ORIGINAL RESEARCH

Blood Pressure Checks for Diagnosing Hypertension: Health Professionals' Knowledge, Beliefs, and Practices

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Introduction: **The US Preventive Services Task Force recommends out-of-office blood pressure (BP) measurement before making a new hypertension diagnosis and initiating treatment, using 24-hour ambulatory (ABPM) or home BP monitoring. However, this approach is not common.**

Methods: **e-mail-linked surveys were sent to primary care team members (n = 421) from 10 clinics. The sample included medical assistants, licensed practical nurses, registered nurses, and advanced practice registered nurses (LPN/RN/APRNs), physician assistants (PAs), and physicians. Those licensed to diagnosis hypertension (physician/PA/APRNs) received additional questions. Data were collected from November 2017 to July 2019.**

Results: **2-thirds of invitees responded (163 MA/LPN/RNs, 86 physicians, and 33 PA/APRNs). When making a new hypertension diagnosis, most respondents believed that BP measured manually with a stethoscope (78.6%) or ABPM (84.2%) were very or highly accurate. In contrast, most did not believe that automated clinic BPs, home BP, or kiosk BP measurements were very or highly accurate. Almost all reported always or almost always relying on clinic BP measurements in making a diagnosis (95.7%), but most physician/PA/APRNs (60.5%) would prefer ABPM if it was readily available. Very few physician/PA/APRNs used the guideline-concordant diagnostic threshold (135/85 mmHg) with home monitoring (14.0%) or ABPM (8.4%), with 140/90 mmHg the most commonly reported threshold for home (59.4%) and ABPM (49.6%).**

Discussion: **Our study found health care professional knowledge, beliefs, and practices gaps in diagnosing hypertension. These gaps could lead to clinical care that is not aligned with guidelines.**

Conclusion: **System changes and interventions to increase use of evidence-based practices could improve hypertension diagnosis and outcomes. (J Am Board Fam Med 2022;35:310–319.)**

Keywords: **Advanced Practice Nursing, Blood Pressure, Clinical Competence, Evidence-Based Practice, Hypertension, Licensed Practical Nurses, Physician Assistants, Physicians, Primary Health Care, Surveys and Questionnaires**

Background

The US Preventive Services Task Force (USPSTF) strongly[1,2] recommends screening all adults aged 18 years or older for hypertension. For patients with high screening blood pressure (BP) in clinic, USPSTF and American College of Cardiology and

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American Heart Association (ACC/AHA)[3] hypertension guidelines recommend follow-up BP testing outside of clinics, preferably 24-hour ambulatory BP monitoring (ABPM) or home BP monitoring (HBPM), in part to avoid overdiagnosis of hypertension and unnecessary treatment. Currently, ABPM is infrequently used in the United States, partly from lack of availability, low reimbursement, and perceptions about lower patient preference.[4–6] Clinicians may use HBPM, but do not always follow recommended guidelines.[7–9] BP kiosks, such as those found in pharmacies, provide another option for obtaining out-of-office BPs.

Blood Pressure Checks for Diagnosing Hypertension (BP-CHECK) was a randomized diagnostic study of 510 patients aged 18 to 85 without a hypertension diagnosis and taking no antihypertensive medications who had a high BP recorded in the electronic health record (EHR) and at a screening visit. Participants were randomized to either (1) Clinic, (2) Home, or (3) Kiosk BP monitoring regimens with all participants then completing ABPM.[10] The primary outcomes were the accuracy and acceptability of each of the 3 diagnostic methods compared with ABPM. A secondary aim of the study was to understand health care professionals' was to understand health professional barriers and facilitators to best-practices for diagnosing hypertension in primary care. We report here results from a web-based survey sent to primary care team members at BP-CHECK participating clinics. We describe health professionals' knowledge, beliefs, and practices of using clinic BP, HBPM, kiosk BPs, and ABPM for making a new diagnosis of hypertension, comparing responses by different clinical roles (eg, physicians vs medical assistants [MAs]).

Methods

Activities were reviewed and approved by the Kaiser Permanente Washington (KPWA) Human Subjects Review Committee. Data were collected from November 2017 to July 2019 as part of the BP-CHECK study. Study design and methods are published and include a description of the health care professional survey aims.[10]

Setting, Recruitment, and Participants

The setting was KPWA, an integrated health system that provides health insurance and care in Washington state, specifically 10 of its primary care medical centers that were participating in the BP-CHECK study. Clinic participation activities included learning about the BP-CHECK study at a meeting before clinic patients were recruited, with primary care team members being invited to participate in a web-based survey. Primary care team members included MAs, licensed practical nurses, and registered nurses (collectively referred to as MA/LPN/RNs) and physicians, physician assistants, and advanced practice registered nurses (referred to as physician/PA/APRNs).

Survey Administration

Using staffing lists generated by clinic managers, potential participants were sent a hard copy advance letter followed by an e-mail invitation with an embedded link to the secure survey hosted on a research institute server. They were informed that the survey was voluntary, would not affect their employment or benefits, and no individual-level responses or data would be shared with colleagues, organizational managers or leaders. They were also informed that participants who completed the survey would be entered into a lottery with a 1 in 20 chance of receiving a $100 Amazon gift card. Nonresponders to the initial e-mail were sent up to 2 follow-up e-mails each with the survey link embedded, and if they still did not respond, they were sent a final hard copy letter with a article survey and postage-paid return envelope. The surveys were fielded in a rolling fashion by clinic with incentive winners drawn and notified as the survey closed at each site. Late hard copy responses were accepted until the survey closed at the final site and the data set was closed.

Questionnaires

Web surveys were derived from prior published studies,[11,12] and communications with 1 of the authors (Fletcher). Physician/PA/APRNs received the same short survey as the MA/LPN/RNs, with health care professionals licensed to diagnosis hypertension (physician/PA/APRNs) receiving 5 additional questions specific to HBPM and ABPM (items 6, 21 to 24, **Questionnaires, Online Appendix**).

All respondents were asked questions about their beliefs about different BP monitoring methods for making a new hypertension diagnosis, including: in clinic (manual and automated measurement); HBPM (upper arm and wrist); kiosk-based (such as in the clinic or pharmacy); and ABPM testing.

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Five-point Likert scales were used to assess respondents' perceptions of diagnostic accuracy ("not at all" to "highly" accurate); how much they relied on the measurement method for diagnosis ("never" to "always"); and how easy it was for patients to complete ("not at all easy" to "very easy"). For HBPM, all respondents were asked if patients were ("never" to "always"): trained to use it and interpret results and provided a measurement schedule, and whether home monitors were checked for accuracy. All respondents were asked what BP threshold (mmHg) they used for making a diagnosis in clinic and home, with physician/PA/APRNs additionally asked about ABPM diagnostic thresholds.

