blood pressure monitoring units electronically transmitted the participant's 24-hour blood pressure reading to the clinic computer where the ABPM unit's software was installed. Each ABPM unit was designated with a specific number to ensure data from each specific participant was not mistaken for another participant's data. Baseline clinic blood pressure measurements, 24-hour ABPM average reading, and nighttime measurements were collected on a spreadsheet (See Table 4), utilizing the individual's participant ID number.

The staff's pre- and post-survey and participants' pre- and post-survey results were created and collected using the Qualtrics software. The participant and staff surveys had a Likert scale rating system where the rating "5" was "very good", "4" was "good", "3" was "fair", "2", was "poor", "1" was "very poor", and "0" was not applicable. All electronic forms and data were maintained and stored using the secure UVA Box program. No personally identifiable information was collected.

Procedures

The staff, including a physician, nurse practitioner, physician assistant, medical assistant, and nurses, were given the educational pamphlet (Figure 3.1 and Figure 3.2) and trained on the care and use of the ABPM unit, the purpose of the project, and the criteria for participant enrollment. A 10-minute training in-service was offered every other morning for the first week of the project implementation, which ensured all staff had the opportunity to obtain training. Immediately after the training, the staff were given a pre-survey (Figure 4.1 and 4.2) which assessed the workflow and satisfaction of the current process. Patients who met the pilot criteria were offered the use of the ABPM in accordance with ACC/AHA guidelines by the clinic staff. Patients who accepted the enhanced blood pressure assessment using the ABPM were provided an educational pamphlet (Figure 5.1 and 5.2) that discussed hypertension, the ABPM units, and what to expect during the 24-hour blood pressure assessment. The participants were then given a pre-survey by the staff (see Figure 6) inquiring about their knowledge of ABPM units and to determine if the patient had previously monitored their blood pressure at home. Each participant was assigned a "participant ID" number that was associated with their individual data collection in the project. This number was not associated with their clinic medical record, social security number, or birthday and was generated at random. A linking document was created that

associated the "participant ID" number to the patient record number. This document was securely maintained in a locked filing cabinet in the practice manager's office. At the conclusion of the pilot project, the linking document was shredded by the project lead at the clinic. To ensure participant safety, the participants were instructed to immediately contact the clinic with a systolic and/or a diastolic blood pressure of ≥180 / ≥ 120. ABPM units were programed by the trained clinic staff and placed on participants, which began their 24-hour BP monitoring. Participants were given the project lead's number in the event they had questions about the ABPM unit, the project, or needed technical support. The participants were instructed to return the ABPM to the clinic front desk at the end of their 24-hour BP monitoring. Upon returning the ABPM unit, the participants were given a post-survey (Figure 7.1 and 7.2) by the front desk administrative staff, which the participant filled out and immediately returned to the administrative staff. The survey investigated the participant's opinion about the ease of use, the impact the unit had on their daily activities, work, sleep, and their overall general satisfaction with the ABPM unit. The ABPM unit was cleaned by the administrative staff per the recommendations of the manufacturer and the CDC. All summary results from the 24-hour monitoring were printed the day the unit was returned to the clinic and the results were given to the participant's provider for diagnosis and treatment options. At the conclusion of the EBP project, the staff were given a post-survey (see Figure 8.1 and 8.2) assessing their satisfaction with the current process, the new process, change in work flow, and any suggested improvements to the process.

Data Collection and Analysis

The EBP project began in the fall of 2020 with oversight by the DNP advisor and practice mentor. The data was collected using UVA Qualtrics software and entered into an Excel

spreadsheet that was maintained in UVA Box, which is a secure internet-based electronic storage service. All data was analyzed using Excel and IBM SPSS Statistics, version 27. The goal of this pilot project was to continually assess the implementation and adoption of the proposed practice change of using the ABPM units to diagnose hypertension. Process and outcomes data were collected as a means of assessing acceptance of the practice change as well as to identify issues and barriers that could be targeted and addressed to favor adoption. The process variables for this pilot were the staff compliance and the assessment of the barriers to the adoption of the practice change. The outcome variables included the patient satisfaction, staff satisfaction, and the diagnostic results of the ABPM.

Based on the Iowa Model methodology, procedures and processes were occasionally modified based on the clinic staff and patients' recommendation and feedback to enhance adoption. The first two weeks included staff training and reinforcement of the process and procedures. Process and outcome variables were continuously assessed and collected throughout the entire 11-week implementation period with a goal being utilization of the ABPM units for patients who met the set criteria. At the conclusion of the pilot implementation, the data was analyzed using descriptive statistics, including measures of central tendency and the relationship percentages between pre- and post-surveys.

Results

Characteristics of Sample

Ten possible participants were identified by the staff who qualified for further blood pressure evaluation by the ABPM. Of these possible participants, one was set up with the monitor, but the blood pressure cuff was found to be too big for the participant to maneuver their arm. The participant contacted the project lead and the blood pressure assessment was terminated

until a smaller cuff could be obtained. Another participant had the ABPM programed and placed, but upon arrival at their home, the ABPM unit had turned off and could not be restarted. It was found that the batteries had not been replaced after the previous participant. This individual indicated that they would undergo ABPM evaluation at a later date. A total of eight participants provided data resulting from accurate use of the ABPM device. One participant did not fill out the participant post-survey and was unable to be contacted. Therefore, pre- and post-survey data were collected and assessed on the remaining seven. Out of the eight participants, five (62.5%) participants owned a blood pressure cuff while three (37.5) participants had never taken their blood pressure outside of the clinic setting. One participant was not working during the ABPM evaluation so they refrained from answering the question pertaining to the performance of the ABPM unit at work. The eight participants' baseline blood pressures ranged from a systolic pressure of 142 – 154 mmHg and a diastolic pressure of 81 – 102mmHg.

Out of the nine clinical staff, five completed the pre- and post-survey. Three of the staff who completed the surveys were the primary care providers for the clinic (one medical doctor and two physician assistants). These three providers were the leading contributors to the pilot, advocating and ensuring all eligible patients were assessed by the ABPM unit.

Staff Pre-Survey

The clinic staff's knowledge of ABPM units and capabilities before the pilot were limited, with 80% of the staff reporting they had fair to poor knowledge; but both the quality and understanding of the education given was rated good to very good by all five staff members. As seen in Table 5, a mean rating of 3.20 on a 5-point Likert scale (*SD*= .837 and .447 respectively) was reported for the efficiency and accuracy of the current clinic and home blood pressure monitoring process. Four (80%) staff members rated the patient compliance for HBPM as fair to

poor while three (60%) staff members rated the CBPM patient compliance as fair to poor. Four out of the five staff were not satisfied with the current home and clinic blood pressure monitoring process.

Staff Post-Survey

The ABPM knowledge mean rating after the completion of the program was 4.20 (*SD*= .837) as shown in Table 6. The rating of efficiency and accuracy of the current home and clinic blood pressure monitoring had a mean of 3.80 (*SD*= .837) and 3.60 (*SD*= 1.140) respectively. Twenty percent of the staff felt that patient compliance for HBPM was good to very good while 40% reported CBPM patient compliance was good to very good. The staff's mean satisfaction rating of the home and clinic blood pressure monitoring was 3.60 (*SD*=.894). Eighty percent of the staff rated the efficiency of the ABPM process as good to very good and 100% rated the ABPM accuracy as good to very good. The mean rating for the ABPM patient compliance was 4.40 (*SD*=.894). All five staff rated their overall satisfaction with the ABPM process as very good to good. Additionally, a rating of good to very good by all the providers was observed when assessing the ABPM result interpretation, availability of results, and determination of a diagnosis. Four out of the five staff preferred the use of the ABPM for the diagnosis of hypertension.

Participant Pre-Survey

As seen in Table 7, the usefulness and understandability of the ABPM education was rated good to very good by all eight participants. All the participants also reported the new information and satisfaction of the education as good to very good. The mean knowledge about hypertension was rated 3.75 (*SD*= 1.165)

Participant Post-Survey

The participant post-survey (Table 8) shows that the participant's mean rating of both the ABPM comfort and ability to perform daily activities was 3.86 (*SD*=.690). Six (57.2%) participants rated their ability to perform at work as good to very good. The participant's average rating of comfort at night and ability to sleep with the ABPM was 3.57 (*SD*= .976) and 3.71 (*SD*= 1.254) respectively. Six (85.5%) participants reported that falling asleep was good to very good while three (42.9%) reported ability to stay asleep as good to very good. The mean rating for quality of sleep with the ABPM unit was 3.86 (*SD*= .900). The overall satisfaction, satisfaction with the ABPM education, and the ability to monitor blood pressure at home had a mean rating of 4.29 (*SD*= .756). Only one (14.3%) participant reported bringing the blood pressure unit back to the clinic as fair to poor.

Participant Blood Pressure

The participants' blood pressures were maintained in a raw data format (Table 9) to better observe the participants' data and identify which participants were determined by the providers to have hypertension. Five participants had systolic blood pressure decreases in their 24-hour and daytime average from baseline. These participants had a decrease in systolic blood pressure by 3 – 24mmHg. Three of the participants were determined by the providers to not have hypertension based on their blood pressure decreases and average blood pressures. Participant number one's baseline blood pressure, average 24-hour, and daytime average were very similar and no significant changes could be seen. Participants seven and eight both had an increase in their systolic baseline blood pressure of 3 – 10mmHg. Out of the eight participants, five were found to have hypertension. All participants had nighttime decreases in blood pressure by 10% or more.

Discussion

The staff were given a 10-minute initial training during the beginning of the pilot with additional training as needed weekly. Four out of the five staff rated their pre-survey ABPM knowledge as fair and showed a positive increase by rating their knowledge at the conclusion as good to very good. One staff member initially rated their ABPM knowledge as good, but at the conclusion rated their knowledge as fair. This staff member's apparent decrease in ABPM knowledge raises questions about their perceived baseline knowledge and possible overestimation of their knowledge and, if this was the case, why they did not seek further education. The staff's mean rating of the quality and understandability of the education was 4.40 (SD .548) and 4.50 (SD .577) respectively, signifying that all the staff felt the education was good to very good. For future pilots, implementing an assessment of knowledge to be given immediately after the training is recommended to ensure the recipients fully understood the education prior to implementation.

Both the efficiency and accuracy of the current hypertension diagnosis (before use of the ABPM device) process had mixed results from the pre- and post-surveys. Initially three staff members rated the current process's efficiency as poor but then increased their rating to good at the conclusion of the pilot. This is similar to the current process's accuracy rating in which the four staff rated it as fair then two of them increased their rating to good/very good. This increase in ratings across these two questions could be due to the staff's misunderstanding of the question, assuming the referenced "current process" was the new ABPM process and not the home and clinic blood pressure monitoring. Conversely, the staff's perception of the current diagnosis process could have improved after the implementation of this pilot due to an increased understanding of different diagnostic techniques. For future implementation, specifying which

blood pressure method was being evaluated on the survey would decrease any confusion as well as adding a written follow up question investigating the reasons the staff chose this ranking.

During the initiation of the pilot four out of the five staff members reported they were dissatisfied by the current hypertension diagnosis process. They stated that the blood pressure results and accuracy are dependent on the compliance and involvement of the patient. Additionally, the staff questioned the accuracy of the one-time clinic blood pressure results due to the myriad of outside influences that could increase or decrease the patient's blood pressure. The staff felt that a benefits of the current process was that HBPM limited the amount of time the patient was in the clinic, but the accuracy was dependent on the patient's compliance and honesty, as well as the cost for the patient to purchase the home blood pressure machine. One staff member felt that if the patient adhered to good follow-up, they could be managed well, but this also calls for patient's involvement and investment. Initially, four staff members rated patient compliance with HBPM as fair to poor while three staff rated CBPM patient compliance as fair to poor. At the conclusion of the pilot, two of the staff members increased their ratings for HBPM patient compliance to very good and fair while two others decreased their rating to fair and poor. Two staff members increased their rating of the CBPM patient compliance to good and very good while one decreased it to fair. Some of the staff's perceptions of the patients' compliance with the current blood pressure monitoring technique seemed to improve, while others decreased. Further, when asked about their satisfaction with the current process at the end of the project, three staff rated it as fair while two rated it as good and very good. Unfortunately, this post-survey question was not posed as a "yes" or "no" question like the pre-survey question, so there is insufficient evidence to support a conclusion concerning the staff's level of dissatisfaction from the beginning of the pilot to the conclusion. Ensuring that the before and

after questions used the same metrics would have been optimal, but going forward, future implementation metrics should be created consistently as to guarantee accurate measurable data.

The post-survey questionnaire showed that the majority of the staff's overall perception of the ABPM was good to very good. The staff's average rating for the ABPM efficiency and accuracy was 4.20 (SD .837) and 4.60 (SD .548) respectively, with only one staff member rating that the efficiency was fair. Four out of the five staff members rated the ABPM patient compliance as good to very good and all staff rated their satisfaction with the ABPM process as good to very good. The ambulatory blood pressure monitor was a preferable method of hypertension diagnosis by four staff members. The staff reported that this method provides quality and efficient data which allows them to be able to distinguish patients with true hypertension from those who present to the clinic with white coat hypertension. One staff member did report that home blood pressure monitoring was preferable, but they did not give a reason for this answer. Only the providers were questioned about the patient results from the ABPM since they were the ones determining the diagnosis for the patient. All three providers reported that the interpretation, availability, and plan determination from the ABPM patient results were good to very good. These positive results suggest that the providers had a positive perception the new ABPM process and found the data interpretation and diagnosis determination to be helpful.

