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ORIGINAL RESEARCH

# Self-Measured Blood Pressure Monitoring in Primary Care: Retrospective Analysis from a Large US Healthcare System

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**Purpose:** Self-measured blood pressure (SMBP) monitoring, or home blood pressure monitoring, is an evidence-based strategy for hypertension management. However, the extent to which SMBP readings are documented in the electronic health record (EHR)—a critical step in integrating SMBP monitoring into routine care—remains unclear. The objective of this study was to evaluate how race/ethnicity, insurance status, and preferred language are associated with documented SMBP monitoring adoption.

**Patients and Methods:** This retrospective study included adults (aged ≥18 years) with a diagnosis of hypertension and at least one uncontrolled ambulatory blood pressure reading in 2023. All patients had ≥2 primary care visits in 2023. The primary outcome was the presence of at least one SMBP reading documented in the EHR using a structured patient-reported blood pressure readings field. Logistic regression was used to assess associations between patient characteristics and SMBP monitoring documentation.

**Results:** Among 156,444 eligible patients, only 5.0% had at least one SMBP reading documented in the EHR. SMBP readings were mostly recorded during office visits (62.8%). In fully adjusted analyses, Black (OR 0.68; 95% CI, 0.63–0.72) and Hispanic (OR 0.72; 95% CI, 0.65–0.80) patients compared to White patients, Medicaid-insured patients (OR 0.88; 95% CI, 0.79–0.98) compared to Commercial-insured patients, those preferring non-English languages (OR 0.77; 95% CI, 0.67–0.88) compared to those preferring English, had lower odds of SMBP monitoring documentation.

**Conclusion:** SMBP monitoring documentation in the EHR was rare and significantly lower among populations experiencing inequities in access, language, and outcomes. Although remote monitoring strategies show promise, poor EHR integration and scalability challenges limit their adoption. Targeted efforts are needed to improve SMBP monitoring documentation workflows, enhance EHR integration, and promote equitable access to hypertension self-management tools.

**Keywords:** hypertension, self-management, SMBP monitoring, EHR, primary care

## Introduction

Hypertension remains a significant public health challenge in the United States and worldwide.[1,2] Self-measured blood pressure (SMBP) monitoring, also known as home blood pressure monitoring, refers to the strategy of patients taking their blood pressure readings outside of the clinic (eg home or other location) and reporting it back to their clinician. This strategy has been recommended in clinical practice guidelines since 2008 and is effective in achieving blood pressure control.[3,4] These recommendations are strengthened by several systematic reviews and meta-analyses of randomized controlled trials (RCTs) indicating that SMBP monitoring is a strong predictor of silent cerebrovascular disease, major nonfatal cardiovascular outcomes, cardiovascular and all-cause mortality and may help supplement ambulatory blood pressure measures.[5–7] The literature indicates that the effectiveness of SMBP monitoring is achieved only when coupled with clinical support, highlighting the need to share and document the readings with the care team.[8,9]

One challenge of implementing effective SMBP monitoring is sharing readings with the care team in a structured fashion. Little is known about the adoption of this evidence-based practice, particularly among minority and underserved

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populations, where the burden of hypertension is the greatest.[10–16] Self-reported data from the National Health and Nutrition Examination Survey (NHANES) indicates that SMBP monitoring adoption remains low with fewer than 25% of individuals in the US using SMBP monitoring.[17] A more recent survey by the University of Michigan National Healthy Poll on Aging reported that among patients with hypertension, 51% of them regularly monitor their blood pressure outside of their clinic visits and about half of them shared their SMBP readings with their clinician.[18] This data demonstrates the narrow adoption of SMBP monitoring; however, it is limited to self-reported data and there is a need for a more reliable method of capturing adoption of effective SMBP monitoring.

Building on this gap, we sought to evaluate SMBP monitoring adoption using electronic health record (EHR) documentation, providing a more reliable measure of uptake in routine practice. Limited evidence exists on whether SMBP monitoring uptake differs across patient subgroups in real-world settings outside of trials or interventions. To address this, we examined how three patient characteristics—race/ethnicity, insurance status, and preferred language — are associated with documented SMBP monitoring adoption. These factors were selected because they reflect equity-relevant domains (structural disparities in hypertension outcomes and access) and patient engagement. By clarifying how these characteristics shape real-world uptake, our objective is to generate evidence that informs equity-focused implementation strategies to ensure SMBP monitoring benefits reach diverse patient populations. This is a hypothesis-generating analysis intended to describe subgroup differences rather than to establish causal inference.