Physician/PA/APRNs were asked which BP monitoring method they preferred to use now for making a new diagnosis (choose 1), and if there were no barriers to access or patient use, which they would prefer to use in the future (choose 1). They were also asked how often they had patients check home BPs and the ABPM threshold they used to make a new hypertension diagnosis. Respondents were also given an opportunity to add comments: "Is there anything we haven't asked about BP monitoring that you would like us to know or consider?" in a free text field.

Analysis

Descriptive analyses were used to summarize survey responses. Responses were reported overall and stratified by subgroup based on health care delivery role within the primary care team. Responses from MA/LPN/RNs were reported separately from responses by physician/PA/APRNs, because only the latter health professionals are licensed to order tests (eg, ABPM) and diagnose and treat hypertension.

Results

Participating medical center clinical staff received a web-based survey after enrollment began in their clinic, with 70.0% (163/233) of MA/LPN/RNs and 63.3% (119/188) of physician/PA/APRNs returning questionnaires. Most of the MA/LPN/RNs were MAs (61.1%) of most the physician/PA/APRNs were physicians (72.3%), (Table 1). The majority of respondents were female and younger than age 60. Most health professionals had heard of ABPM, particularly physician/PA/APRNs (81.5%), but almost 70% had not ordered 1 in the prior year (Table 2). The majority of physician/PA/APRNs (60.5%) reported ABPM as their top choice for

Table 1. Health Professional Characteristics

	MA/LPN/RN n = 163 n (%)	Physician/PA/APRN n = 119 n (%)
Provider Type*		
Medical Assistant (MA)	99 (61.1)	
Licensed Practical Nurse (LPN)	28 (17.3)	
Registered nurse (RN)	33 (20.4)	
Other	2 (1.2)	
Physician		86 (72.3)
Physician Assistant (PA)		29 (24.4)
Advanced Practice Registered Nurse (APRN)		4 (3.4)
Age†		
Under 30	21 (13.0)	5 (4.2)
30 to 39	48 (29.6)	43 (36.4)
40 to 59	77 (47.5)	55 (46.6)
60 and over	16 (9.9)	15 (12.7)
Sex‡		
Male	7 (4.3)	38 (32.5)
Female	150 (92.6)	74 (63.3)
Other or prefer not to say	5 (3.1)	5 (4.3)

*Missing provider type, MA/LPN/RN, n = 1.
†Missing age, MA/LPN/RN, n = 1; Physician/PA/APRN, n = 1.
‡Missing sex, MA/LPN/RN, n = 1; Physician/PA/APRN, n = 2.

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Table 2. Use and Preferences for Ambulatory BP Monitoring and BP Measurement for Making a New Diagnosis of Hypertension

Provider Type	MA/ LPN/RN n = 163 n (%)	Physician/ PA/APRN n = 119 n (%)
Before reading the description knew what 24-hour ambulatory BP measurement was?*		
No	60 (37.0)	17 (14.3)
Yes	88 (54.3)	97 (81.5)
Uncertain	14 (8.6)	5 (4.2)
Over the past 12 months, how often have you ordered 24-hour ambulatory BP measurements?(Physician/ PA/APRNs only)†		
None	NA§	69 (68.3)
1 to 2 times	NA	18 (17.8)
3 or more times	NA	14 (13.9)
If there were no barriers to access to different methods, obtaining BP data, which method would you prefer for making a new diagnosis of hypertension (choose 1, Physicians/PA/APRNs only)‡		
Clinic BPs	NA§	33 (29.0)
Home BPs	NA	11 (9.7)
Kiosk BPs	NA	1 (0.9)
24-hour ambulatory BP	NA	69 (60.5)

*Missing MA/LPN/RN, n = 1.
†Missing n = 18.
‡Missing n = 5.
§NA, not applicable (not asked).
Abbreviations: APRN, advanced practice registered nurse; BP, blood pressure; MA, medical assistant; LPN, licensed practical nurse; PA, physician assistant; RN, registered nurse.

making a new diagnosis of hypertension if there were no barriers to access, getting BP data, or patient acceptability.

Most respondents, especially MA/LPN/RNs (88.9%), rated clinic BPs taken manually with an aneroid BP monitor and stethoscope as very or highly accurate. Only a minority of providers rated automated clinic BP, home BP, or kiosk BP as very or highly accurate, with little difference between the 2 health professional groups (Figure 1), and most respondents rating measurements taken at home with a wrist BP monitor as not very or not at all accurate. Both groups, especially physician/PA/APRNs (93.2%) rated ABPM as very or highly accurate.

Nearly all respondents (>95%), reported that they relied on BPs taken in clinic when making a new diagnosis of hypertension (Figure 2). However, almost half reported also relying on home BP (categories were not mutually exclusive). Only 1-third of physician/PA/APRNs (35.1%) reported relying on ABPM for making a new hypertension diagnosis. Both MA/LPN/RN (65.2%) and physician/PA/APRN (67.2%) groups rated home BP as easy or very easy for patients to do to confirm a new diagnosis of hypertension, but less than half thought clinic BP, kiosk, or ABPM would be easy or very easy for patients.

When making a new diagnosis of hypertension, about half of the respondents reported that home BP monitors were checked for accuracy (always or almost always: MA/LPN/RNs 53.3%; physician/PA/APRNs 53.6%), and most said they always or almost always provided patients with advice on how often to measure their BP (MA/LPN/RNs 85.6%; physician/PA/APRNs 87.4%) and how to interpret the results (MA/LPN/RNs 71.1%; physician/PA/APRNs 82.0%). Physician/PA/APRNs were asked to report the number of days of home monitoring recommended when making a new hypertension diagnosis, with no recommended schedule the most common response (37.3%), followed by 14 days (19.1%), and 7 days (10.9%). The majority answered that they recommended checking BP once a day (55.9%) regardless of the number of days. Physician/PA/APRNs were