The patient processes and clinic flow were taken into consideration while performing this pilot. On average, the providers diagnose hypertension in five to ten patients per month. Currently, to diagnose (or out) hypertension, the patient is usually required to follow up with the clinic nurse in two-weeks for a blood pressure check. The patients may be required to have the two-week blood pressure checks performed two or three times, depending on the results. The

clinic nurse gives the provider the blood pressure results or the provider would check the patient's chart for their results after the patient left. The patient would be notified of their blood pressure results at their next scheduled appointment with the provider. For the ABPM process, the staff spent about 10 minutes educating the patient about the ABPM unit and the evaluation process. The staff reported this process minimally impacted their workflow. One staff member reported that the minimal impact was worth the ability to accurately assess the patient's blood pressure. Once the monitor was returned, the providers were immediately given the patient results, allowing them to determine an expeditious plan of action for the patients. The providers contacted the patient or schedule them for a follow up visit to review their results. Depending on when the patient returned the blood pressure unit and when the patient was contacted, this process took about two to five days. In this outpatient clinic, the new evidence-based ABPM process decreased the assessment and diagnosis timeframe by more than three weeks, while eliminating require multiple return visits to the clinic by the patient.

As shown in Table 8, all the participants rated all aspects of the ABPM patient education as good to very good which indicated that the ABPM education was well-received and understood. Five out of the seven participants reported that the ABPM comfort and ability to perform daily activates was good to very good. This is reassuring in that the participants were not uncomfortable or were not unable to perform tasks needed to get through the day. Only two participants rated the ability to perform work activities as fair, which indicates some interference with work tasks; however, the majority of the participants reported the ability to perform work as good and very good, suggesting the impairment may be specific to those participants' type of work. Six out of the seven participants rated their ability to fall asleep and quality of sleep as good to very good. Three participants rated the comfort of the blood pressure cuff at night as fair

to poor while two of those participants reported their ability to sleep with the unit as poor. Four participants rated their ability to stay asleep while wearing the blood pressure unit as fair to poor. The majority of the participants reported they would wake up when the blood pressure cuff inflated, but they were able to go back to sleep immediately. Nighttime discomfort, sleep disturbance, and annoyance are a commonly reported in the literature (Parati et al., 2014). Unfortunately, the nighttime values are needed to assess nocturnal dipping patterns in the patient's blood pressure. The ABPM units are programed to inflate every hour at night, but they can be programed to inflate every 1.5 to 2, hours if needed. This adjustment may decrease some participant annoyance at night and give reassurance to other participants who may be apprehensive to be evaluated due to the aspect of poor sleep. Additionally, properly educating the patients on the ABPM diagnostic timeframe, compared to the timeframe of the traditional HBPM and CPBM diagnostic methods, may influence patients to utilize the ABPM and reduce the need for frequent clinic visits or financial burdens.

The mean score for the participants' overall satisfaction, satisfaction with education given, and ability to monitor blood pressure at home was 4.29 (*SD*= .756). This indicated that all but one participant rated these three sections as good to very good and that overall, the ABPM process was adopted well by the participants. Only one participant gave the rating of poor to the question about their satisfaction with bringing the blood pressure unit back, but all other responses were good to very good. This participant did not give feedback as to why they chose this rating, but for future implementations allowing a short-written section of the participant's experiences would be beneficial. With the majority of participants rating the process of dropping the unit off at the clinic as good to very good, it can be assumed that the inconvenience for that participant may have been isolated to that individual. The practice owner was made aware of the

participant's rating and reported that the clinic would find alternative processes for returning the ABPM device in an effort to maximize adoption.

The participants had a few recommendations to improve the process in the future. One participant recommended that the staff inform the patients to wear loose clothing if they are to be scheduled in advance since the blood pressure cuff can be bulky under the clothing. This recommendation was also given on the SunTech Medical ABPM tutorial and was brought to the attention of the practice owner. Another participant requested that a smaller blood pressure cuff be purchased. Due to this feedback, and the fact that one participant was unable to participate due to cuff size, a decision was made by the practice owner to purchase additional cuff sizes to improve access for all patients who would benefit from the use of the ABPM.

To fully appreciate and understand the participant's blood pressure throughout the ABPM monitoring, a line graph was created as seen in Figure 9 and Figure 10. There was a 24-hour and daytime average increase in systolic blood pressure from the baseline blood pressure seen in Participants seven and eight. Participant seven had a systolic increase of 3 – 7 mmHg while Participant 8 had a systolic increase of 5 – 10 mmHg. Both participants' nighttime readings were in the 130s / 60s which, per the ACC/AHA, is in the range for nocturnal hypertension. The ABPM unit did not register nocturnal hypertension because the participants' nighttime readings dropped by more than 10%. Participants one's baseline, 24-hour average, and daytime average was about the same throughout the day. Similar to Participants seven and eight, Participant one's nighttime blood pressure was 132/79 mmHg and would indicate nocturnal hypertension by the ACC/AHA standards, but again, the participant had a 10% decrease so the ABPM reported it was normal.

Table 9

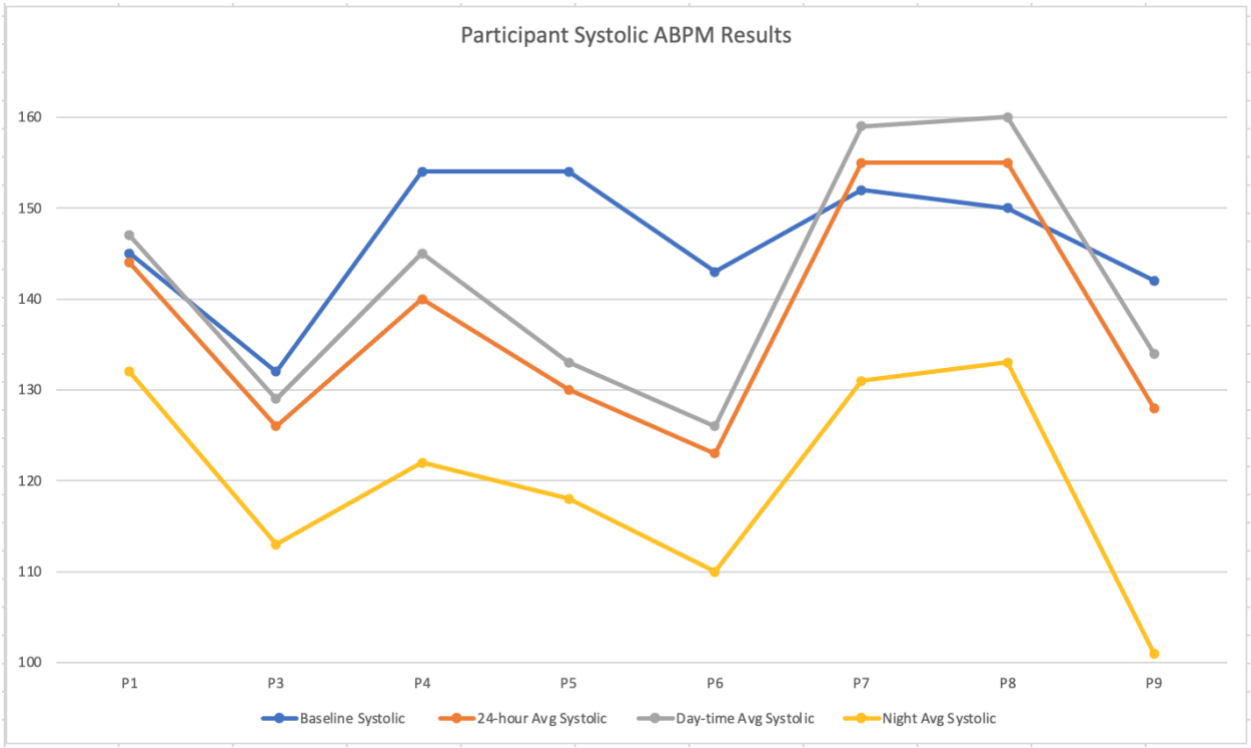
Participant ABPM Results

Participant ID Number	Baseline BP (Clinic BP)	Average 24-hour ABPM BP	Average Day-time BP	Average Nighttime BP	Average Nighttime BP	ABPM Overall Results
1	145/90	144/91	147/94	132/79	10.2% dipping	HTN
3	132/92	126/74	129/77	113/61	12% dipping	No HTN
4	154/81	140/80	145/83	122/69	15% dipping	HTN
5	154/86	130/86	133/89	118/77	11% dipping	HTN
6	143/81	123/76	126/79	110/65	12% dipping	No HTN
7	152/82	155/82	159/85	131/68	17% dipping	HTN
8	150/100	155/85	160/89	133/67	16% dipping	HTN
9	142/102	128/81	134/86	101/61	24% dipping	No HTN

Note. ID= Identification. BP= Blood Pressure. ABPM= Ambulatory Blood Pressure Monitor.

Figure 9

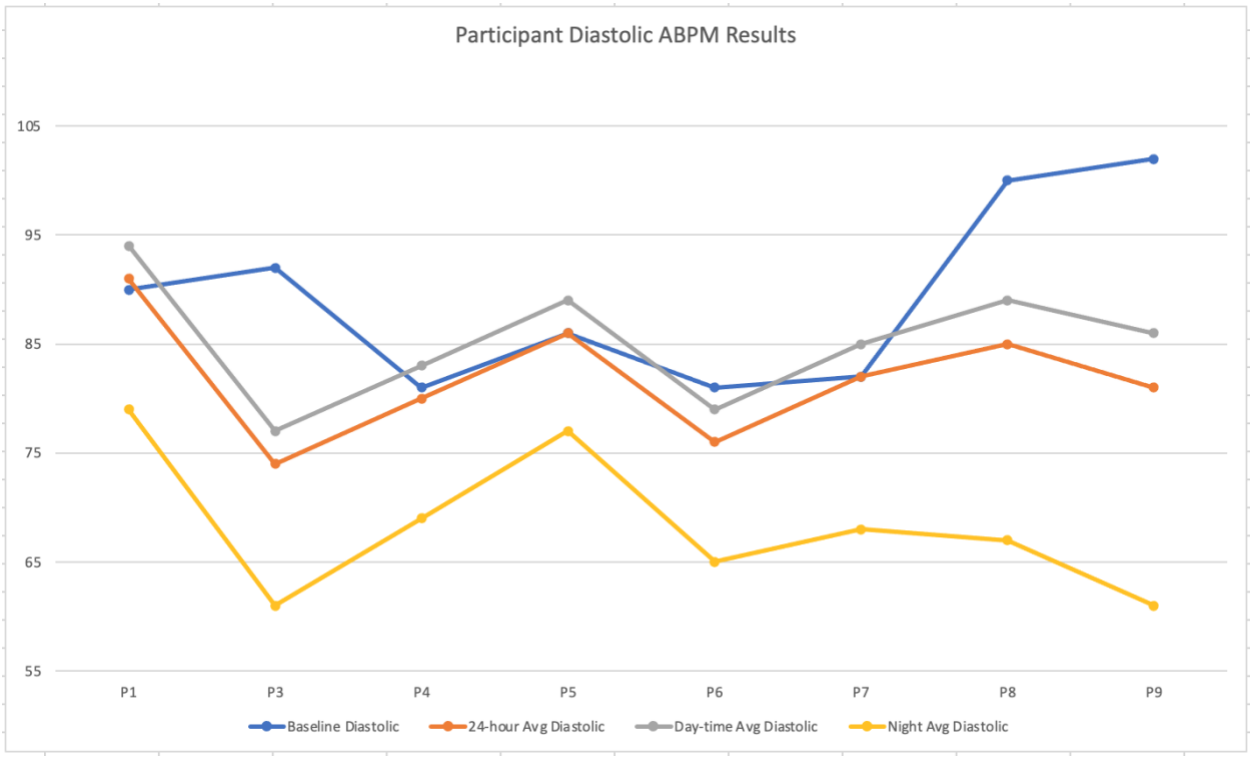
Participant Systolic ABPM Results



Note. P1= Participant ID 1. P3= Participant ID 3. P4= Participant ID 4. P5= Participant ID 5. P6= Participant ID 6. P7= Participant ID 7. P8= Participant ID 8. P9= Participant ID 9.

Figure 10

Participant Diastolic ABPM Results



Note. P1= Participant ID 1. P3= Participant ID 3. P4= Participant ID 4. P5= Participant ID 5. P6= Participant ID 6. P7= Participant ID 7. P8= Participant ID 8. P9= Participant ID 9.

Based on the participants' baseline clinic blood pressure measurements, three participants would appear to be in the ACC/AHA range for hypertension, but with the use of the ABPM device, the providers were able to determine they did not have hypertension, ensuring overmedication and the associated cost and risk was avoided. Two participants were found to have a decrease in systolic blood pressure by 10 – 15 mmHg and 20 – 25 mmHg, but were diagnosed to have hypertension based on their 24-hour and average daytime blood pressures which were within the ACC/AHA guideline range. The use of the ABPM allowed providers to have an accurate observation of the participants' blood pressures ensuring patients would be

diagnosed and medicated appropriately. The difference between baseline clinic blood pressure to the ABPM measurements in this clinic are also similarly referenced throughout the literature (Ringrose et al., 2018). Many authors have portrayed this as the rationale to their argument to have ambulatory blood pressure monitoring as the standard of care and ensure accurate representation of the blood pressure (Muntner et al., 2019).