# Methods

This retrospective study follows the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) cohort study reporting guidelines. The study was approved by the Advocate Aurora Health Institutional Review Board.

## Setting/Data Source

This study was conducted in a large nonprofit health system spanning Illinois and Wisconsin encompassing 27 hospitals and more than 500 ambulatory sites. The system serves a diverse patient population in terms of geographic location, race, ethnicity, and medical conditions.

Data was extracted from the fully integrated electronic health record (EHR) system. The EHR system documents blood pressure in one of three structured methods (1) in-clinic reading', (2) "self-reported reading", (3) "patient portal-reported reading". The "self-reported reading" field, intended to document home blood pressure readings reported by patients, went live in 2020. A patient reported blood pressure reading(s) can be documented during an office visit, nurse only visit, virtual visit, telephonic visit, telephone visit, or e-advice. If a patient has brought other self-reported blood pressure values monitored at home to the visit, medical assistants, licensed practical nurses, registered nurses, or clinicians are instructed to manually document them in the patient reported section with the date of when they were taken and the BP location, BP position, and cuff size, if known. This field allowed us to further explore the adoption of effective SMBP monitoring and determine patient demographics and clinical characteristics of SMBP monitoring adopters.

## Participants

Patients who were 18 years or older, had at least one uncontrolled ambulatory blood pressure reading during the study period (January 1$^{st}$-December 31$^{st}$, 2023), had a previous hypertension diagnosis, and had at least one additional primary care visit at least one month apart from the baseline were identified. Baseline visit was defined as the first primary care visit with an uncontrolled ambulatory reading. All patient level data including baseline demographics, comorbidities, clinical characteristics along with patient reported blood pressure readings occurring within one year of the patient's baseline visit were extracted from the EHR.

## Key Independent Variable Definitions

Race and ethnicity was categorized into five categories including Asian (Asian=yes, Hispanic=no), Black/African America (Black/African American=yes, Hispanic=no), Hispanic (Hispanic=yes, regardless of their race), White (White=yes, Hispanic=no), or Other (American Indian or Alaskan Native, Native Hawaiian, Other Pacific Islander,

two or more races, or unknown). Insurance was categorized into commercial, Medicare, Medicaid, or self-pay. Preferred language was categorized as English or Non-English.

## Other Variable Definitions

Age was categorized into four groups (18–44, 45–64, 65–74, ≥75). Sex was categorized into two groups (Female, Male). Smoking was defined as current smoker vs not current smoker (never or former). Clinical characteristics included diabetes, hyperlipidemia, and coronary artery disease and were identified using ICD-10 codes. Number of blood pressure lowering medications at baseline were categorized as 0–1 medications or 2+ medications, since previous research has shown that the majority of hypertension patients require two or more blood pressure medications to successfully manage high blood pressure.[19] Number of ambulatory visits during the year of follow up was categorized as 2–3 or 4+ visits.

The primary outcome was defined as having a SMBP reading documented in the EHR, dichotomized into yes or no, within one year of the baseline visit. If a patient had a minimum of one patient reported blood pressure readings documented during a primary care visit within one year of their baseline visit, they were categorized into the yes category. Primary care visits included any visit occurring at a family medicine, internal medicine or geriatrics department and could be an office visit, virtual visit, telephone visit, or nurse only visit.

## Statistical Methods

We calculated descriptive statistics of all variables for the overall sample and by the primary outcome. Counts and percentages were used for categorical variables and mean ± standard deviation (SD) or median (interquartile range: IQR) for continuous variables. Group comparisons were made using Chi-square or Fisher's exact tests for categorical variables and Student's t-tests or Wilcoxon sum rank tests for continuous variables, as applicable. We identified race/ethnicity, insurance status, and preferred language as the three key independent variables of interest based on their conceptual relevance to equity in hypertension care. Other demographic and clinical factors were treated as potential confounders. For each key predictor, we first estimated associations with the outcome of having at least one SMBP reading documented using logistic regression with a clinic-level random effect, minimally adjusted for age and sex. We then fit a fully adjusted multivariable logistic regression model that included all three key independent variables simultaneously, along with additional confounders (age, sex, smoking status, diabetes, hyperlipidemia, coronary artery disease [CAD], number of blood pressure–lowering medications at baseline, and number of ambulatory visits). This approach allowed us to estimate the independent association of each key variable while accounting for correlations between them and other clinical characteristics. Results for the three key predictors are presented in forest plots, while full model results (including confounders) are provided in tabular form. Sensitivity analysis using only SMBP readings documented in office visits was performed. All tests were two-tailed and a p-value of $<0.05$ was considered statistically significant. Analyses were completed using SAS software, version 9.4 (SAS Institute Inc).