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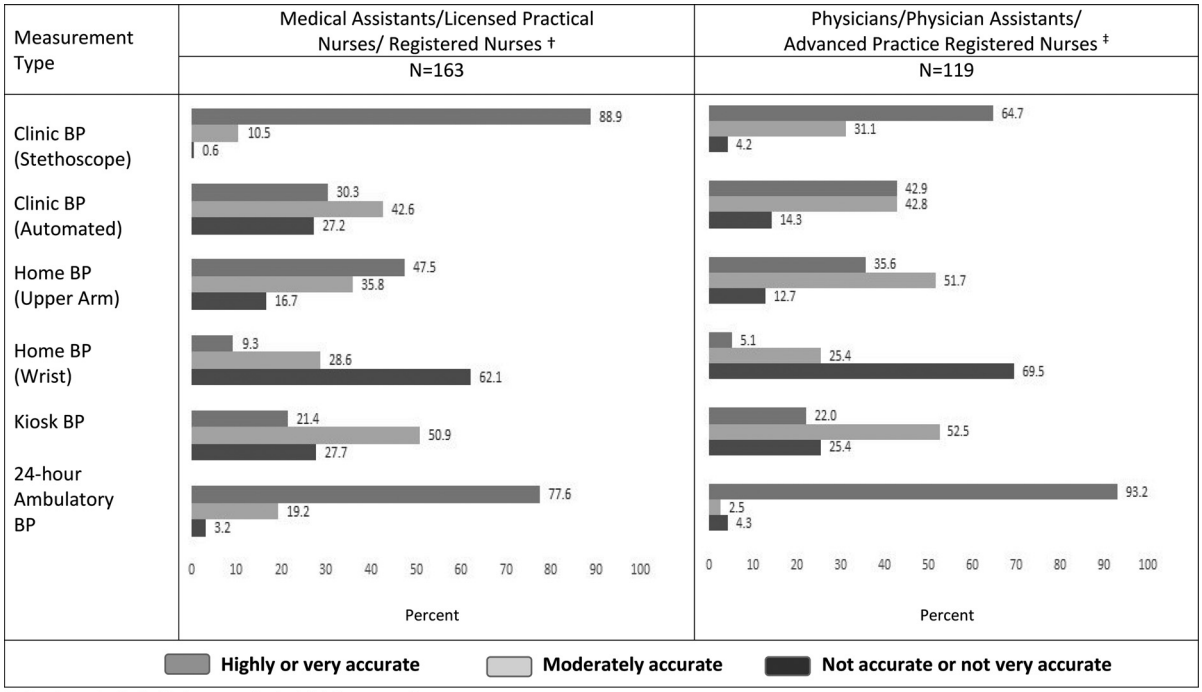
Figure 1. Under optimal circumstances (such as no barriers to access, adherence) how accurate do believe the following screening procedures are in making a new diagnosis of hypertensions?* Abbreviations: BP, blood pressure.



*Likert scale 1–5, Not accurate to highly accurate
†Missing data: Clinic BP stethoscope (n=1); Clinic BP automated (n=1); Home BP upper arm (n=1); Home BP wrist (n=2); Kiosk BP (n=4); 24-hour ambulatory (n=7)
‡Missing data: Home BP upper arm (n=1); Home BP wrist (n=1); Kiosk BP (n=1); 24-hour ambulatory (n=2)

asked how patients shared home BP measurements, with almost all reporting sharing by bringing in a written diary (91.5%) or recording by the patient in secure e-mail (92.4%), with some noting reviewing BP data saved on home BP monitors (45.8%).

Almost all respondents reported using a threshold of 140/90 mmHg for making a new diagnosis of hypertension, regardless of the screening method used, but a few reported 130/80 mmHg (Figure 4). Only physician/PA/APRNs were asked about ABPM thresholds, with 140/90 mmHg as the most common response, although 28 of 191 (23.5%) respondents did not answer the question. Physician/PA/APRNs were asked to report the top 3 sources that influenced their clinical decisions when diagnosing hypertension. Most (89.8%) reported that organizational guidelines were used, with the next most common response (69.5%) as national screening guidelines (eg, USPSTF, Eighth Joint National Committee). Health professionals were less likely to report being influenced by colleagues (22.9%), specialists (15.2%), systematic reviews (11.9%), patient requests (6.8%), or individual trials (0.8%).

In subgroup analyses (Online Appendix Tables 1-4) PA/APRNs reported being younger than physicians and more frequently had not heard of ABPM (27.3% vs 9.3%) or ordered ABPM in the prior year (91.3% vs 61.5%). PA/APRNs also more frequently reported preferring clinic BP over other methods for diagnosing hypertension than physicians (53.3% vs 20.2%).

Some respondents (MA/LPN/RNs 16.6%, physician/PA/APRNs 12.6%) responded to the free text question: Is there anything we haven't asked about BP monitoring that you would like us to know or consider? MA/LPN/RNs reported concerns including: not trusting the automated monitor used in clinic, that automated measurements were higher than manual measurements, or they had issues related to losing data when batteries ran out, finding time to preplace them during a busy day. They also reported concerns about home BP monitor costs, how to address BPs that were high in clinic but normal at home, and making sure

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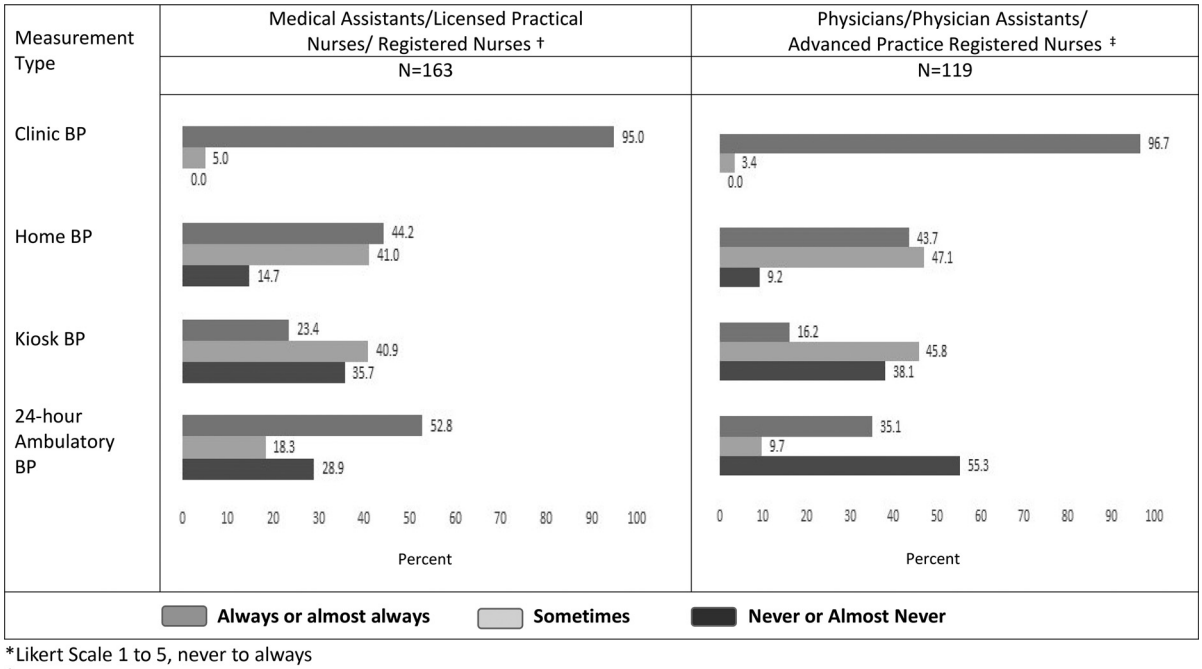
Figure 2. When making a new diagnosis of hypertension how often do you (or the providers you work with) rely on BP measurements form each of the following types of monitors?* Abbreviations: BP, blood pressure.