Strengths and Limitations

The main strength of this project was the overwhelming support of the staff and practice owner to implement this practice change in their already busy clinic. The education provided was clear and thorough which allowed the staff and providers to have a greater understanding of this project. The project was conducted in a remote area where further blood pressure evaluation could be challenging, so the implementation and adoption of this project was easily accepted by both the patients and providers. The donation of the ABPM units from TSNRP allowed this project to be conducted and decreased the financial burden and stress of the family practice clinic. Installing the ABPM computer program on four additional staff members' computers allowed the project to excel and lessened the burden of all the clinic staff. Even though this project was widely accepted by staff and patients, the major limitation to this project was the COVID-19 pandemic. The pandemic made it difficult to fully assess all patients since any patient who had their EHR flagged for previous COVID diagnosis or current investigation were not included in this study. Additionally, many patients were converted to virtual appointments decreasing the available patients to assess. The difference between the ACC/AHA guidelines for nocturnal hypertension and the ABPM unit's assessment of the patient's nighttime blood pressure decrease made nighttime assessment of the patient's blood pressure difficult because the unit reported acceptable ranges, while the guidelines state the range is not acceptable. A smaller

blood pressure cuff would have been optimal in this study because the ABPM units only come with a medium and large blood pressure cuff which were both too big for one participant and prevented further blood pressure evaluation on that participant. Finally, the project was implemented over three months which limited the enrollment to only a short time frame and decreased other potential participant enrollments.

Integrate and Sustain the Practice Change

Given the clinical significance of the outcomes, the potential for cost avoidance, substantial clinic staff support, feasibility and applicability of this project, and the potential positive impact on the patient population, the project was determined by the clinical team to be appropriate for adoption and integration into their practice.

Advanced Nursing Practice Implications

The use of ABPM units for the diagnosis of hypertension allows providers, including nurse practitioners, to have accurate, real-time results within 24 hours of the recorded elevated blood pressure. With timely results, providers are able to appropriately treat and manage each patient. Patient health outcomes are improved with the immediate recognition of hypertension that may have gone untreated, decreasing the patient's risk for further cardiovascular disease. Additionally, monitoring the patient's blood pressure at home, the clinic may increase clinic productivity and patient capacity since the patient being evaluated is not returning for multiple repeat blood pressure monitoring appointments allowing for other patients to be seen by the providers. The improvement of patient outcomes, expedited and accurate diagnosis, and improved clinic productivity and capacity, allows for increased patient satisfaction and rapport which is critical for an effective primary care clinic.

There is also military relevance to the use of ABPM to diagnose hypertension. In 2008 an estimated 13% of the active-duty military members between the ages of 20 – 44, and 37% among veterans, had HTN (Department of Veteran Affairs & Department of Defense [VA/DoD], 2020). The VA/DoD guidelines (2020) reported that monitoring out-of-office blood pressures were found to be more accurate than the routine office blood pressures in the prediction of cardiovascular events. Even though periodic assessments of blood pressure with automated office blood pressure monitoring (AOBP) is strongly recommended by the VA/DoD, they support the use of ABPM when the diagnosis or the control of HTN remains uncertain (e.g., diagnosing masked or white coat HTN) (See Figure 11). Unfortunately, during the COVID-19 pandemic, many clinic appointments have been converted to virtual visits (Health.mil, 2020). With the military using telemedicine for primary care visits, the use of ABPM is highly versatile in assessing the patient's high blood pressure from a distance without potential exposures to the solider or their family. Rural military environments and clinics also pose a barrier for military members and their families to obtain a timely evaluation of their hypertension. The ABPM would give those rural clinics more autonomy in assessing hypertension among military members and their families. Additionally, the health of the military member is impacted by the health of their family and spouse. Holliday et al. (2017) found that the spouses of military members on longer deployments had higher daytime and nighttime ABPM measurements. This could be due to the increased stress, lack of social support, or worrying (Holliday et al., 2017). Effective hypertension evaluation and management are critical for the health and medical readiness of the soldier, their family, and their units.

Sustainment Plan

Continuing the use of the ABPM units for hypertension diagnosis is simple, manageable and can greatly impact this rural family practice clinic. The practice mentor and manager were both engaged and invested in this pilot as well as satisfied with its outcomes, so a decision was made to sustain the changes. During the pilot conclusion meeting, the recommendation of incorporating ABPM education, materials, and training in with new students and staff orientation was given to the practice mentor and manager. The practice manager was been identified as the unit champion to continue the sustainment and involve other key personnel. Each medical assistant's clinic computer will have the ambulatory blood pressure monitoring program installed ensuring each provider has the access for patient ABPM evaluations. The ABPM results will be scanned and placed in the patient's electronic medical record (EMR) for providers to review and reference in the future. As previously stated, additional ABPM cuff sizes were purchased to improve accessibility for all patients. The practice mentor and manager will be instrumental in the staff education and training as well as ensuring the most accurate and up-to-date patient education about the units and hypertension.

Disseminate Results

The results from this evidence-based practice project were reviewed and shared with both the practice mentor and practice manager at the family practice clinic. The ABPM units and all materials remained with the clinic for further integration and sustainment of the project. A completed manuscript will be submitted to the University of Virginia's scholarly institutional repository Libra database for publication and to the University of Virginia's School of Nursing for completion of the Doctor of Nursing Practice Program. Based on the guidelines, a manuscript will also be submitted to the Journal of American Association of Nurse Practitioners (JANNP). This EBP project will also be presented at the TriService Nursing Research Program

Dissemination Course in May 2021, where a poster presentation will be given to Active duty, Reserve, and retired Nurse Corps officers from the Army, Navy, and Air Force, as well as nursing personnel working within the Military Health System.

Conclusion

Hypertension is a significant issue that has detrimental secondary complications associated with persistent uncontrolled hypertension. This commonly diagnosed disease requires evaluation and diagnosis that is efficient and accurate to improve patient outcomes and prevent serious lifelong injury or complications for patients. Ambulatory blood pressure monitoring is an accurate and efficient method of hypertension diagnosis that is underutilized, although the literature supports it as the standard of care for diagnosis. This evidence-based practice project validates the literature and shows how the use of this diagnostic method is feasible and effective in the primary care setting. The ABPM allowed the providers a more accurate observation of the patient's blood pressure and assisted their ability to make a well-informed clinical decision for the patient's care. The provider has a responsibility and duty to be well-informed, have accurate information, and act efficiently to be able to fully address, manage, and intervene in individuals with suspected hypertension.

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Tables

Table 1

ACC/AHA Hypertension Category Stages

Blood Pressure Categories

American Heart Association.

BLOOD PRESSURE CATEGORY	SYSTOLIC mm Hg (upper number)		DIASTOLIC mm Hg (lower number)
NORMAL	LESS THAN 120	and	LESS THAN 80
ELEVATED	120 – 129	and	LESS THAN 80
HIGH BLOOD PRESSURE (HYPERTENSION) STAGE 1	130 – 139	or	80 – 89
HIGH BLOOD PRESSURE (HYPERTENSION) STAGE 2	140 OR HIGHER	or	90 OR HIGHER
HYPERTENSIVE CRISIS (consult your doctor immediately)	HIGHER THAN 180	and/or	HIGHER THAN 120

Note. Obtained from American Heart Association. (2020). *Understanding Blood Pressure Readings*. https://www.heart.org/en/health-topics/high-blood-pressure/understanding-blood-pressure-readings

Table 2

Johns Hopkins Nursing Evidence-Based Practice (JHNEBP) Level of Evidence and Quality

Evidence Levels	Quality Ratings
Level I Experimental study, randomized controlled trial (RCT) Explanatory mixed method design that includes only a level I quaNtitative study Systematic review of RCTs, with or without meta-analysis	**QuaNtitative Studies** **A High quality**: Consistent, generalizable results; sufficient sample size for the study design; adequate control; definitive conclusions; consistent recommendations based on comprehensive literature review that includes thorough reference to scientific evidence. **B Good quality**: Reasonably consistent results; sufficient sample size for the study design; some control, fairly definitive conclusions; reasonably consistent recommendations based on fairly comprehensive literature review that includes some reference to scientific evidence. **C Low quality or major flaws**: Little evidence with inconsistent results; insufficient sample size for the study design; conclusions cannot be drawn.
Level II Quasi-experimental study Explanatory mixed method design that includes only a level II quaNtitative study Systematic review of a combination of RCTs and quasi-experimental studies, or quasi-experimental studies only, with or without meta-analysis	**QuaLitative Studies** No commonly agreed-on principles exist for judging the quality of quaLitative studies. It is a subjective process based on the extent to which study data contributes to synthesis and how much information is known about the researchers' efforts to meet the appraisal criteria. *For meta-synthesis, there is preliminary agreement that quality assessments of individual studies should be made before synthesis to screen out poor-quality studies*[1]. **A/B High/Good quality** is used for single studies and meta-syntheses[2]. The report discusses efforts to enhance or evaluate the quality of the data and the overall inquiry in sufficient detail; and it describes the specific techniques used to enhance the quality of the inquiry. Evidence of some or all of the following is found in the report: • Transparency: Describes how information was documented to justify decisions, how data were reviewed by others, and how themes and categories were formulated. • Diligence: Reads and rereads data to check interpretations; seeks opportunity to find multiple sources to corroborate evidence. • Verification: The process of checking, confirming, and ensuring methodologic coherence. • Self-reflection and scrutiny: Being continuously aware of how a researcher's experiences, background, or prejudices might shape and bias analysis and interpretations. • Participant-driven inquiry: Participants shape the scope and breadth of questions; analysis and interpretation give voice to those who participated. • Insightful interpretation: Data and knowledge are linked in meaningful ways to relevant literature. **C Low quality** studies contribute little to the overall review of findings and have few, if any, of the features listed for high/good quality.
Level III Nonexperimental study Systematic review of a combination of RCTs, quasi-experimental and nonexperimental studies, or nonexperimental studies only, with or without meta-analysis Exploratory, convergent, or multiphasic mixed methods studies Explanatory mixed method design that includes only a level III quaNtitative study QuaLitative study Meta-synthesis	

Note. Level I-III, Dang, D., & Dearholt, S. (2017). *Johns Hopkins nursing evidence-based practice: model and guidelines.* 3rd ed. Indianapolis, IN: Sigma Theta Tau International. Reprinted with permission

Table 3

Summary of Literature Review

Author, year	Design	Sample Size, Setting, and comparison	Study Outcome	Level of Evidence and Quality Grade (Johns Hopkins)
Albasri et al. (2017).	Systematic Review with meta-analysis	8 studies were used to compare blood pressure in community pharmacies with ambulatory, home and general practitioner office readings	They found there was no significant difference between systolic CPBP and daytime ABPM. CPBP was higher than ABPM (by 7.8mmHg). CPBP vs general practitioner readings was inconclusive. And CPBP vs home BP, when low quality studies were excluded there was no significant difference. The authors suggest that since the ABPM have lower BPs and a greater degree of sensitivity for HTN (135/85) the CPBP reading would use the ABPM threshold for diagnosis. This creates a higher sensitivity for detecting HTN, but could also over tax the providers with the increased influx of patients.	II; B
Hodgkinson et al. (2011)	Systematic Review with meta-analysis	20 studies were used to assess relative effectiveness of clinic and home blood pressure monitoring compared with ambulatory blood pressure monitoring in diagnosis of hypertension	The study showed that neither the clinic or the home measurements could be recommended as a single diagnostic test. Ambulatory testing was suggested before medication intervention. Ambulatory monitoring leads to a more appropriate targeting of treatment.	II; A
Kario, K. (2014).	Retrospective Cohort Study	462 hypertensive patients from ACHIEVE-ONE Study were used to assess the sensitivity of HBPM and ABPM.	They found that HBPM cannot be used for suspected HTN for BPs that are <135. ABPM is more sensitive and can distinguish these blood pressure variations. If the SBP is <135 the HBPM will record it as a normal pressure missing the "true uncontrolled HTN"	III; A
Kronish et al. (2017).	Cross-sectional Study	42 primary care providers were asked about barriers to the use of ABPM and HBPM for HTN screening in the United States.	Barriers identified were cost, resources, time constraints, and inability to get ABPM. Many providers did not see this inability to get the ABMP as an issue, even though the USPSTF reports that it should be used. Limitation: they used a survey that may not have been ensured validity and it is not reproducible.	III; B
O'Flynn et al. (2016).	Prospective Cohort study	931 patients between 50-60-year-old were used to assess the rates of HTN prevalence, awareness, treatment, and evaluate the used of ABPM on those rates.	Using daytime BP measured by ABPM as the gold standard, the sensitivity and specificity of the study BP was 70% and 76%, with office BP sensitivity was 56% and 74%, respectively. There was also a large portion of normotensive patients were hypertensive and some of the hypertensive patients (dx in clinic) were actually normotensive. This article alludes to not screening patients appropriately, placing them on medication when they may not need it, and not placing others on medications when they really have masked HTN. They addressed the need for a consistent level of threshold for the ABPM. "There has been considerable debate over diagnostic thresholds for ABPM. BP and its relationship with cardiovascular disease is continuous and the use of diagnostic thresholds therefore has limitations".	II; A
Piper et al. (2014).	Systematic Review without meta	96 studies were used in the systematic review for the screening for high blood pressure in adults for the U.S. Preventive Services Task Force Agency for Healthcare Research and Quality (US).	This systematic review found that ABPM is a better predictor of long-term CV outcomes than OBPM and should be considered the reference standard for evaluating BP. Eleven studies reported that daytime, nighttime, and 24-hour ABPM predicted stroke and other fatal and nonfatal CV events independently of OBPM. Up to 5-65% of participants with an elevated BP measurement who are normotensive upon confirmatory testing by ABPM (or HBPM). The false-positive results of this group when screened by OBPM methods have "isolated clinic	II; A