# Results

## Patient Characteristics

We identified 156,444 adult patients who had least one uncontrolled ambulatory blood pressure reading documented in 2023, had a prior hypertension diagnosis, and had at least two primary care visits during the study period. (Figure 1) The majority of the patients were 45–64 years old (35.7%), female (55.3%), White (64.1%), on Medicare (55.2%), had English as their preferred language (94.9%), and were not current smokers (87.9%). Common comorbidities included hyperlipidemia (66.6%), diabetes (35.0%), and coronary artery disease (17.2%). Most patients were on two or more blood pressure medications at baseline (60.3%). Fifty-one percent had 4+ ambulatory visits during the 1-year study period. Patient characteristics are also stratified by those who had at least one SMBP readings and those who did not have an SMBP reading (Table 1).

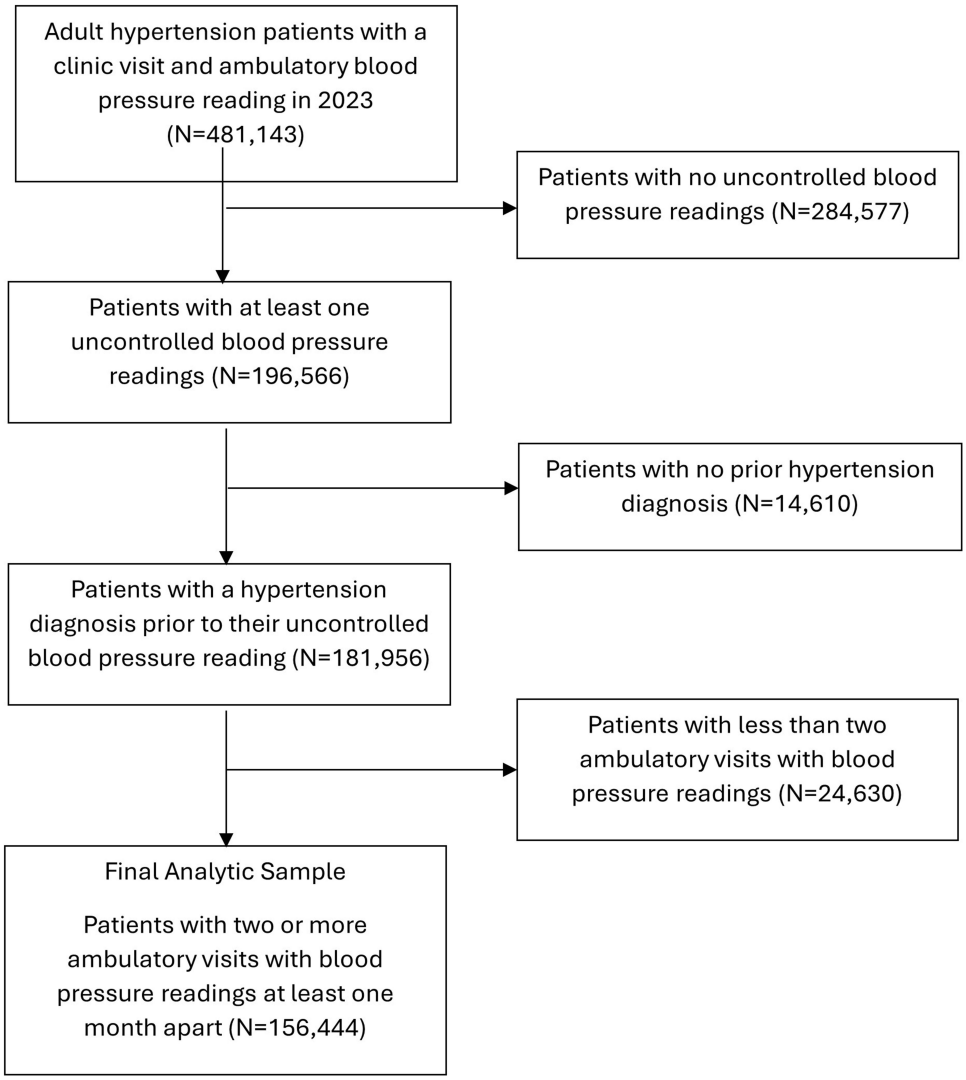


**Figure 1** Patient flow.

## SMBP Monitoring Documentation Within the EHR

Of the 156,444 identified patients, 7,496 (5.0%) had at least one SMBP reading documented in the EHR within one year from their baseline visit. Among those with at least one SMBP reading, patients reported, on average, a total of 1.36 (0.82) SMBP readings. SMBP readings were most documented in office visits (62.8%), followed by nurse visits (20.6%), virtual visits (13.4%), telephonic visits (3.1%) and immunization visits (0.1%). Among patients that had two or more SMBP readings, the majority had their SMBP readings documented across two visits (51.6%), while fewer had SMBP readings documented across one (34.9%), three (10.0%), four (1.7%), five (1.0%), six (0.6%), seven (0.1%) or twelve (0.1%) visits.

## Associations with Key Independent Variables

In models minimally adjusted for age and sex, and in fully adjusted models including all three key independent variables and additional confounders, we observed consistent differences in SMBP monitoring documentation (Figure 2). In fully adjusted models, compared to White patients, Black/African American (OR 0.68; 95% CI 0.63–0.72) and Hispanic (OR 0.72; 95% CI 0.65–0.80) patients had lower odds of having at least one SMBP reading documented, while Asian patients had greater odds (OR 1.32; 95% CI 1.17–1.48). Medicaid patients had lower odds of SMBP monitoring documentation