*Likert Scale 1 to 5, never to always
†Missing data: Clinic BP (n=3); Home BP (n=7); Kiosk BP (n=9); 24-hour ambulatory (n=21)
‡Missing data: Kiosk BP (n=1); 24-hour ambulatory (n=5)

patients were properly trained. Physician/PA/APRNs reported having concerns about patients not having adequate rest or proper positioning when self-monitoring, costs of home BP to patients, difficulties entering home BP values into the EHR, not being able to access ABPM (long wait times for appointments, patients having to travel to far away clinics), and perceived intrusiveness of ABPM testing).

Discussion

Our study found gaps between knowledge, beliefs, and practices of health care professionals in diagnosing hypertension, compared with guideline recommendations. While many studies have evaluated these features of health professionals related to BP measurement and treatment, few have focused on hypertension diagnosis. Todkar et al. conducted a systematic review of studies that used surveys to assess health professionals' knowledge, perceptions, and practice regarding BP measurement.[13] Of 72 studies identified, 40 addressed clinic BP measurement, 25 HBPM, and 14 ABPM, with no studies that addressed using BP kiosks for BP monitoring or hypertension diagnosis. Similar to our study, Todkar et al. found that in general, health professionals' knowledge and practices about BP measurement and monitoring were suboptimal. How-ever, most studies were from countries other than the US and few focused on hypertension diagnosis. Thus, our study provides new information on hypertension diagnosis specific to primary care practice in the US.

Health professionals in our study reported trusting and relying mainly on clinic BP measurements for making hypertension diagnostic decisions, despite USPSTF and ACC/AHA guideline recommendations that out-of-office BP measurements be taken before making and initiating treatment for a new diagnosis of hypertension.[1–3] The reason for the USPSTF recommendation is to avoid overdiagnosis of hypertension and unnecessary treatment by identifying white coat hypertension, in which BP is high in clinic but normal outside of clinic,[14] and also to identify masked hypertension, in which BP is normal in clinic and high outside of clinic. Health professionals in our study also perceived that BPs taken manually with aneroid manometers were more accurate than automated BP measurements despite numerous studies that have demonstrated that clinic BP measurements, particularly when taken manually, are prone to errors because of difficulties hearing Korotoff

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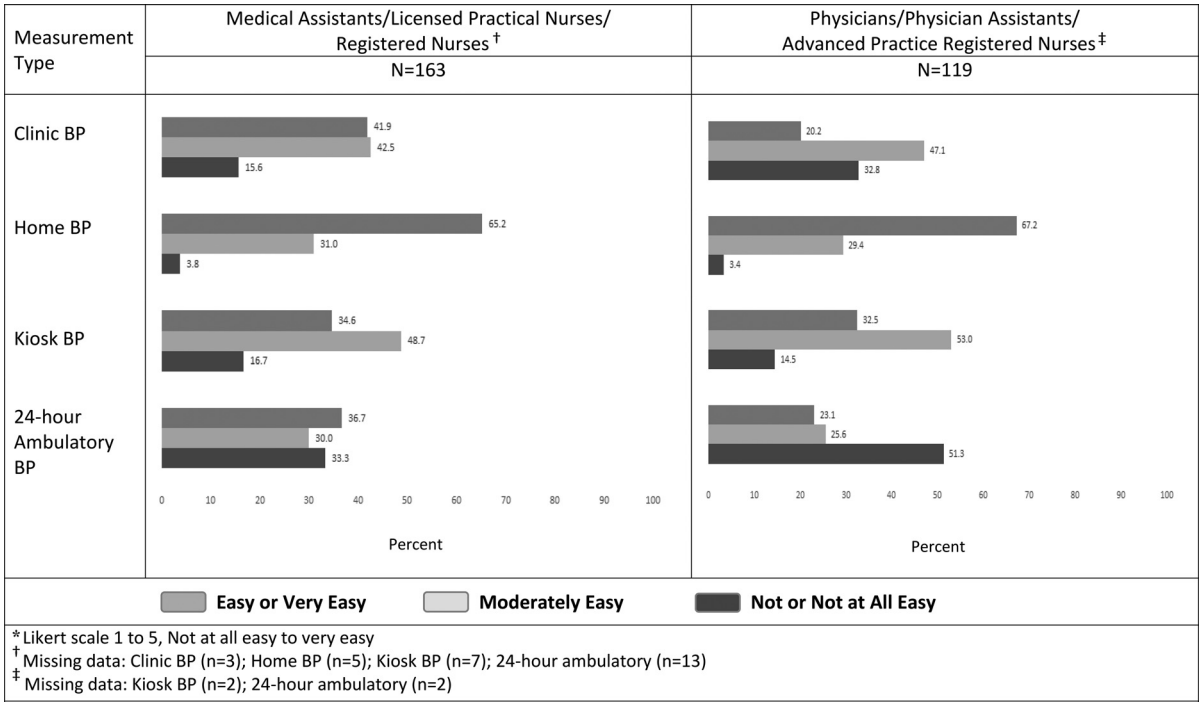
Figure 3. How Easy Would it Be for Patients to Complete the Following BP Measurement Methods for Confirming a New Diagnosis of Hypertension?* Abbreviations: BP, blood pressure.



*Likert scale 1 to 5, Not at all easy to very easy
†Missing data: Clinic BP (n=3); Home BP (n=5); Kiosk BP (n=7); 24-hour ambulatory (n=13)
‡Missing data: Kiosk BP (n=2); 24-hour ambulatory (n=2)

sounds, cuff deflation that is too rapid, and end-number rounding.[15–17] To reduce these errors, guidelines and advocacy groups recommend using validated automated BP monitors.[7,18,19]

Health professionals in our study also perceived HBPM as easy for patients to do, but still thought it was less accurate and relied on it less than clinic BPs when making a new hypertension diagnosis. Physician/PA/APRNs ranked it as their third choice for making a new diagnosis, after ABPM and clinic BP. Logan et al., in a survey of 765 Canadian primary care physicians, reported similar results, with 52% preferring ABPM, 26% clinic, and only 12% HBPM.[20] Fletcher et al., in a survey of 300 United Kingdom general practitioners, found that they were more likely to recommend HBPM for ongoing hypertension management (84%), than diagnosis (58%).[11,21] Similar to our study, Fletcher found that physicians lacked knowledge about HBPM diagnostic thresholds recommended by US and UK guidelines (and BP measurement schedules (optimally 3 to 7 days with duplicate BPs morning and night),[22] and that BPs should be averaged. Kronish conducted a series of focus groups to understand physicians' barriers to using HBPM to diagnose hypertension. Physicians were concerned about patients' ability to measure BP correctly, costs of home monitors, and home BP data not going into the EHR.[6] Physician/PA/APRNs in our study reported similar concerns and that barriers could be overcome by training patients, loaning them home monitors (or providing them as part of insurance benefits), and having better methods for remotely capturing home BP in the EHR via telemonitoring, texting, or telephone communications.