			hypertension." The increasing baseline BP in clinic was associated with increasing predictive ABPM, confirming hypertension. The likelihood of misdiagnosis of hypertension based only on screening measurement is greater as measurements approach the threshold for a diagnosis of hypertension.	
Reino-Gonzalez et al. (2017).	Systematic Review with meta-analysis	12 studies were included in the systematic review to assess the validity of office blood pressure measurements in primary care using ABPM as the gold standard in monitoring HTN receiving treatment.	There are 4 clinical findings for blood pressure: isolated clinic or office (white-coat) hypertension (ICH); isolated ambulatory (masked) hypertension (IAH); consistent normotension; and sustained hypertension. ICH: BP is high in clinic and normal on ABPM – this can lead to an overestimation of uncontrolled BP and may result to overtreatment (cardiovascular risk may be lower than those with sustained HTN). IAH: BP is normal in officer and high with ABPM – leads to underestimation of uncontrolled BP and may result in undertreatment (associated with cardiovascular risk similar to sustained HTN). Compared with ABPM in diagnosing uncontrolled BP, office BP measurement had a sensitivity of 55.7% to 91.2% and a specificity of 25.8% to 61.8%. The office-based BP readings in the outpatient clinic does not compare well with ABPM. The author reported that when making management decision based on the in-office BP ready, the provider should express caution.	II; B
Ringrose et al. (2018).	Retrospective Cross sectional	96 charts were used to assess the comparability of mean Ambulatory Office BP (AOBP) and ABPM in clinical practice.	The AOBP underestimated the SBP compared to the ABPM by about 5 mmHg for almost 90% of the patients. Addition, BP variability between the 2 methods were very high, with an SD of the difference of 13.5 mm Hg much greater than the 8 mm Hg upper variability threshold considered acceptable by BP measurement validation standards committees. Findings support the underestimation of BP by AOBP. Lower AOBP readings may lead to underdiagnosis, undertreatment, and under recognition of the prevalence and burden of hypertension	III; A
Schwartz et al. (2016).	Quasi-experimental Design: Time series Design - no control	1011 participants were used to assess the relationship of BP measures to age and BMI. The prevalence of discrepancies in ABPM and Clinic blood pressure monitoring (CBPM) were also examined.	On average, systolic ABPM was 7 mmHg higher than CBP, and diastolic ABPM was 2 mmHg higher. ABPM exceeded CBP by 10 mmHg or more in nearly 35% of participants and 9% had a comparably large diastolic difference; in contrast, CBP exceeded ABP by this amount in only 2.5% (systolic) and 4.2% (diastolic) of participants. 5% of the sample met criteria for hypertension based on CBP, 19% had hypertension based on their ABPM. Only 1% met criteria for white-coat hypertension, while 14.9% met criteria for masked hypertension. This study suggests the use of ABPM because ABPM was able to identify a sizeable number of individuals with masked hypertension who were normotensive in the clinic setting but have average daytime blood pressures that exceed the threshold for hypertension.	II; A
Sheppard et al. (2018).	Prospective observational cohort study	887 participants were used for PROOF-BP (Predicting Out-of-Office Blood Pressure) algorithm strategy to triage patients with suspected HTN for the use of ABPM in routine clinical practice	This article uses PRROF-BP as an initial triage to using ABPM. The algorithm used three blood pressure readings taken at the clinic appointment, combined with information from the individual's EMR: age, sex, body mass index, hypertensive and treatment history, and the presence of cardiovascular disease. This algorithm identified three groups: those with definitively normal blood pressure, those with definitively high blood pressure, and those requiring further investigation using ABPM. This triage strategy correctly classified hypertensive status in 801 of the 887 participants with 97% sensitivity and 76% specific for hypertension. The use of triage instead of current practices for the referral criteria for ABPM, would have resulted in 435 patients being referred for ABPM and 69 of these participants would have received treatment deemed unnecessary had they received ABPM. This triage strategy is useful in the management of patients where ABPM is being considered, especially where there are limited resources.	II; A

Note. ABPM = ambulatory blood pressure monitoring; CBPM = clinic blood pressure monitoring; HBPM = home blood pressure monitoring; OBPM = office blood pressure monitoring; HTN = Hypertension; BP = blood pressure; CV = cardiovascular; SBP = systolic blood pressure; USPSTF = US Preventive Service Task Force; AOBP = ambulatory blood pressure monitoring; EMR = electronic medical record

Table 4

Participant Ambulatory Blood Pressure Monitor 24-hour Data Chart, Original

Participant ID	Monitor Number	Date Monitor Given	Baseline BP (Clinic BP)	Average 24-hour ABPM BP	Average Day-time BP	Average Nighttime BP	Presence of Nocturnal Hypertension	ABPM Overall Results
1	2	7-Oct	152/82	144/91	147/94	132/79	None (10.2%)	HTN
3	1	14-Oct	132/92	126/74	129/77	113/61	None (12% dipping)	No HTN
4	2	15-Oct	154/81	140/80	145/83	122/69	None (15% dipping)	HTN
5	1	23-Oct	154/86	130/86	133/89	118/77	None (11% dipping)	HTN
6	2	26-Oct	143/81	123/76	126/79	110/65	None (12% dipping)	No HTN
7	1	29-Oct	152/82	155/82	159/85	131/68	None (17% dipping)	HTN
8	1	11-Nov	150/100	155/85	160/89	133/67	None (16%)	HTN
9	2	30-Nov	142/102	128/81	134/86	101/61	None (24%)	HTN

Note. ID = Identification; BP = Blood Pressure; ABPM = Ambulatory Blood Pressure Monitor

Table 5

Staff Pre-Survey Questionnaire Results

Questions	*n*	*M*	SD	Good/Very Good %	Fair/Poor %
ABPM Knowledge	5	3.20	.447	20	80
ABPM Education: Quality	5	4.40	.548	100	
ABPM Education: Understanding	4	4.50	.577	100	
Current Process: Efficiency	5	3.20	.837	40	60
Current Process: Accuracy	5	3.20	.447	20	80
Current Process: Compliance HBPM	5	3.00	.707	20	80
Current Process: Compliance CBPM	5	3.20	.837	40	60

Note. ABPM= Ambulatory Blood Pressure Monitor. HBPM= Home Blood Pressure Monitor. CBPM= Clinic Blood Pressure Monitor.

Table 6

Staff Post-Survey Questionnaire Results

Questions	*n*	*M*	SD	Good/Very Good%	Fair/Poor%
ABPM Knowledge	5	4.20	.837	80	20
Current Process: Efficiency	5	3.80	.837	60	40
Current Process: Accuracy	5	3.60	1.140	60	40
Current Process: Compliance HBPM	5	3.20	1.095	20	80
Current Process: Compliance CBPM	5	3.60	.894	40	60
Current Process: Satisfaction	5	3.60	.894	40	60
ABPM Process: Efficiency	5	4.20	.837	80	20
ABPM Process: Accuracy	5	4.60	.548	100	
ABPM Process: Compliance	5	4.40	.894	80	20
ABPM Process: Satisfaction	5	4.60	.548	100	
ABPM Results: Interpretation	3	4.67	.577	100	
ABPM Results: Availability	3	4.67	.577	100	
ABPM Results: Plan Determination	3	4.67	.577	100	

Note. ABPM= Ambulatory Blood Pressure Monitor. HBPM= Home Blood Pressure Monitor. CBPM= Clinic Blood Pressure Monitor.

Table 7

Participant Pre-Survey Questionnaire Results

Pre-Survey Questions	*n*	*M*	SD	Very Good/Good %	Fair/Poor %
ABPM Education: Usefulness	8	4.50	.535	100 (50/50)	
ABPM Education: Understandable	8	4.50	.535	100 (50/50)	
ABPM Education: New Information	8	4.50	.535	100 (50/50)	
ABPM Education: Satisfaction	8	4.50	.535	100 (50/50)	
General HTN Knowledge	8	3.75	1.165	50	50

Note. ABPM= Ambulatory Blood Pressure Monitor.

Table 8

Participant Post-Survey Questionnaire Results

Post-Survey Questions	*n*	*M*	SD	Good/Very Good %	Fair/Poor%
ABPM: Comfort	7	3.86	.690	71.4	28.6
ABPM: Perform Daily Activities	7	3.86	.690	71.4	28.6
ABPM: Perform Work	6	3.83	.753	57.2	28.6
ABPM: Comfort at Night	7	3.57	.976	57.2	42.9
ABPM: Ability to Sleep	7	3.71	1.254	71.4	28.6
Ability to Fall Asleep	7	4.14	1.069	85.8	14.3
ABPM: Ability to Stay Asleep	7	3.57	1.134	42.9	57.1
ABPM: Quality of Sleep	7	3.86	.900	85.7	14.3
ABPM Satisfaction: Overall	7	4.29	.756	85.7	14.3
ABPM Satisfaction: Education	7	4.29	.756	85.7	14.3
ABPM Satisfaction: Monitoring BP at Home	7	4.29	.756	85.7	14.3
ABPM Satisfaction: Bringing Unit Back	7	3.86	1.345	85.7	14.3

Note. ABPM= Ambulatory Blood Pressure Monitor.

Table 10

Staff Pre- and Post-Survey Questionnaire Comparison

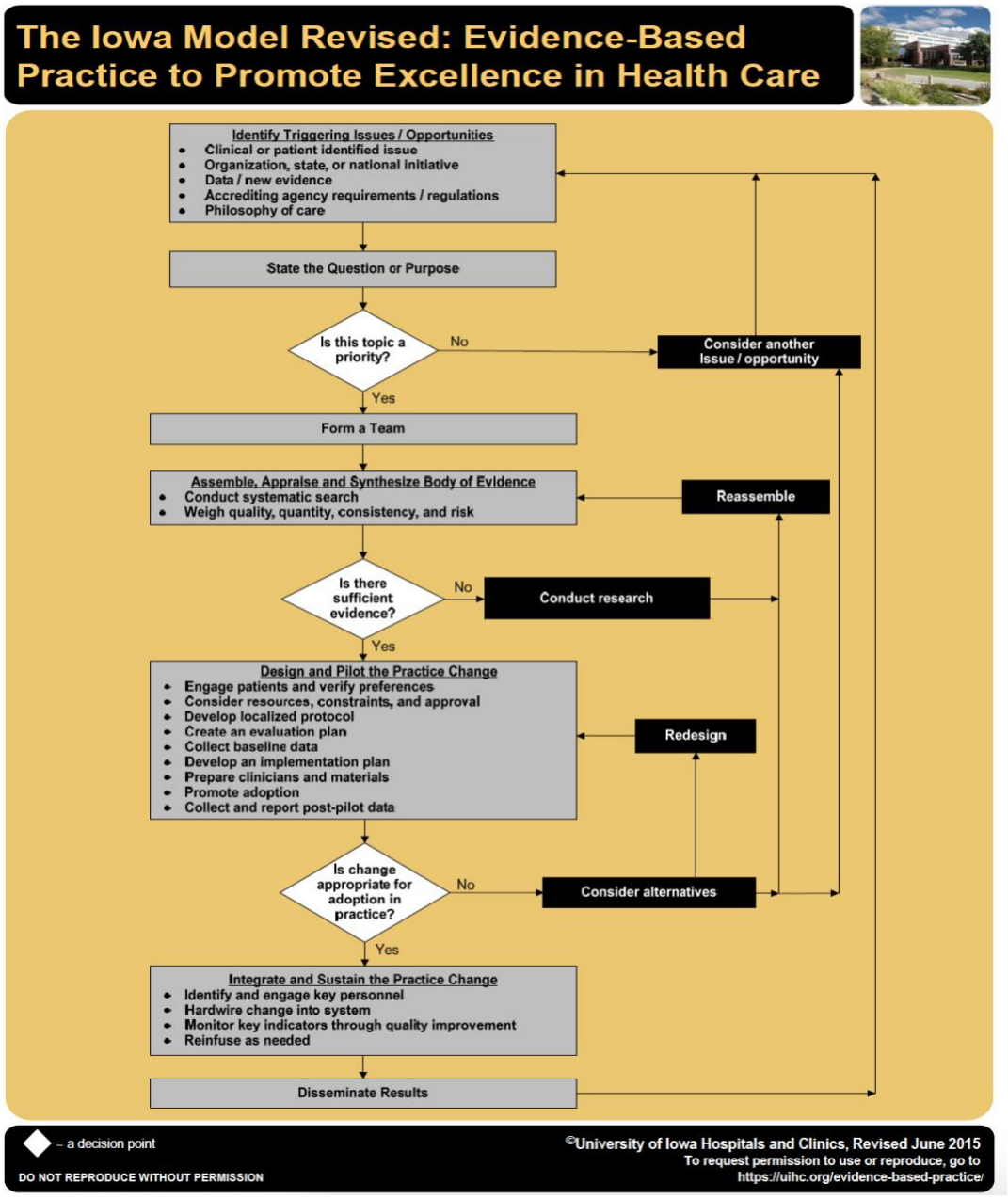
Pre- and Post-Survey Questions	Staff Identification Number									
	1		2		3		4		5	
	Pre-Survey	Post-Survey	Pre-Survey	Post-Survey	Pre-Survey	Post-Survey	Pre-Survey	Post-Survey	Pre-Survey	Post-Survey
ABPM Knowledge	3	4	3	5	4	3	3	4	3	5
Current Process: Efficiency	3	4	4	3	4	3	3	4	2	5
Current Process: Accuracy	3	4	3	2	3	3	4	4	3	5
Current Process: Compliance HBPM	4	3	3	3	3	2	3	5	2	3
Current Process: Compliance CBPM	4	3	3	3	2	4	4	5	3	3

Note. ABPM= Ambulatory Blood Pressure Monitor. HBPM= Home Blood Pressure Monitor. CBPM= Clinic Blood Pressure Monitor. Values: 2- Poor, 3- Fair, 4- Good, 5- Very Good.