**Table 1** Demographic and Clinical Characteristics of Patients with Uncontrolled Hypertension and at Least Two Primary Care Visits in a Large Integrated Healthcare System in 2023 (N=156,444)

| Characteristics | Overall (N=156,444) | At Least One SMBP Reading (N=7,496) | No SMBP Reading (N=148,948) | P-value |
|---|---|---|---|---|
| Age Category, n(%) | | | | <0.0001 |
| 18-44 | 13,519 (8.6) | 513 (6.8) | 13,006 (8.7) | |
| 45-64 | 55,816 (35.7) | 2,227 (29.7) | 53,589 (36.0) | |
| 65-74 | 45,418 (29.0) | 2,450 (32.7) | 42,968 (28.9) | |
| ≥75 | 41,691 (26.7) | 2,306 (30.8) | 39,385 (26.4) | |
| Female, n (%) | 86,562 (55.3) | 4,715 (62.9) | 81,847 (55.0) | <0.0001 |
| Race/Ethnicity, n (%) | | | | <0.0001 |
| Asian | 5,344 (3.4) | 342 (4.6) | 5,002 (3.4) | |
| Black/African American | 36,051 (23.0) | 1,346 (18.0) | 34,705 (23.3) | |
| Hispanic | 13,102 (8.4) | 450 (6.0) | 12,652 (8.5) | |
| Other/Unknown | 1,723 (1.1) | 70 (0.9) | 1,653 (1.1) | |
| White | 100,224 (64.1) | 5,288 (70.5) | 94,936 (63.7) | |
| Insurance | | | | <0.0001 |
| Commercial | 56,237 (36.0) | 2,350 (31.3) | 53,887 (36.2) | |
| Medicare | 86,347 (55.2) | 4,663 (62.2) | 81,684 (54.8) | |
| Medicaid | 12,270 (7.8) | 417 (5.6) | 11,853 (8.0) | |
| Self-pay/Other/Unknown | 1,590 (1.0) | 66 (0.9) | 1,524 (1.0) | |
| Preferred language | | | | <0.0001 |
| English | 148,529 (94.9) | 7,201 (96.1) | 141,328 (94.9) | |
| Non-English | 7,915 (5.1) | 295 (3.9) | 7,620 (5.1) | |
| Smoking | | | | <0.0001 |
| Not current smoker | 137,446 (87.9) | 6,912 (92.2) | 130,534 (87.6) | |
| Current smoker | 18,998 (12.1) | 584 (7.8) | 18,414 (12.4) | |
| Comorbidities | | | | |
| Diabetes | 54,678 (35.0) | 2,237 (29.8) | 52,441 (35.2) | <0.0001 |
| Hyperlipidemia | 104,253 (66.6) | 4,892 (65.3) | 99,361 (66.7) | 0.0095 |
| Coronary artery disease | 26,879 (17.2) | 1,232 (16.4) | 25,647 (17.2) | 0.0794 |
| Number of BP lowering medications at baseline* | | | | <0.0001 |
| 0-1 | 62,170 (39.7) | 2,800 (37.3) | 59,370 (39.9) | |
| 2+ | 94,274 (60.3) | 4,696 (62.7) | 89,578 (60.1) | |
| Number of ambulatory visits | | | | <0.0001 |
| 2-3 | 76,155 (48.7) | 3,149 (42.0) | 73,006 (49.0) | |
| 4+ | 80,289 (51.3) | 4,347 (58.0) | 75,942 (51.0) | |