While ABPM was the first choice of physician/PA/APRNs for making a new diagnosis of hypertension, several had not heard of this test, and most had not ordered ABPM in the prior year. These findings of lack of availability and/or use of ABPM are mirrored in other studies from the US. Carter et al., in a 2016 survey of 143 community primary care providers in Oregon, found that over half had never ordered ABPM,[4] and a 2017 survey of 123 US-based primary clinics found that only 25% had access to ABPM.[23] In contrast, Carrera et al. reported high use and provider preference for using ABPM for hypertension diagnosis in the Netherlands, and less trust in and use of home BP monitoring.[24] In Kronish's focus group study, physicians ranked cost as an important ABPM

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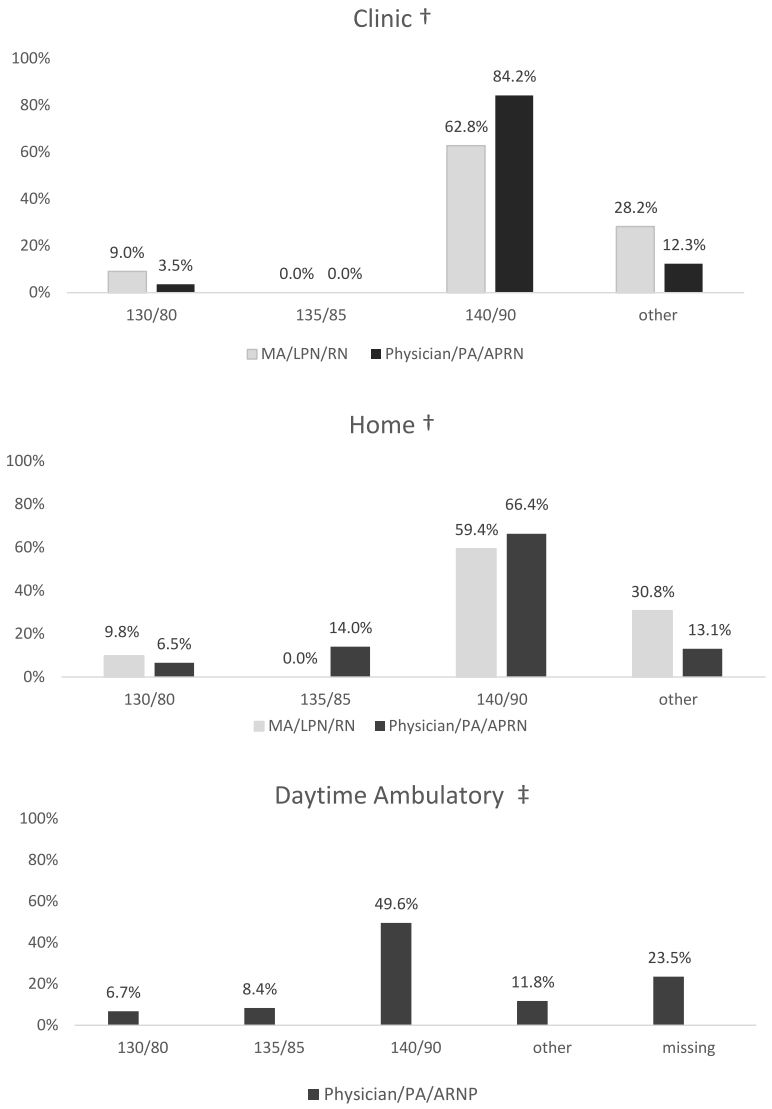
Figure 4. Provider Reported Target BP Thresholds Clinic, Home, And 24-Hour Ambulatory BP Measurements Used For Making A Diagnosis Of Hypertension.* Abbreviations: BP, blood pressure; MA, medical assistant; LPN, licensed practical nurse; RN, registered nurse; PA, physician assistant; APRN, advanced practice registered nurse.



*"When diagnosing hypertension, what target BP threshold do you use for clinic, home, and 24-hour ambulatory BP measurements for a typical patient aged 50? If unsure, make your best guess."
†Missing data excluded from the denominator in 4a and 4b: Clinic BP (MA/LPN/RNs n=7/163, 4.3%; physician/PA/APRNs n =5/119, 4.2%); Home BP (MA/LPN/RNs n=21/163, 12.9%; physician/PA/APRNs n =12/119, 10.1%)
‡Missing data included in the denominator in 4c (physician/PA/APRNs n=23/119, 23.5%)

barrier, including costs of the equipment, low reimbursement, and concerns about patient out-of-pocket costs.[6] Similar to HBPM, physician/PA/APRNs in our study lacked knowledge of guideline-recommended ABPM diagnostic BP thresholds (ABPM daytime average ≥135 mmHg systolic or ≥85 mmHg diastolic). Daflo-Pibernat et al., in a study conducted in Spain,[25] found that in contrast to our study, a majority of health professionals (72%) were able to correctly identify ABPM diagnostic thresholds, with this increasing to 96.6% after a 2-hour training workshop. ABPM is widely used in Spain. Increased access to ABPM and HBPM plus training in the US could decrease gaps in clinicians knowledge of guideline-recommended hypertension diagnostic thresholds.

Health professionals' confusion about HBPM and ABPM diagnostic BP thresholds in our study could be due to recent changes in US hypertension guidelines. Before 2013, clinic BP thresholds for

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diagnosing hypertension and initiating treatment were ≥140 mmHg systolic or ≥90 mmHg diastolic for all adult patients.[26] From 2013 to 2017, the guidelines changed, incorporating a threshold of ≥150 mmHg systolic for adults aged 60 and over.[27] In 2017, the guideline diagnostic thresholds changed again to ≥130 mmHg systolic or ≥80 mmHg diastolic for stage 1 hypertension and ≥140 mmHg systolic or ≥90 mmHg diastolic for stage 2,[3] with treatment thresholds based on risk factors for cardiovascular disease. In contrast, US quality performance measures currently define uncontrolled hypertension as ≥140 mmHg systolic or ≥90 mmHg diastolic, regardless of whether BP is measured in the clinic or at home.[28] Aligning quality performance metrics with guidelines (and including the differences between clinic and out-of-office BP measurements)[29] could lead to improved knowledge by health professionals of recommended clinic BP, HBPM, and ABPM diagnostic and treatment thresholds and improved clinical care.

Health professionals' knowledge, beliefs, and practices about patients self-measuring BP at kiosks in pharmacies or clinics for making a new diagnosis of hypertension have not been previously studied. We found that health professionals rarely relied on kiosk BPs for making a new diagnosis and perceived them to be less accurate than clinic, HBPM (with an upper arm monitor), and ABPM, but perceived kiosks as easier for patients to use than clinic or ABPM testing. We did not ask any knowledge questions about kiosk BP, as kiosk BP diagnostic thresholds and frequency of measurement have not been established.