Figures

Figure 1

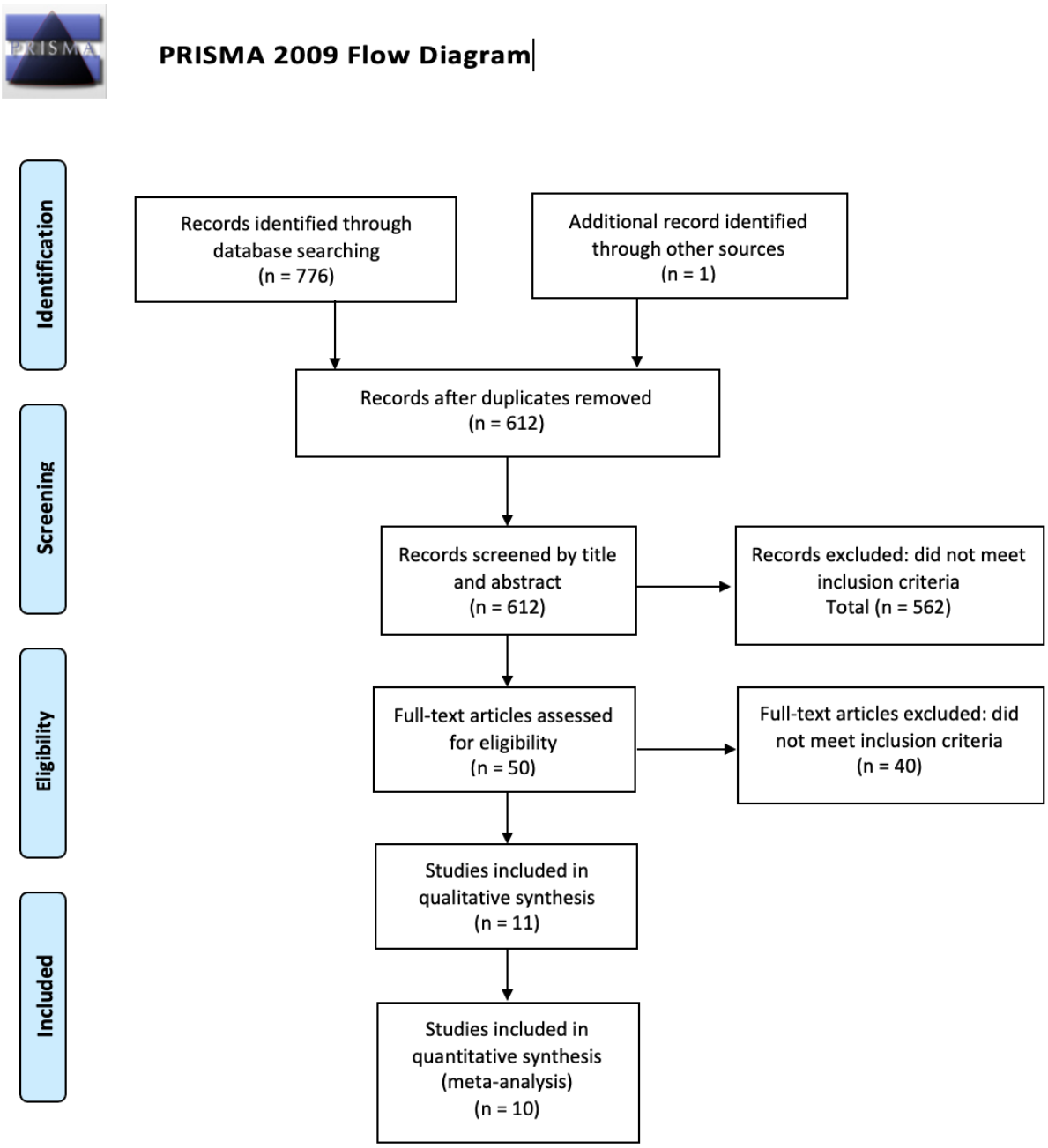
Iowa Model Revised: EBP Algorithm Model



Note. The Iowa Model Revised: Evidence-Based Practice to Promote Excellence in Health Care. Iowa Model Collaborative. (2017). Iowa model of evidence-based practice: Revisions and validation. *Worldviews on Evidence-Based Nursing, 14(3), 175-182. doi:10.1111/wvn.12223.* Reprinted with permission

Figure 2

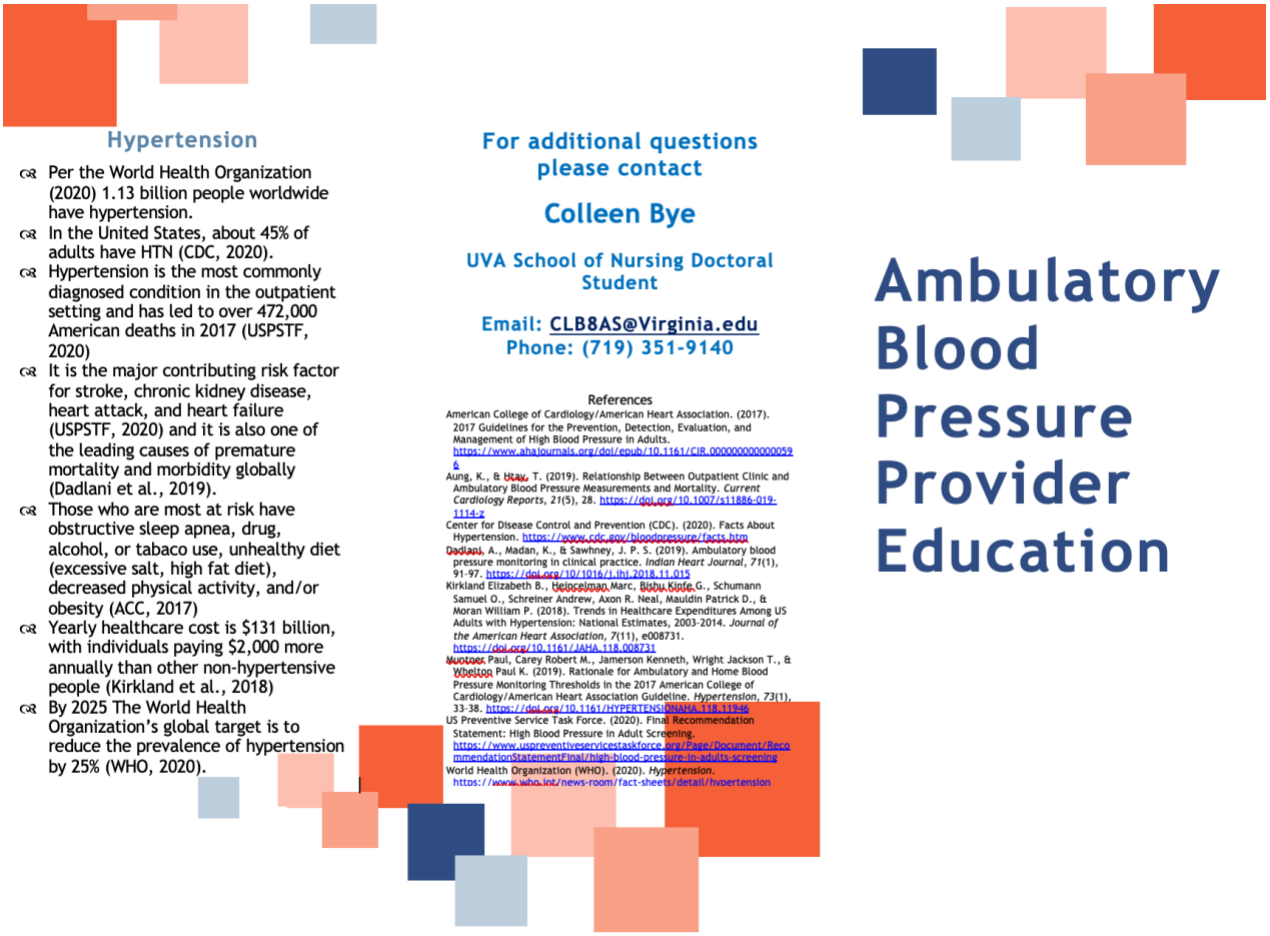
PRISMA Flow Diagram



Note. Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) flow outlining search and selection of articles. Adapted "Preferred Reporting Items for Systematic Reviews and *M*eta-*A*nalysis: The PRISMA Statement" by D. Moher, A. Liberati, J.Tatzalaff, D.G. Altman, 2009, The PRISMA Group, PLoS Med 6(6): e1000097.

Figure 3.1

ABPM Provider Education Pamphlet, Front



Note. Staff Trifold Educational Pamphlet, first page

Figure 3.2

ABPM Provider Education Pamphlet, Back

Why Ambulatory Blood Pressure Monitoring?

- The patient naturally has different blood pressures throughout the day and the multiple measurement by the ABPM over 24 hours accounts for the variability as well as reduce the number of false readings seen with home and clinic BP readings (Dadlani et al., 2019).
- Medicare and Medicaid began covering the cost of ABPM, the ACC/AHA is now recommending the use of ABPM for the measuring of blood pressure outside the clinic for the diagnosis of hypertension (Muntner et al., 2019), and the USPSTF (2020) recommends the use of ABPM as a diagnostic tool for hypertension to prevent misdiagnosis or overtreatment of hypertension.
- ABPM collects an estimate of the true or mean blood pressure, the diurnal rhythm of blood pressure, and blood pressure variability

Selection Criteria for This Project

- Inclusion criteria:
  - Blood pressure range during clinic visit ≥130 - 159 / ≥80 - 99 mmHg
  - Ages between 21-85 years old
  - Scheduled for wellness visit
  - The patient is not sick for appointment (i.e. cough, fever, upper respiratory infection, abdominal pain, etc.)
- Exclusion criteria:
  - Previous diagnosis of hypertension
  - Currently on antihypertensive medications
  - Currently on medications or that could artificially elevate blood pressure
  - Previous diagnosis of chronic pain

What is 24-hour Ambulatory Blood Pressure Monitoring?

- Ambulatory Blood Pressure Monitoring (ABPM) measures your blood pressure over a 24-hour period. You will wear a blood pressure cuff on your upper arm that is connected to a monitor. The monitor records your blood pressure readings 3 times per hour while awake and 1 time per hour while sleeping.
- The ABPM evaluates for:
  - Suspected white-coat hypertension (high blood pressure in clinic, with low blood pressures outside the clinic setting).
  - Masked hypertension (normal pressures in clinic, but elevated blood pressures outside clinic setting)
  - High blood pressure without a diagnosis of hypertension requiring further investigation.
  - Hypertension medication assessment, with or without drug resistant hypertension.
  - Episodic hypertension and hypotension events.

Ambulatory Blood Pressure Monitor at night

- The ABPM is able to perform assessments on the patient's blood pressure at night to identify isolated nocturnal hypertension (nighttime without daytime hypertension) and nocturnal nondipping patterns (failure of the blood pressure to decreased by at least 10%), which has been found to be a stronger predictor of cardiovascular mortality and events (Aung & Htay, 2019).

Insurances

- Most insurance companies cover the use of ambulatory blood pressure monitoring. Criteria are similar to Medicare.
- Medicare Criteria:
  - White coat hypertension: (>130 mmHg but <160 mmHg (or) / >80 mmHg <100 mmHg) need two separate clinic visits with at least two separate measurements made at each visit and with at least two blood pressure measurements taken outside the office which are <130/80 mm Hg.
  - Masked hypertension (BP range 120 - 129 mmHg (or) / 75 - 79 mmHg) need two separate clinic visits with at least two separate measurements made at each visit and with at least two blood pressure measurements taken outside the office which are ≥130/80 mm Hg.
  - ABPM is covered once per year.

CPT and ICD-10 Codes

- CPT Code: 93784 (Ambulatory blood pressure monitoring, utilizing a system such as magnetic tape and/or computer disk, for 24 hours or longer; including recording, scanning analysis, interpretation and report).
- ICD-10 Codes usually accepted:
  - R03.0: Elevated blood pressure reading, without diagnosis of hypertension
  - I10: Hypertension (malignant only)
  - I11.9: Hypertensive heart disease without heart failure
  - I15.0 - I16.2: Secondary hypertension (malignant only)
  - I95.0 - I95.9: Hypotension
  - R55: Syncope and collapse

Note. Staff Trifold Educational Pamphlet, second page

Figure 4.1

Staff Pre-Survey, pg. 1

Staff Satisfaction and work flow Pre-Survey

Staff Name: _____ Date: _____

	Very Good	Good	Fair	Poor	Very Poor	
1. Rate your current level of knowledge of Ambulatory Blood Pressure Units	5 ☐	4 ☐	3 ☐	2 ☐	1 ☐	NA ☐
2. Rate the quality of the ABPM education provided for: ***Quality***	5 ☐	4 ☐	3 ☐	2 ☐	1 ☐	NA ☐
3. Rate the quality of the ABPM education provided for: ***Easy to Understand***	5 ☐	4 ☐	3 ☐	2 ☐	1 ☐	NA ☐
4. Rate the Clinic's Current Process of diagnosing hypertension: ***Efficiency***	5 ☐	4 ☐	3 ☐	2 ☐	1 ☐	NA ☐
5. Rate the Clinic's Current Process of diagnosing hypertension: ***Accuracy***	5 ☐	4 ☐	3 ☐	2 ☐	1 ☐	NA ☐
6. Rate the Clinic's Current Process of diagnosing hypertension: ***Compliance (Home BP Monitoring)***	5 ☐	4 ☐	3 ☐	2 ☐	1 ☐	NA ☐
7. Rate the Clinic's Current Process of diagnosing hypertension: ***Compliance (Clinic BP Monitoring)***	5 ☐	4 ☐	3 ☐	2 ☐	1 ☐	NA ☐
8. How satisfied are you with the current process?	5 ☐	4 ☐	3 ☐	2 ☐	1 ☐	NA ☐
a. Why or why not?	a)					
b. What are the benefits of continuing the current process?	b)					
c. What are the limitations of the current process?	c)					
d. How would you improve the current process?	d)					
9. (For Providers): On Average, how often do you diagnose a patient with hypertension in a given month?						