**Notes**: *Baseline is defined as the first uncontrolled blood pressure value measured at a primary care visit between 1/1/2023 and 12/31/2023.
**Abbreviations**: SMBP, self-measured blood pressure; BP, blood pressure.

compared to patients with commercial insurance (OR 0.88; 95% CI 0.79–0.98). Patients whose preferred language was not English (OR 0.77; 95% CI 0.67–0.88) had lower odds of SMBP monitoring documentation.

## Associations with Other Patient Characteristics

Other demographic and clinical characteristics showed expected but secondary associations (Table 2). In fully adjusted models, older adults (65–74 years: OR 1.34; 95% CI 1.18–1.51; ≥75 years: OR 1.27; 95% CI 1.11–1.44) and women (OR 1.33; 95% CI 1.27–1.40) had greater odds of SMBP monitoring documentation. Patients who were current smokers (OR 0.65; 95% CI 0.60–0.71) had lower odds of SMBP monitoring documentation. Among clinical factors, patients with diabetes (OR 0.79; 95% CI 0.75–0.83), hyperlipidemia (OR 0.89; 95% CI 0.85–0.94), and coronary artery disease (OR 0.90; 95% CI 0.85–0.97) were less likely to have SMBP monitoring documented, while patients prescribed two or more blood pressure–lowering medications were more likely (OR 1.14; 95% CI 1.09–1.20). Patients with more frequent clinic visits were also more likely to have SMBP readings documented:

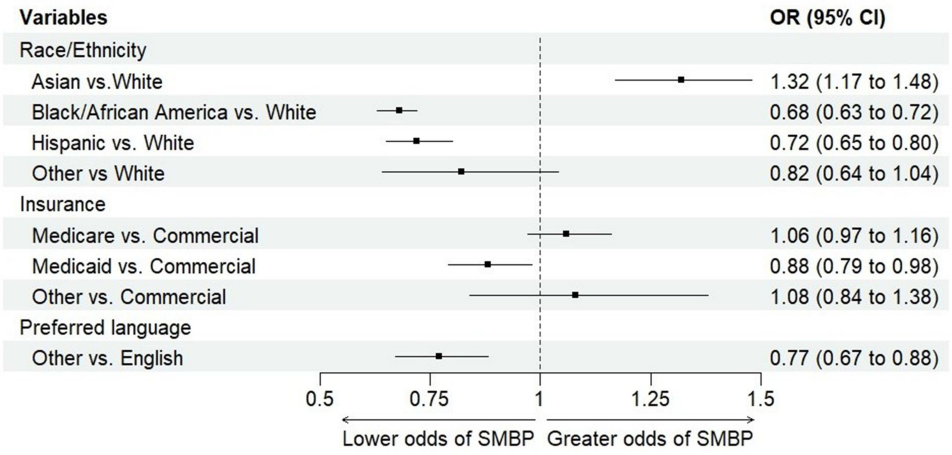


**Figure 2** Key characteristics associated with the odds of reporting at least one SMBP reading (N=156,444) Results from fully adjusted logistic regression model with clinic random effect. Adjusted for age, sex, smoking, diabetes, hyperlipidemia, coronary artery disease, medications at baseline, and number of ambulatory visits.
**Abbreviations**: SMBP, self-measured blood pressure; OR, odds ratio; CI, confidence interval.

those with four or more visits had significantly greater odds than those with fewer than four (OR 1.36; 95% CI 1.29–1.42). In sensitivity analysis, findings were similar when restricting the outcome to SMBP readings documented during office visits (N = 5,073) across all models.