Strengths of our study include a high survey response and our comparative assessments of different types of health professionals, and different methods for diagnosing hypertension. In contrast, prior studies focused on 1 or 2 BP diagnostic methods, evaluated only 1 or 2 content areas (such as knowledge and practice, but not all 3 domains), rarely analyzed both MA/LPN/RN and physician/PA/APRN responses, and were not specific to diagnostic testing.[13] Our study also has several limitations. Before conducting the survey, providers were told about the study and that some of their patients would be completing ABPM testing, which may have influenced their answers. In addition, although we distributed the surveys soon after we began recruiting patients at each clinic, some providers may have completed their survey after their patients had completed ABPM and thus were more familiar with the test. Finally, our study took place before the COVID-19 pandemic, and provider knowledge, beliefs, and practices may have changed since then with more focus on out-of-office care.

Conclusion

Our study found gaps between knowledge, beliefs, and practices of health care professionals in diagnosing hypertension, compared with guideline recommendations. System changes and interventions to increase use of evidence-based practices could improve hypertension diagnosis and outcomes.

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Appendix: Appendix Tables 1-6 and the Physician, Physician Assistant, Advanced Practice Registered Nurse Hypertension Diagnosis Survey

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Appendix Table 1. Physician and PA/APRN Characteristics

	Physician n = 86 n (%)	PA/APRN n = 33 n (%)
Age[†]		
Under 30	5 (5.9)	0 (0.0)
30 to 39	26 (30.6)	17 (51.5)
40 to 59	43 (50.6)	12 (36.4)
60 and over	11 (12.9)	4 (12.1)
Sex[‡]		
Male	26 (31.0)	12 (36.4)
Female	56 (66.7)	18 (54.6)
Other or prefer not to say	2 (2.4)	3 (9.1)

[†]Missing age, Physician, n = 1.
[‡]Missing sex, Physician, n = 2.
Abbreviations: APRN, Advanced Practice Registered Nurse; PA, Physician Assistant.

Appendix Table 2. Physician and PA/APRN Use and Preferences for Ambulatory bp Monitoring and BP Measurement for Making a New Diagnosis of Hypertension

Provider Type	Physician n = 86 n (%)	PA/APRN n = 33 n (%)
Before reading the description knew what 24-hour ambulatory BP measurement was?		
No	8 (9.3)	9 (27.3)
Yes	74 (86.1)	23 (69.7)
Uncertain	4 (4.7)	1 (3.0)
Over the past 12 months, how often have you ordered 24-hour ambulatory BP measurements?*		
None	48 (61.5)	21 (91.3)
1 to 2 times	16 (20.5)	2 (8.7)
3 or more times	14 (18.0)	0 (0.0)
If there were no barriers to access to different methods, obtaining BP data, which method would you prefer for making a new diagnosis of hypertension (choose 1)[†]		
Clinic BPs	17 (20.2)	16 (53.3)
Home BPs	9 (10.7)	2 (6.7)
Kiosk BPs	1 (1.2)	0 (0.0)
24-hour ambulatory BP	57 (67.9)	12 (40.0)

*Missing, Physician, n = 8; PA/APRN, n = 10.
[†]Missing, Physician, n = 2; PA/APRN, n = 3.
Abbreviations: APRN, Advanced Practice Registered Nurse; BP, Blood pressure; PA, Physician Assistant.

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Appendix Table 3. Physician and PA/APRN Responses to the Question: Under Optimal Circumstances (Such as No Barriers to Access, Adherence) How Accurate Do Believe the following Screening Procedures Are in Making a New Diagnosis of Hypertensions?*

	Physician† n = 86 n (%)	PA/APRN‡ n = 33 n (%)
Clinic BP (Stethoscope)		
Highly or very accurate	54 (62.8)	23 (69.7)
Moderately accurate	27 (31.4)	10 (30.3)
Not accurate or not very accurate	5 (5.8)	0 (0.0)
Clinic BP (Automated)		
Highly or very accurate	42 (48.8)	9 (27.3)
Moderately accurate	36 (41.9)	15 (45.5)
Not accurate or not very accurate	8 (9.3)	9 (27.3)
Home BP (Upper Arm)		
Highly or very accurate	39 (45.9)	3 (9.1)
Moderately accurate	38 (44.7)	23 (69.7)
Not accurate or not very accurate	8 (9.4)	7 (21.2)
Home BP (Wrist)		
Highly or very accurate	4 (4.7)	2 (6.1)
Moderately accurate	26 (30.6)	4 (12.1)
Not accurate or not very accurate	55 (64.7)	27 (81.8)
Kiosk BP		
Highly or very accurate	22 (25.9)	4 (12.1)
Moderately accurate	46 (54.1)	16 (48.5)
Not accurate or not very accurate	17 (20.0)	13 (39.4)
24-hour Ambulatory BP		
Highly or very accurate	82 (97.6)	27 (81.8)
Moderately accurate	1 (1.2)	2 (6.1)
Not accurate or not very accurate	1 (1.2)	4 (12.1)

*Likert scale 1 to 5, Not accurate to Highly accurate.
†Missing data: none.
‡Missing data: Home BP, upper arm (n = 1); Home BP, wrist (n = 1); Kiosk BP (n = 1); 24-hour ambulatory (n = 2).
Abbreviations: APRN, Advanced Practice Registered Nurse; BP, blood pressure; PA, Physician Assistant.

Appendix Table 4. Physician and PA/APRN Responses to the Question: When Making a New Diagnosis of Hypertension How Often Do You (or the Providers You Work with) Rely on BP Measurements Form Each of the following Types of Monitors?*

	Physician† n = 86 n (%)	PA/APRN‡ n = 33 n (%)
Clinic BP		
Always or almost always	83 (96.5)	32 (97.0)
Sometimes	3 (3.5)	1 (3.0)
Never or almost never	0 (0.0)	0 (0.0)
Home BP		
Always or almost always	44 (51.2)	8 (24.2)
Sometimes	34 (39.5)	22 (66.7)
Never or almost never	8 (9.3)	3 (9.1)
Kiosk BP		
Always or almost always	14 (16.5)	5 (15.2)
Sometimes	43 (50.6)	11 (33.3)
Never or almost never	28 (32.9)	17 (51.5)
24-hour Ambulatory BP		
Always or almost always	27 (32.9)	13 (40.6)
Sometimes	7 (8.5)	4 (12.5)
Never or almost never	48 (58.5)	15 (46.9)

*Likert scale 1 to 5, Never to Always.
†Missing data: Home BP (n = 6); Kiosk BP (n = 1); 24-hour ambulatory (n = 4).
‡Missing data: Home BP (n = 1); 24-hour ambulatory (n = 1).
Abbreviations: APRN, Advanced Practice Registered Nurse; BP, blood pressure; PA, Physician Assistant.