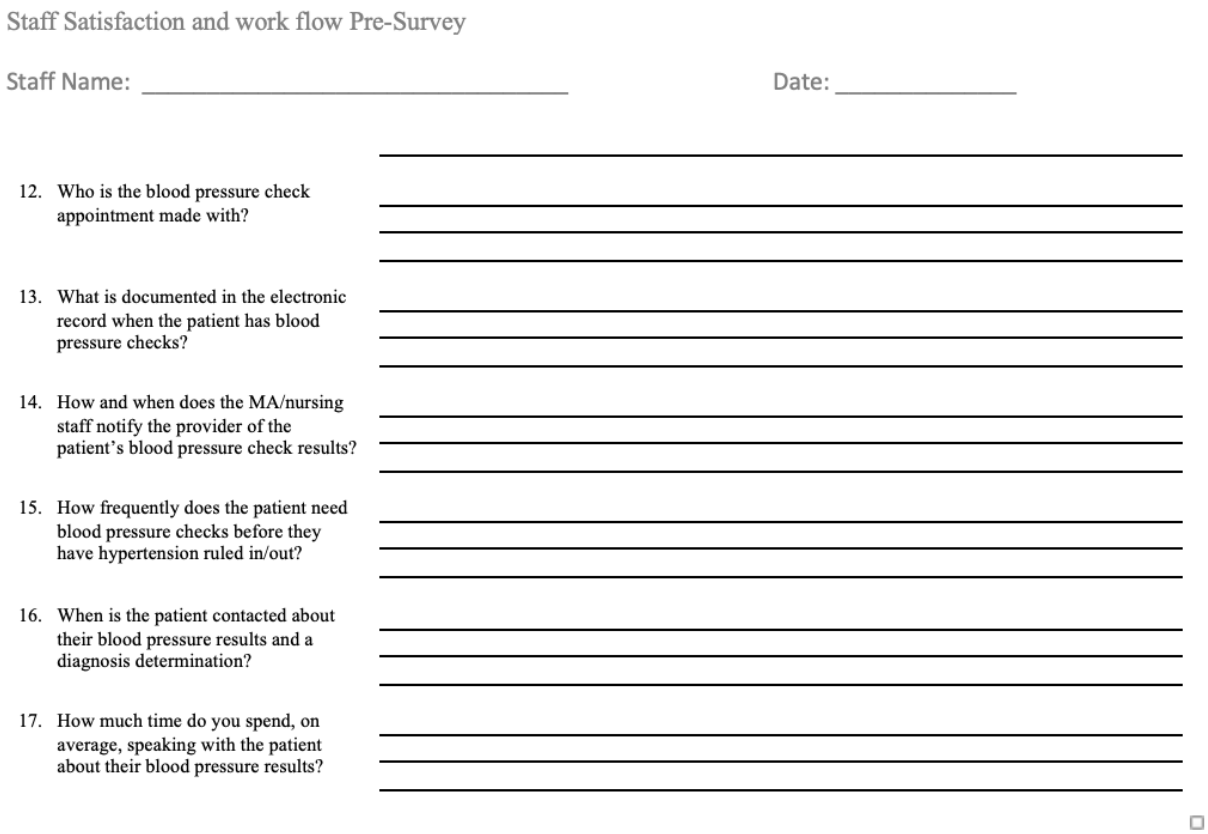
10. When a patient has a questionable blood pressure in clinic, how is the blood pressure check appointment made? _____

11. How soon is the first blood pressure check appointment scheduled? _____

Note. Staff Satisfaction and Workflow Pre-Survey, page 1

Figure 4.2

Staff Pre-Survey, pg. 2



Staff Satisfaction and work flow Pre-Survey

Staff Name: _____ Date: _____

12. Who is the blood pressure check appointment made with?

13. What is documented in the electronic record when the patient has blood pressure checks?

14. How and when does the MA/nursing staff notify the provider of the patient's blood pressure check results?

15. How frequently does the patient need blood pressure checks before they have hypertension ruled in/out?

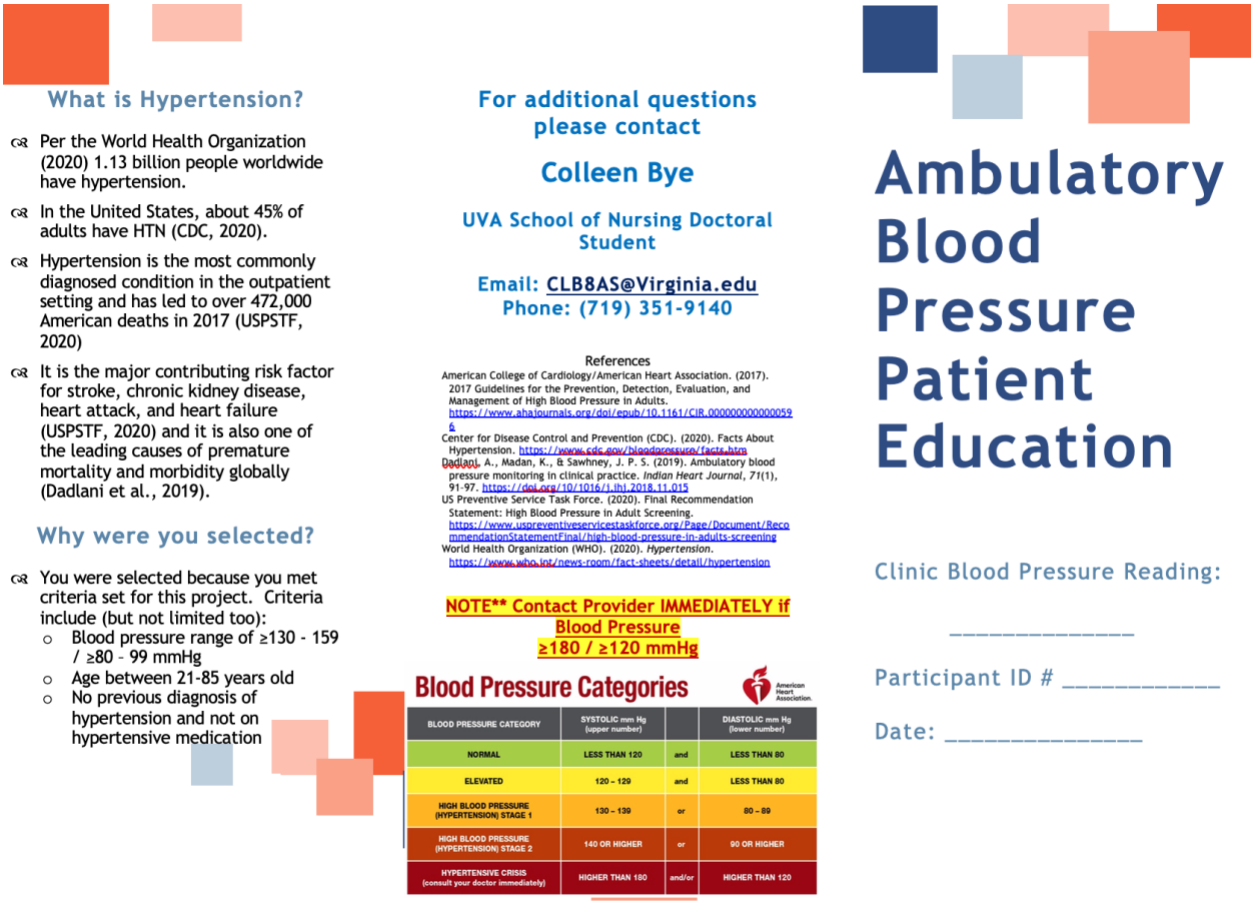
16. When is the patient contacted about their blood pressure results and a diagnosis determination?

17. How much time do you spend, on average, speaking with the patient about their blood pressure results?

Note. Staff Satisfaction and Workflow Pre-Survey, page 2

Figure 5.1

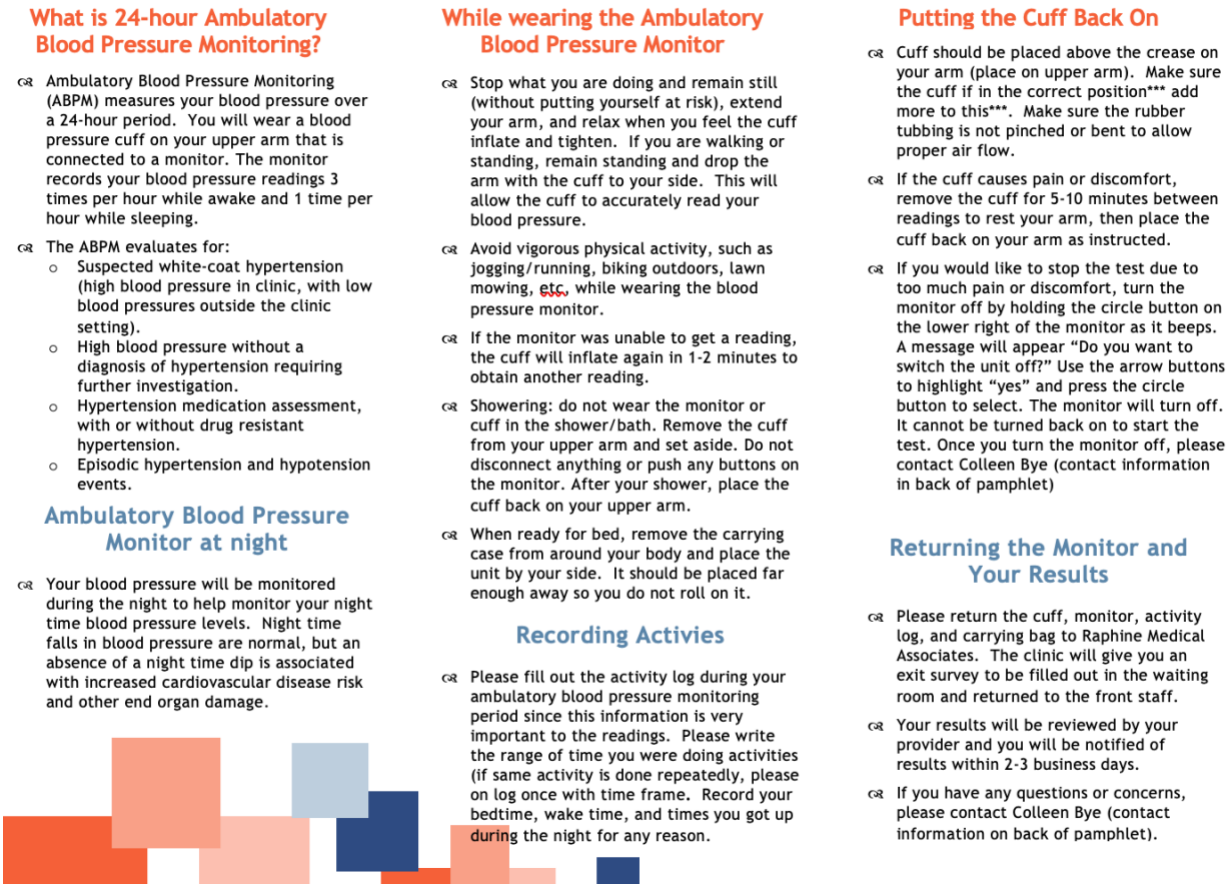
ABPM Participant Education, Front



Note. Participant Trifold Educational Pamphlet, page 1

Figure 5.2

ABPM Participant Education, Back



What is 24-hour Ambulatory Blood Pressure Monitoring?

- Ambulatory Blood Pressure Monitoring (ABPM) measures your blood pressure over a 24-hour period. You will wear a blood pressure cuff on your upper arm that is connected to a monitor. The monitor records your blood pressure readings 3 times per hour while awake and 1 time per hour while sleeping.
- The ABPM evaluates for:
  - Suspected white-coat hypertension (high blood pressure in clinic, with low blood pressures outside the clinic setting).
  - High blood pressure without a diagnosis of hypertension requiring further investigation.
  - Hypertension medication assessment, with or without drug resistant hypertension.
  - Episodic hypertension and hypotension events.

Ambulatory Blood Pressure Monitor at night

- Your blood pressure will be monitored during the night to help monitor your night time blood pressure levels. Night time falls in blood pressure are normal, but an absence of a night time dip is associated with increased cardiovascular disease risk and other end organ damage.