**Table 2** Characteristics Associated with the Odds of Reporting at Least One SMBP Reading (N=156,444)

| Characteristics | Minimally Adjusted OR[a] | 95% CI | Fully Adjusted OR[b] | 95% CI |
|---|---|---|---|---|
| Race/Ethnicity | | | | |
| White | Ref | | Ref | |
| Asian | 1.22 | 1.09–1.36 | 1.32 | 1.17–1.48 |
| Black/African American | 0.69 | 0.65–0.73 | 0.68 | 0.63–0.72 |
| Hispanic | 0.66 | 0.60–0.73 | 0.72 | 0.65–0.80 |
| Other | 0.79 | 0.62–1.00 | 0.82 | 0.64–1.04 |
| Insurance | | | | |
| Commercial | Ref | | Ref | |
| Medicare | 1.03 | 0.94–1.12 | 1.06 | 0.97–1.16 |
| Medicaid | 0.79 | 0.71–0.88 | 0.88 | 0.79–0.98 |
| Other | 1.00 | 0.78–1.28 | 1.08 | 0.84–1.38 |
| Preferred language | | | | |
| English | Ref | | Ref | |
| Other | 0.73 | 0.64–0.82 | 0.77 | 0.67–0.88 |
| Age | | | | |
| 18-44 | Ref | | Ref | |
| 45-64 | 1.05 | 0.95–1.16 | 1.08 | 0.98–1.20 |
| 65-74 | 1.42 | 1.29–1.56 | 1.34 | 1.18–1.51 |
| ≥75 | 1.42 | 1.28–1.56 | 1.27 | 1.11–1.44 |
| Female | 1.35 | 1.28–1.42 | 1.33 | 1.27–1.40 |
| Smoking | | | | |
| Not current smoker | Ref | | Ref | |
| Current smoker | 0.65 | 0.60–0.71 | 0.65 | 0.60–0.71 |

(*Continued*)

**Table 2** (Continued).

| Characteristics | Minimally Adjusted OR[a] | 95% CI | Fully Adjusted OR[b] | 95% CI |
|---|---|---|---|---|
| Diabetes | | | | |
| No | Ref | | Ref | |
| Yes | 0.77 | 0.73–0.81 | 0.79 | 0.75–0.83 |
| Hyperlipidemia | | | | |
| No | Ref | | Ref | |
| Yes | 0.88 | 0.84–0.93 | 0.89 | 0.85–0.94 |
| CAD | | | | |
| No | Ref | | Ref | |
| Yes | 0.91 | 0.85–0.97 | 0.90 | 0.85–0.97 |
| Medications at baseline | | | | |
| 0-1 | Ref | | Ref | |
| 2+ | 1.08 | 1.03–1.14 | 1.14 | 1.09–1.20 |
| No. of Ambulatory visits | | | | |
| 2 | Ref | | Ref | |
| 3+ | 1.28 | 1.22–1.35 | 1.36 | 1.29–1.42 |

**Notes**: [a]Adjusted for age and sex only. [b]Fully adjusted for race/ethnicity, insurance, preferred language, age, sex, smoking, diabetes, hyperlipidemia, coronary artery disease, medications at baseline, and number of ambulatory visits.
**Abbreviations**: SMBP, self-measured blood pressure; OR, odds ratio; CI, confidence interval; Ref, reference.

## Discussion

In this large retrospective cohort study of over 150,000 adult patients with uncontrolled hypertension receiving primary care within a large integrated health system, we found that only 5% had at least one SMBP reading documented in the EHR over the course of a year. Among these patients, SMBP readings were most documented during office, with relatively few captured through virtual visits. We also identified significant disparities in SMBP monitoring documentation. Patients who were Black, Hispanic, Medicaid-insured, non-English-speaking had lower odds of documented SMBP readings. In terms of clinical characteristics, patients on multiple antihypertensive medications and patients with 4 or more ambulatory visits were more likely to have SMBP readings recorded, while current smokers and patients with comorbidities such as diabetes, hyperlipidemia, and coronary artery disease were less likely to have documented SMBP readings.