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Appendix Table 5. Physician and PA/APRN Responses to the Question: How Easy Would It Be for Patients to Complete the following BP Measurement Methods for Confirming a New Diagnosis of Hypertension?*

	Physician† n = 86 n (%)	PA/APRN‡ n = 33 n (%)
Clinic BP		
Easy or very easy	19 (22.1)	5 (15.2)
Moderately easy	39 (45.4)	17 (51.5)
Not very or not at all easy	28 (32.6)	11 (33.3)
Home BP		
Easy or very easy	57 (66.3)	23 (69.7)
Moderately easy	26 (30.2)	9 (27.3)
Not very or not at all easy	3 (3.5)	1 (3.0)
Kiosk BP		
Easy or very easy	28 (33.3)	10 (30.3)
Moderately easy	43 (51.2)	19 (57.6)
Not very or not at all easy	13 (15.5)	4 (12.1)
24-hour Ambulatory BP		
Easy or very easy	15 (17.9)	12 (36.4)
Moderately easy	21 (25.0)	9 (27.3)
Not very or not at all easy	48 (57.1)	12 (36.4)

*Likert scale 1 to 5, Not at all easy to very easy.
†Missing data: Kiosk BP (n = 2); 24-hour ambulatory (n = 2).
‡Missing data: none.
Abbreviations: APRN, Advanced Practice Registered Nurse; BP, blood pressure; PA, Physician Assistant.

Appendix Table 6. Physician and PA/APRN Reported Diagnostic bp Thresholds Used for Making a Diagnosis of Hypertension Using Clinic, Home, and Daytime Ambulatory BP Measurements.*

	Physician† n = 86 n (%)	PA/APRN‡ n = 33 n (%)
Clinic BP		
130/80	3 (3.7)	1 (3.1)
135/85	0 (0.0)	0 (0.0)
140/90	72 (87.8)	24 (75.0)
Other	7 (8.5)	7 (21.9)
Home BP		
130/80	4 (5.1)	3 (10.7)
135/85	14 (17.7)	1 (3.6)
140/90	52 (65.8)	19 (67.9)
Other	9 (11.4)	5 (17.9)
24-hour Ambulatory BP		
130/80	6 (8.2)	2 (11.1)
135/85	9 (12.3)	1 (5.6)
140/90	48 (65.8)	11 (61.1)
Other	10 (13.7)	4 (22.2)

*Thresholds assessed via text field. All non-missing responses other than 130/80, 135/85, and 140/90 are classified as "other".
†Missing data: Clinic BP (n = 4); Home BP (n = 7); 24-hour ambulatory (n = 13).
‡Missing data: Clinic BP (n = 1); Home BP (n = 5); 24-hour ambulatory (n = 15).
Abbreviations: APRN, Advanced Practice Registered Nurse; BP, Blood pressure; PA, physician assistant.

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THE SURVEY WILL BE SENT TO PHYSICIANS, PHYSICIAN ASSISTANTS, AND NURSE PRACTITIONERS.

THE LINK TO THE SURVEY IS IN THE EMAIL THAT IS SENT TO THEM INVITING THEM TO PARTICIPATE IN THE STUDY. THE SURVEY IS LOCATED ON A WEB PAGE WHEN THEY CLICK THE LINK.

Kaiser Permanente Washington Health Research Institute (KPWHRI) invites you to participate in a survey concerning blood pressure (BP) as part of a research study called **Blood Pressure Checks for Diagnosing Hypertension** (BP-CHECK). The survey will take about 10 minutes to complete. Staff completing the survey will have an opportunity to be entered into a drawing for a $100 Amazon.com gift card.

Please read the following before agreeing to complete the survey:

- **WHO?** This research is sponsored by the Patient-Centered Research Outcomes Institute (PCORI) study awarded to Kaiser Permanente Washington Health Research Institute. Dr. Beverly Green, a family physician and investigator at Kaiser Permanente Washington Health Research Institute is leading the study.
- **WHY?** We are studying how to improve BP measurement and hypertension diagnosis. The feedback we collect from you and others will help us better understand health care providers' practice knowledge, attitudes, and beliefs about BP measurement and hypertension diagnosis.
- **WHAT WILL HAPPEN IF I TAKE PART IN THIS STUDY?** We will ask you to complete an online survey about BP measurement as described above. You can skip any question you don't want to answer.
- **WILL BEING IN THE STUDY HELP ME?** This study may not help you personally. We hope the results of this study will help us learn more about BP measurement and improve care.
- **CAN ANYTHING BAD HAPPEN TO ME FROM BEING IN THIS STUDY?** You might feel uncomfortable answering some study questions. It's possible that someone other than the researchers could find out you were in the study or see your study information. The steps we take to keep this from happening are described below.
- **CONFIDENTIALITY**. If you participate, your identity and the information you share will be confidential. We will not share this outside the research team. To help protect your confidentiality, we will only publish and share the results overall. We will never mention your name.
- **YOUR RIGHTS.** You have the right to choose whether or not to participate in this survey. If you choose to participate, you can skip items you do not want to answer. Whether or not you agree to participate in this study, will not affect your employment or benefits at Kaiser Permanente Washington.
- **WHO DO I CALL IF I HAVE QUESTIONS?** Please call XXX. If you have questions about your rights as a research participant, please call Kaiser Permanente Human Subjects Review Office at XXX.

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- **PRIZE DRAWING:**
    - If you complete the survey, you will be included in the drawing for a $100 Amazon gift card.
    - You will have a 1 in 20 chance of winning.
    - To be eligible, you must complete the survey by [DATE}.
    - Winners will be notified via email within 14 days of the survey closing.

PLEASE INDICATE IF WHETHER OR NOT YOU AGREE TO PARTICIPATE IN THIS SURVEY.

- ☐ I agree
- ☐ I do not agree

Provider type:

1. **What is your provider type?**

:

- ☐ Physician
- ☐ Physician Assistant
- ☐ Registered Nurse Practitioner
- ☐ Registered Nurse
- ☐ Licensed Practical Nurse
- ☐ Medical Assistant
- ☐ Other _____

2. Please check the clinic where you do the majority of your work* (*clinic names concealed).

- ☐ Clinic 1
- ☐ Clinic 2
- ☐ Clinic 3
- ☐ Clinic 4
- ☐ Clinic 5
- ☐ Clinic 6
- ☐ Clinic 7
- ☐ Clinic 8
- ☐ Clinic 9
- ☐ Clinic 10

3. What is your gender identity?

- ☐ Male
- ☐ Female
- ☐ Non-binary
- ☐ Other, please specify:
- ☐ Prefer not to say

4. Your age

- ☐ Under 30
- ☐ 30 – 39
- ☐ 40 – 49
- ☐ 50 – 59
- ☐ 60 or over

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Physician, Physician Assistant, Advanced Registered Nurse Practitioner Survey

There are several similar and sometimes interchangeable terms relating to the measurement of blood pressure (BP). For the purposes of this study, please use the following definitions:
Clinic BP measurements are BP measurements performed by a medical assistant, nurse, physician, or other allied health professional using either a BP cuff and monitor (aka, sphygmomanometer) and stethoscope (manually) or a digital BP monitor in clinic.

Home BP measurements of BP (or home blood pressure monitoring), are BP measurements done by patients using a home BP monitor (wrist or arm cuff) away from the clinic environment, usually at home.