While wearing the Ambulatory Blood Pressure Monitor

- Stop what you are doing and remain still (without putting yourself at risk), extend your arm, and relax when you feel the cuff inflate and tighten. If you are walking or standing, remain standing and drop the arm with the cuff to your side. This will allow the cuff to accurately read your blood pressure.
- Avoid vigorous physical activity, such as jogging/running, biking outdoors, lawn mowing, etc, while wearing the blood pressure monitor.
- If the monitor was unable to get a reading, the cuff will inflate again in 1-2 minutes to obtain another reading.
- Showering: do not wear the monitor or cuff in the shower/bath. Remove the cuff from your upper arm and set aside. Do not disconnect anything or push any buttons on the monitor. After your shower, place the cuff back on your upper arm.
- When ready for bed, remove the carrying case from around your body and place the unit by your side. It should be placed far enough away so you do not roll on it.

Recording Activies

- Please fill out the activity log during your ambulatory blood pressure monitoring period since this information is very important to the readings. Please write the range of time you were doing activities (if same activity is done repeatedly, please on log once with time frame. Record your bedtime, wake time, and times you got up during the night for any reason.

Putting the Cuff Back On

- Cuff should be placed above the crease on your arm (place on upper arm). Make sure the cuff if in the correct position*** add more to this***. Make sure the rubber tubbing is not pinched or bent to allow proper air flow.
- If the cuff causes pain or discomfort, remove the cuff for 5-10 minutes between readings to rest your arm, then place the cuff back on your arm as instructed.
- If you would like to stop the test due to too much pain or discomfort, turn the monitor off by holding the circle button on the lower right of the monitor as it beeps. A message will appear "Do you want to switch the unit off?" Use the arrow buttons to highlight "yes" and press the circle button to select. The monitor will turn off. It cannot be turned back on to start the test. Once you turn the monitor off, please contact Colleen Bye (contact information in back of pamphlet)

Returning the Monitor and Your Results

- Please return the cuff, monitor, activity log, and carrying bag to Raphine Medical Associates. The clinic will give you an exit survey to be filled out in the waiting room and returned to the front staff.
- Your results will be reviewed by your provider and you will be notified of results within 2-3 business days.
- If you have any questions or concerns, please contact Colleen Bye (contact information on back of pamphlet).

Note. Participant Trifold Educational Pamphlet, page 2

Figure 6

Participant Pre-Survey

Participant Satisfaction Pre-Survey

Participant ID # _____ Date: _____

	Very Good	Good	Fair	Poor	Very Poor	
1. Rate the education (or information) you received on ambulatory blood pressure monitor (ABPM): *Useful*	5 ☐	4 ☐	3 ☐	2 ☐	1 ☐	NA ☐
2. Rate the education (or information) you received on ABPM: *Understandable*	5 ☐	4 ☐	3 ☐	2 ☐	1 ☐	NA ☐
3. Rate the education (or information) you received on ABPM: *New Information*	5 ☐	4 ☐	3 ☐	2 ☐	1 ☐	NA ☐
4. How satisfied were you with the information provided?	5 ☐	4 ☐	3 ☐	2 ☐	1 ☐	NA ☐
5. Rate your knowledge on hypertension in general	5 ☐	4 ☐	3 ☐	2 ☐	1 ☐	NA ☐

6. Do you own a blood pressure machine at home?	Yes ☐	No ☐
7. Have you ever taken your blood pressure outside the clinic?	Yes ☐	No ☐
a. If yes, where have you had your blood pressure taken and why?	_____	

8. Do you have any recommendations for improvements to our ambulatory blood pressure monitoring education? Please explain. _____

Note. ABPM = ambulatory blood pressure monitoring

Figure 7.1

Participant Post-Survey, pg. 1

Participant Satisfaction Post-Survey

Participant ID # _____ Date: _____

	Very Good	Good	Fair	Poor	Very Poor	
1. Rate the ambulatory blood pressure monitoring unit: *Comfort while worn throughout day*	5 ☐	4 ☐	3 ☐	2 ☐	1 ☐	NA ☐
2. Rate the ambulatory blood pressure monitoring unit: *Your ability to perform of daily activities while wearing the ambulatory blood pressure monitoring unit.*	5 ☐	4 ☐	3 ☐	2 ☐	1 ☐	NA ☐
3. Rate the ambulatory blood pressure monitoring unit: *Your ability to perform work activities while wearing the ambulatory blood pressure monitoring unit.*	5 ☐	4 ☐	3 ☐	2 ☐	1 ☐	NA ☐
4. Rate the ambulatory blood pressure monitoring unit: *Comfort while worn throughout the night*	5 ☐	4 ☐	3 ☐	2 ☐	1 ☐	NA ☐
5. Rate the ambulatory blood pressure monitoring unit: *Ability to sleep while wearing the unit*	5 ☐	4 ☐	3 ☐	2 ☐	1 ☐	NA ☐
6. Rate the ambulatory blood pressure monitoring unit: *Ability fall asleep while wearing the unit*	5 ☐	4 ☐	3 ☐	2 ☐	1 ☐	NA ☐
7. Rate the ambulatory blood pressure monitoring unit: *Ability stay asleep while wearing the unit*	5 ☐	4 ☐	3 ☐	2 ☐	1 ☐	NA ☐
8. Rate the ambulatory blood pressure monitoring unit: *Quality of sleep while wearing the unit*	5 ☐	4 ☐	3 ☐	2 ☐	1 ☐	NA ☐
9. If you had difficulty with *sleeping, staying asleep, or falling asleep,* was this specifically due to the ABPM unit and why?						
10. Rate your overall satisfaction with the ambulatory blood pressure monitoring ***unit***	5 ☐	4 ☐	3 ☐	2 ☐	1 ☐	NA ☐
11. Rate your overall satisfaction with the ambulatory blood pressure monitoring ***process*****:** *Education*	5 ☐	4 ☐	3 ☐	2 ☐	1 ☐	NA ☐

Note. ABPM = ambulatory blood pressure monitoring

Figure 7.2

Participant Post-Survey, pg. 2

Participant Satisfaction Post-Survey

Participant ID # _____ Date: _____

12. Rate your overall satisfaction with the ambulatory blood pressure monitoring ***process*****:** *Monitoring blood pressure at home with provided unit*	5 ☐	4 ☐	3 ☐	2 ☐	1 ☐	NA ☐
13. Rate your overall satisfaction with the ambulatory blood pressure monitoring ***process*****:** *Bringing the ambulatory blood pressure back to clinic*	5 ☐	4 ☐	3 ☐	2 ☐	1 ☐	NA ☐
14. Did you have to contact project coordinator for assistance with the ABPM unit?		Yes ☐			No ☐	
a. If yes, please indicate the reason and issue.	_____					

15. Would you change or improve anything related to the ***education you received*** on the Ambulatory blood pressure monitoring? _____

16. Would you change or improve anything pertaining to the ***process you experienced*** using the ambulatory blood pressure monitoring units? _____

Note. ABPM = ambulatory blood pressure monitoring

Figure 8.1

Staff Post-Survey, pg. 1

Staff Satisfaction and work flow Post-Survey

Staff Name: _____ Date: _____

	Very Good	Good	Fair	Poor	Very Poor	
1. Rate your current level of knowledge of Ambulatory Blood Pressure Units	5 ☐	4 ☐	3 ☐	2 ☐	1 ☐	NA ☐
2. Rate the Clinic's **Current Process** of diagnosing hypertension: ***Efficiency***	5 ☐	4 ☐	3 ☐	2 ☐	1 ☐	NA ☐
3. Rate the Clinic's **Current Process** of diagnosing hypertension: ***Accuracy***	5 ☐	4 ☐	3 ☐	2 ☐	1 ☐	NA ☐
4. Rate the Clinic's **Current Process** of diagnosing hypertension: ***Compliance (Home BP Monitoring)***	5 ☐	4 ☐	3 ☐	2 ☐	1 ☐	NA ☐
5. Rate the Clinic's **Current Process** of diagnosing hypertension: ***Compliance (Clinic BP Monitoring)***	5 ☐	4 ☐	3 ☐	2 ☐	1 ☐	NA ☐
6. Rate how satisfied are you with the **current process**?	5 ☐	4 ☐	3 ☐	2 ☐	1 ☐	NA ☐
7. Rate the **New ABPM Process** of diagnosing hypertension: ***Efficiency***	5 ☐	4 ☐	3 ☐	2 ☐	1 ☐	NA ☐
8. Rate the **New ABPM Process** of diagnosing hypertension: ***Accuracy***	5 ☐	4 ☐	3 ☐	2 ☐	1 ☐	NA ☐
9. Rate the **New ABPM Process** of diagnosing hypertension: *Compliance (Using ABPM for 24-hrs)*	5 ☐	4 ☐	3 ☐	2 ☐	1 ☐	NA ☐
10. Rate how satisfied are you with the **New ABPM Process** of diagnosing hypertension.	5 ☐	4 ☐	3 ☐	2 ☐	1 ☐	NA ☐
11. Which hypertension diagnosis process would you prefer to continue using and why?						

Note. ABPM = ambulatory blood pressure monitoring

Figure 8.2

Staff Post-Survey, pg. 1

Staff Satisfaction and work flow Post-Survey

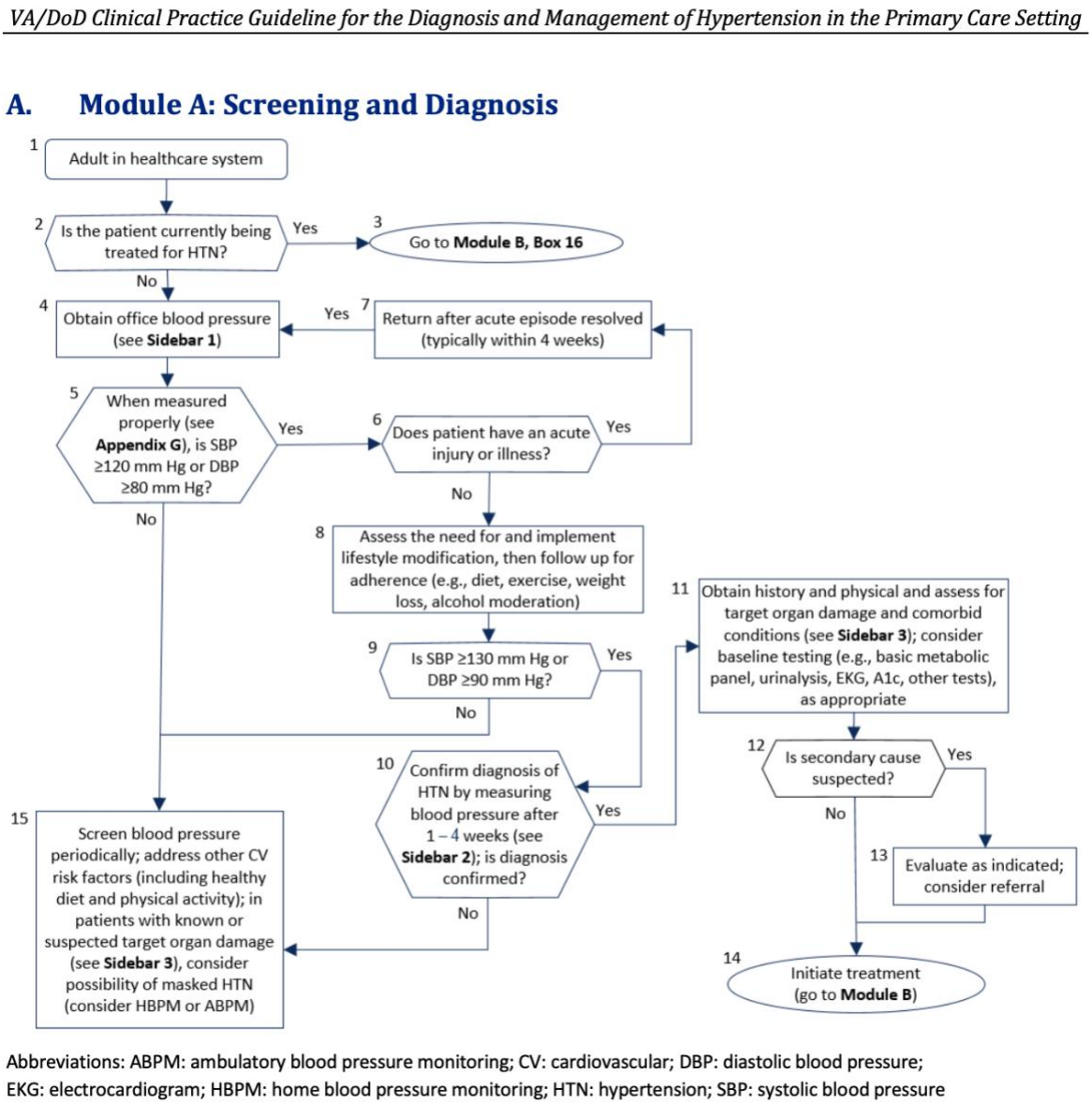
Staff Name: _____ Date: _____

12. (For Providers): Rate the results from the APBM: *Ease of understanding and interpretation*	5 ☐	4 ☐	3 ☐	2 ☐	1 ☐	NA ☐
13. (For Providers): Rate the results from the APBM: *Result availability*	5 ☐	4 ☐	3 ☐	2 ☐	1 ☐	NA ☐
14. (For Providers): Rate the results from the APBM: *Determination of plan of action for patient*	5 ☐	4 ☐	3 ☐	2 ☐	1 ☐	NA ☐
15. On average, how much time was spent on educating the patients on the Ambulatory blood pressure monitoring unit? a. How did this impact your workflow? b. How did it affect your time available for patient care? c. What were some barriers to educating patients on ABPM? d. How would you improve this ABPM process?	_____ Minutes a) _____ b) _____ c) _____ d) _____					