Our findings are consistent with prior national surveys (eg, NHANES) showing that fewer than one in four US adults with hypertension engage in SMBP monitoring, and only a minority report sharing these readings with their clinical team.[17,18] These self-reported figures likely overestimate actual documentation in practice. By using EHR data, our study builds on this prior literature and provides a more accurate estimate of SMBP monitoring implementation in real-world clinical settings.

We also corroborate previous work showing persistent disparities in hypertension management among racial and ethnic minorities, Medicaid beneficiaries, individuals with limited English proficiency, and individuals with clinical comorbidities.[10–16] Our findings add a critical piece to this evidence by identifying disparities not only in hypertension control but also in the documentation of SMBP monitoring, a key step in delivering guideline-concordant care.

These findings highlight important gaps in the implementation of the evidence-based strategy- SMBP monitoring as a routine component of hypertension care. Despite strong guideline support and clear clinical benefits, SMBP monitoring remains underutilized and inconsistently documented particularly among the populations that carry the biggest burden of hypertension and its associated comorbidities. Effective use of SMBP monitoring requires that patients measure their blood pressure at home and then communicate those readings back to their care team for interpretation and treatment adjustment. Our study highlights a major breakdown in this process—the lack of documentation in the EHR—which limits providers' ability to use SMBP monitoring to guide clinical decisions and adjust therapy.

Newer strategies have attempted to streamline this workflow through the use of automated Bluetooth-enabled blood pressure monitors that transmit readings to remote monitoring platforms, often integrated into patient portals or vendor

dashboards.[20] While these tools reduce patient burden and improve data accuracy, a critical limitation is that the data often reside outside the EHR, requiring additional steps for care teams to access or manually enter the readings. This "data silo" problem introduces workflow inefficiencies and limits scalability in large health systems where clinical workflows depend on centralized and interoperable data systems.[21] Moreover, the cost and IT infrastructure needed to implement these remote monitoring tools may further widen disparities if not equitably deployed.

These findings underscore the need to build systems that not only promote SMBP monitoring use but also facilitate seamless integration into routine clinical practice, particularly for populations experiencing inequities in access, language, and outcomes. This study has several limitations. First, we relied on a specific EHR field designed to document self-reported SMBP readings, and it is possible that readings shared with clinicians were recorded elsewhere or not documented at all. Second, while our data captures a large and diverse patient population within a single integrated health system, findings may not be generalized to other health systems with different documentation practices, patient demographics, or technology infrastructure. Third, we did not assess clinical outcomes such as blood pressure control or medication changes in relation to SMBP monitoring use, which would provide further insight into the impact of effective documentation. Finally, we could not capture qualitative aspects of SMBP monitoring engagement, such as patient or provider preferences, which may influence documentation patterns.

## Conclusion

Despite the proven efficacy of SMBP monitoring in managing hypertension, our findings reveal that documentation of SMBP monitoring remains rare and is marked by stark disparities across demographic and clinical subgroups. Language-related inequities, along with disparities by race/ethnicity and insurance status, highlight how structural and communication barriers limit equitable adoption. Although remote monitoring technologies offer a promising path forward, their current limitations—including poor EHR integration and implementation challenges in large health systems—must be addressed. Ensuring that SMBP monitoring is both accessible and actionable within clinical workflows will be essential to improving hypertension outcomes and reducing disparities. Future work must center equity in implementation, designing scalable and interoperable solutions that ensure SMBP monitoring benefits are realized across all patient populations.

## Data Sharing Statement

The datasets generated and/or analyzed during the current study are available from the corresponding author on reasonable request.

## Author Contributions

All authors made a significant contribution to the work reported, whether that is in the conception, study design, execution, acquisition of data, analysis and interpretation, or in all these areas; took part in drafting, revising or critically reviewing the article; gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agree to be accountable for all aspects of the work.

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## Disclosure

*Competing interest declaration*: All authors have completed the Unified Competing Interest form at www.icmje.org/coi_disclosure.pdf (available on request from the corresponding author) and declare IG, NG, JC, JB, and RK have no conflicts of interest that may be relevant to the submitted work. Dr Rasha Khatib reports grants from Advocate Health, during the conduct of the study; grants from Advocate Health, outside the submitted work.

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