Kiosk BP measurements of BP with the patient using a kiosk/machine located at a pharmacy, clinic, or other public space.

Ambulatory 24-hour BP is the measurement of BP over 24 hours as the patient is moving around, living their normal daily life. The patient wears a digital BP monitor that is attached by a belt or carrying strap to the patient's body and a cuff on their arm that automatically inflates and measures BP every 20- 30 minutes throughout the day and less often at night.

High BP refers to a BP measurement that is over a targeted threshold.

Hypertension refers to the diagnosis that is made if BP is repeatedly high.

5. Before reading the description just provided, did you know what 24-hour ambulatory BP measurement was?

- ☐ Yes
- ☐ No (skip to 7)
- ☐ Uncertain

6. Over the last 12 months, how often have you ordered 24-hour ambulatory BP measurements for your patients?

0	1	2	3	4	5 or more times
☐	☐	☐	☐	☐	☐

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Under optimal circumstances (such as no barriers to access, high adherence) how accurate do believe the following screening procedures are in diagnosing hypertension? Please use a scale of 1 to 5, with 1 as not accurate and 5 as highly accurate.

		Not accurate		Moderately accurate		Highly accurate
		1	2	3	4	5
7	Clinic BP measurements – done manually (with a stethoscope)	☐1	☐2	☐3	☐4	☐5
8	Clinic BP measurements – done with an automated BP monitor	☐1	☐2	☐3	☐4	☐5
9	Home BP measurements – upper arm BP monitor	☐1	☐2	☐3	☐4	☐5
10	Home BP measurements-wrist BP monitor	☐1	☐2	☐3	☐4	☐5
11.	Kiosk BP measurements	☐1	☐2	☐3	☐4	☐5
12	24-hour ambulatory BP measurements	☐1	☐2	☐3	☐4	☐5

When making a diagnosis of hypertension how often do you rely on BP measurements from each of the following types of monitors? Using a scale of 1 to 5, with 1 as never and 5 as always…

		Never		Sometimes		Always
		1	2	3	4	5
13	Clinic BP measurements	☐1	☐2	☐3	☐4	☐5
14	Home BP measurements	☐1	☐2	☐3	☐4	☐5
15	Kiosk BP measurements	☐1	☐2	☐3	☐4	☐5
16	24-hour ambulatory BP measurements	☐1	☐2	☐3	☐4	☐5

<u>If 14 and 15 are both never</u>, skip questions 23 through 28

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How easy would it be for patients to complete the following BP measurement methods for confirming a diagnosis of hypertension? Please use a scale of 1 to 5, with 1 as not at all easy and 5 as very easy.

		Not at all easy		Moderately easy		Very Easy
		1	2	3	4	5
17	Repeat visits to the clinic (one or two extra visits.	☐1	☐2	☐3	☐4	☐5
18	Home BP measurements	☐1	☐2	☐3	☐4	☐5
19	Pharmacy kiosk BP measurements	☐1	☐2	☐3	☐4	☐5
20	24-hour ambulatory BP measurements	☐1	☐2	☐3	☐4	☐5

21 Given the BP measurement presently available to you and your patients, which method do you prefer for diagnosing hypertension (choose one)?

- ☐ Clinic BPs
- ☐ Home BPs
- ☐ Kiosk BPs
- ☐ 24-hour ambulatory BP monitoring

22.If there were no barriers for access to different methods, for obtaining BP data, or patient concerns, which method would you prefer for diagnosing hypertension (choose one)?

- ☐ Clinic BPs
- ☐ Home BPs
- ☐ Kiosk BPs
- ☐ 24-hour ambulatory BP monitoring

The next set of questions asks about BP measurements taken outside of the medical clinic.

When making diagnosing hypertension using home BP measurements, how often do you ask patients to self-measure their BP?

	Numeric; range 0-99	I do not follow a specific schedule
23.How many days?		
24.How many times a day?		

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Using a scale of 1 to 5, with 1 as never and 5 as always, when diagnosing hypertension with home BP measurements, how often do you…

		Never		Sometimes		Always
		1	2	3	4	5
25.	recommend that the patient be trained by a nurse or medical assistant	☐1	☐2	☐3	☐4	☐5
26.	check the patient's home BP monitor for accuracy	☐1	☐2	☐3	☐4	☐5
27.	give the patient advice about when and how often to monitor their BP	☐1	☐2	☐3	☐4	☐5
28.	provide patients with advice on how to interpret home BP results	☐1	☐2	☐3	☐4	☐5

29. When diagnosing hypertension, what target BP threshold do you use for clinic, home, and 24-hour ambulatory BP measurements for a typical patient aged 50? If unsure, make your best guess.

	Clinic BPs	Home BPs	24-hour ambulatory BP (daytime BP)
Systolic (mmHg)			
Diastolic (mmHg)			

Numeric; range 60-200

30. Now, think about all of the different ways your patients can collect their BP outside of your clinic. How do you ask them to record this information and share it with you? Mark all that you typically ask patients to do.

I typically ask patients to…

- ☐ Bring me a written diary
- ☐ Bring in their BP monitor so I can review their saved measurements
- ☐ Call me or my assistant to report measurements
- ☐ Send me an email or secure email
- ☐ Directly enter their results into their online health record
- ☐ None of these, I don't ask patients to share their BP measurements with me
- ☐ Other (please specify): _____

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Now think about the type of information you rely on to inform your medical practice…

31. Which of the following most influence your clinical decisions when diagnosing hypertension? Choose your top three choices and rank them as 1st, 2nd, and 3rd. If you do not rely on any of these, choose "None."

- ☐ Organization guidelines (i.e. Group Health, Kaiser)
- ☐ Primary care colleagues
- ☐ Cardiologists, nephrologists, or other specialists
- ☐ Results of individual randomised controlled trial)
- ☐ Results of systematic reviews/meta-analyses)
- ☐ National screening recommendations (i.e. US Preventive Services Task Force, JNC8)
- ☐ National hypertension diagnosis and management guidelines (Joint National Commission on the Diagnosis and Treatment of Hypertension, JNC7, JNC8)
- ☐ Patient request
- ☐ Other (specify)
- ☐ None

32. The US Preventive Services Task Force (USPSTF), the group that makes evidence-based screening recommendations about prevention and screening for the country, makes recommendations for measuring BP and making a diagnosis of hypertension. Which of the following best summarizes the US Preventive Services Task Force's current evidence-based recommendation on <u>diagnosing of hypertension</u>?

- ☐ A. Obtaining BPs from at least 2 clinic visits before making a diagnosing hypertension
- ☐ B. Using home BP monitoring before diagnosing hypertension
- ☐ C. Using 24-hour ambulatory BP monitoring before diagnosing hypertension
- ☐ Either A or B
- ☐ A, B, or C
- ☐ None of the above
- ☐ Don't know

33. Is there anything we haven't asked about BP monitoring that you would like us to know or consider?

Open text – not coded. Blank answers allowed

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