Note. ABPM = ambulatory blood pressure monitoring

Figure 11

VA/DoD Hypertension Clinical Practice Guidelines

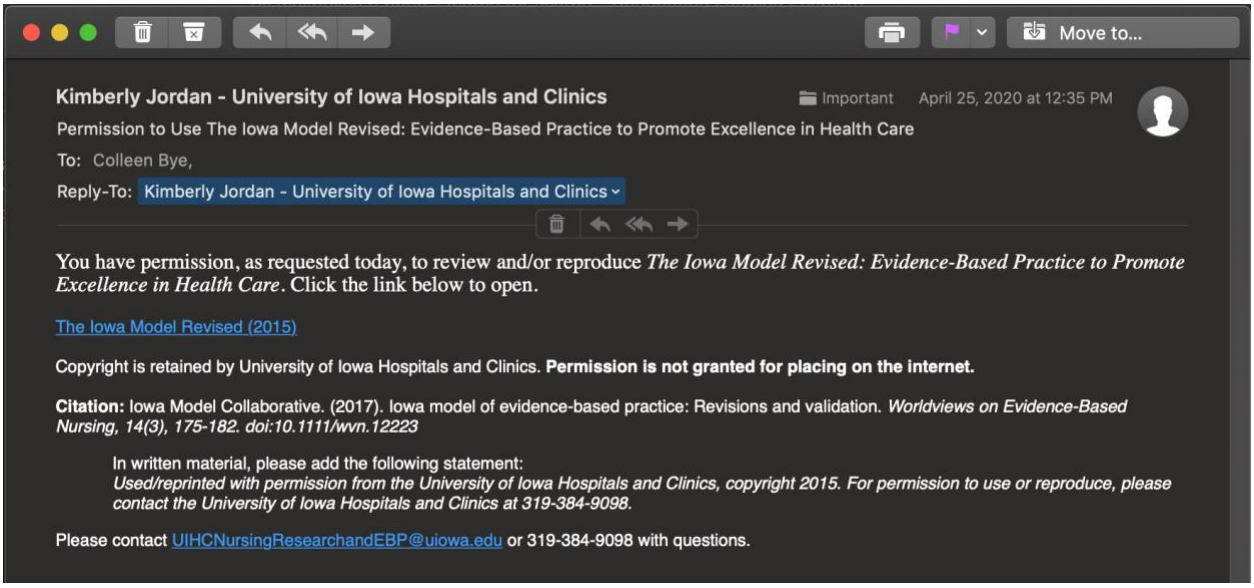


Note. VA/DoD Clinical Practice Guidelines for the Diagnosis and Management of Hypertension in the Primary Care setting, Model A: Screening and Diagnosis

Appendices

Appendix A

Email permission to use The Iowa Model Revised



Move to...

Kimberly Jordan - University of Iowa Hospitals and Clinics Important April 25, 2020 at 12:35 PM

Permission to Use The Iowa Model Revised: Evidence-Based Practice to Promote Excellence in Health Care

To: Colleen Bye,

Reply-To: Kimberly Jordan - University of Iowa Hospitals and Clinics

You have permission, as requested today, to review and/or reproduce *The Iowa Model Revised: Evidence-Based Practice to Promote Excellence in Health Care*. Click the link below to open.

The Iowa Model Revised (2015)

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Citation: Iowa Model Collaborative. (2017). Iowa model of evidence-based practice: Revisions and validation. *Worldviews on Evidence-Based Nursing, 14(3), 175-182. doi:10.1111/wvn.12223*

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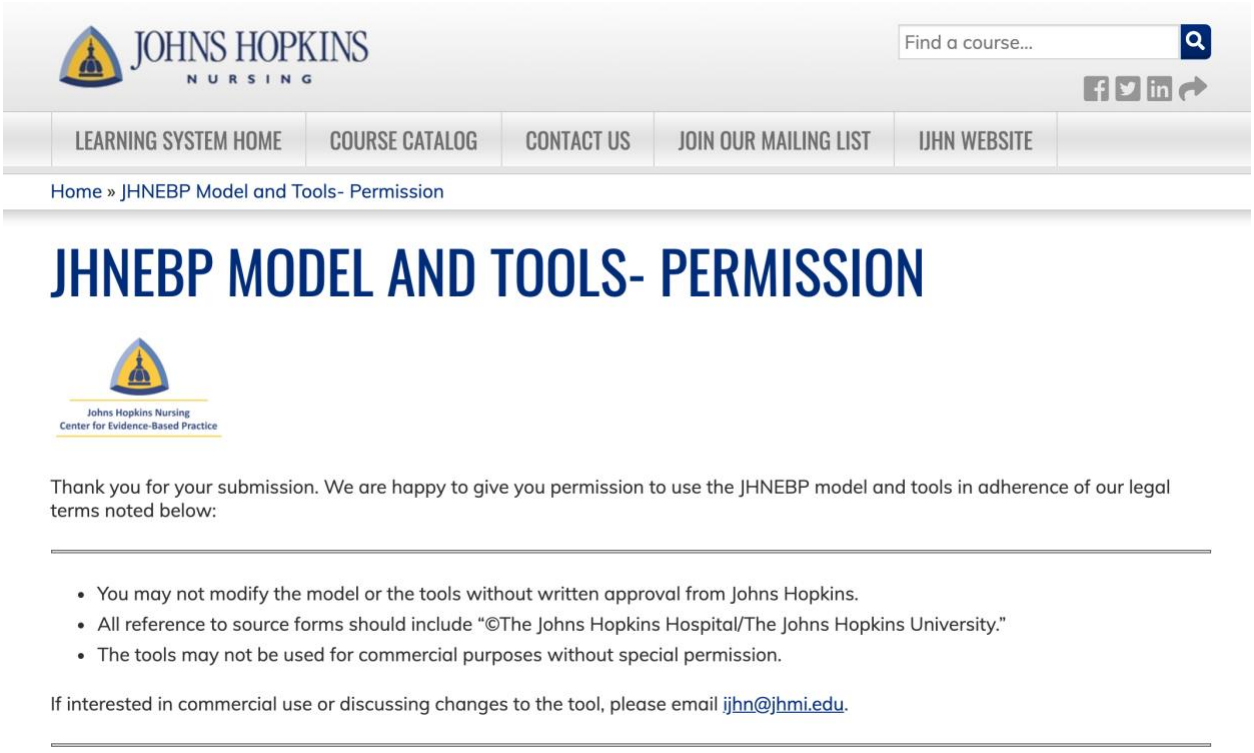
Please contact UIHCNursingResearchandEBP@uiowa.edu or 319-384-9098 with questions.

Note. Email from Kimberly Jordan authorizing use of The Iowa Model Revised: Evidence-Based Practice to Promote Excellence in Health Care.

Appendix B

Permission to use the Johns Hopkins Nursing Evidence-Based Practice Model and Tools



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JHNEBP MODEL AND TOOLS- PERMISSION

Johns Hopkins Nursing
Center for Evidence-Based Practice

Thank you for your submission. We are happy to give you permission to use the JHNEBP model and tools in adherence of our legal terms noted below:

- You may not modify the model or the tools without written approval from Johns Hopkins.
- All reference to source forms should include "©The Johns Hopkins Hospital/The Johns Hopkins University."
- The tools may not be used for commercial purposes without special permission.

If interested in commercial use or discussing changes to the tool, please email ijhn@jhmi.edu.

Appendix C

ABPM Staff Script with Questions and Answers

ABPM Script and Common Questions

Introduction to the Patient

1. You have been selected to have your blood pressure evaluated with a 24-hour ambulatory blood pressure unit. The blood pressure cuff and machine should be worn throughout the day and while sleeping at night. During the evaluation the blood pressure cuff will inflate every 30 minutes during the day and every 60 minutes during the night. Nighttime evaluation is very important to assess the nighttime falls in your blood pressure since an absence of falls is associated with increased risk for cardiovascular disease and events.

2. You will receive an activity/symptom log which is very important for your evaluation. Please write the time you were doing activities (if same activity is done repeatedly, please log once with time frame). Record your bedtime, wake time, and times you got up during the night for any reason. If you feel symptoms of dizziness please indicate the time and symptom on this log.

3. When the blood pressure cuff inflates, stop what you are doing and remain still (without putting yourself at risk), and relax your arm to your side. Avoid vigorous physical activity, such as jogging/running, biking outdoors, lawn mowing, etc, while wearing the blood pressure monitor. If activity is unable to be avoided, please indicate on your activity log the time of when the activity is performed.

4. Showering: **do not wear the monitor or cuff in the shower/bath**. Remove the cuff from your upper arm and set aside. Do not disconnect anything or push any buttons on the monitor. After your shower, place the cuff back on your upper arm as instructed.

5. When ready for bed, remove the carrying case from around your body and place the unit by your side. It should be placed far enough away so you do not roll on it.

6. If the cuff causes pain or discomfort, remove the cuff for 5-10 minutes between readings to rest your arm, then place the cuff back on your arm as instructed.

7. If you would like to stop the test due to too much pain or discomfort, turn the monitor off by holding the "Play/Stop button in the center of the unit, until it beeps 5 times (approx. 5 seconds). The monitor will turn off. It cannot be turned back on to start the test. If you turn the machine off before end of 24-hour evaluation please contact Colleen Bye (contact information in back of pamphlet). Return the machine as instructed.

8. Please return the cuff, monitor, activity log, and carrying bag to Raphine Medical Associates once study is complete. The clinic will give you an exit survey to be filled out in the waiting room and returned to the front staff. Your results will be reviewed by your provider and you will be notified of results within 2-3 business days.

How to put on and take off the BP Cuff

- Please instruct the patient on how to properly put on and take off the blood pressure cuff at this time.

Common Questions

Q: Does the Blood pressure cuff, monitor, or tube contain Latex?
A: No, there is no latex in the device, cuff, or tube

Q: Why is the blood pressure machine taking so many measurements?
A: The ambulatory blood pressure machine takes multiple measurements because your blood pressure varies throughout the day and night. The machine is obtaining a 24-hour average, daytime average, and nighttime average. Your provider will use these averages to assess your blood pressure.

Q: Is there any potential risks or health concerns with this machine or taking your blood pressure so many times?
A: No, you may have slight discomfort while the blood pressure cuff inflates, but this will subside as soon as the blood pressure is taken. A heat rash or slight bruising can occur in rare incidences, but this is not common.

Putting on BP Cuff with patient: https://www.youtube.com/watch?v=GdOXqHNI9-8

Set Up: https://www.youtube.com/watch?v=p7ya5cRbiT8

Retrieve Information: https://www.youtube.com/watch?v=qJh1Vr7j2FY

Note. ABPM Staff Script and Common Questions

Appendix D

Wilcoxon Signed Rank Test Results: Staff Questionnaire Results: Comparing Current Process Pre-Intervention and Current Process Post-Intervention n=5

	Pre-Intervention			*Post-Intervention*			
Question	Median (IQR)	Good/ Very Good %	Fair/ Poor %	Median (IQR)	Good/ Very Good%	Fair/ Poor%	p-value
Efficiency	3 (2.5 - 4.0)	40	60	4 (3.0 - 4.5)	60	40	0.480
Accuracy	3 (3.0 - 3.5)	20	80	4 (2.5 - 4.5)	60	40	0.414
Compliance HBPM	3 (2.5 - 3.5)	20	80	3 (2.5 – 4.0)	20	80	0.705
Compliance CBPM	3 (2.5 - 4.0)	40	60	3 (3.0 - 4.5)	40	60	0.414
Satisfaction	2 (1.5 - 2.0)	0	100	3 (3.0 - 4.5)	40	60	**0.038***

Related-Samples Wilcoxon Signed Rank Test

Appendix E

Wilcoxon Signed Rank Test Results: Staff Survey Results Comparing Current Process Pre-Intervention and ABPM Process Post Intervention n = 5

	Pre-Intervention Current Process			*Post-Intervention* ABPM Process			
Question	Median (IQR)	Good/ Very Good %	Fair/ Poor %	Median (IQR)	Good/ Very Good %	Fair/ Poor %	p-value
Efficiency	3 (2.5 - 4.0)	40	60	4 (3.5 - 5.0)	80	20	0.157
Accuracy	3 (3.0 - 3.5)	20	80	5 (4.0 - 5.0)	100	0	0.059
Compliance HBPM	3 (2.5 - 3.5)	20	80	5 (3.5 - 5.0)	80	20	0.102
Compliance CBPM	3 (2.5 - 4.0)	40	60	5 (3.5 - 5.0)	80	20	0.063
Satisfaction	2 (1.5 - 2.0)	0	100	5 (4.0 - 5.0)	100	0	**0.034**

Related-Samples Wilcoxon Signed Rank Test

Appendix F

Wilcoxon Signed Rank Test Results: Staff Survey Results Comparing ABPM Knowledge Pre-Intervention and ABPM Knowledge Post Intervention n = 5

	Pre-Intervention			*Post-Intervention*			
Question	Median (IQR)	Good/ Very Good %	Fair/ Poor %	Median (IQR)	Good/ Very Good %	Fair/ Poor %	p-value
ABPM Knowledge	3 (3 - 3.5)	20	80	4 (3.5 - 5)	80	20	0.129

Related-Samples Wilcoxon Signed Rank Test

Appendix G

Staff Survey Results for ABPM Evaluation Post Intervention

Question	N	Median (IQR)	Good/Very Good %
ABPM Education: Quality	5	4.40 (0.548)	100
ABPM Education: Understanding	4	4.50 (0.577)	100
ABPM Results: Interpretation	3	4.67 (0.577)	100
ABPM Results: Availability	3	4.67 (0.577)	100
ABPM Results: Plan Determination	3	4.67 (0.577)	100