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The Impact of Home Blood Pressure Measurement on Clinical Practice by Cardiologists over 5 Years —The LHAR Project

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Abstract

Introduction: Inadequate blood pressure (BP) control is a significant challenge. Therapeutic decisions based on home blood pressure monitoring (HBPM) have been shown to lead to better blood pressure control compared to those based on office blood pressure (OBP) measurements alone. **Objectives:** To compare, over a five-year period, the annual BP control rates in hypertensive patients who were treated and monitored by the same cardiologists and who periodically used HBPM. **Methodology:** This was a multicenter study conducted with five cross-sectional analyses at annual intervals, with the first in 2019 and the last in 2023. OBP and HBPM measurements were performed according to current guidelines. Two cutoff points were considered for the analysis of BP control by OBP: <140/90 mmHg and <130/80 mmHg. For HBPM, the cutoff was <130/80 mmHg. Comparisons of quantitative variables between years were established using the t-test or chi-square test. A p-value < 0.05 was considered significant. **Results:** A total of 8,890 individuals with a mean age of 63.3 (±14.9) years were included, of whom 65.8% were women. A reduction in mean OBP values was observed between 2019-2020 and 2021-2022. There was also a reduction in the average number of antihypertensive medications used in 2020, with a mean of 1.99 medications taken that year. Compared to 2020, 2022

showed an improvement in control rates for OBP < 130/80 mmHg (31.5% vs. 35.7%; p = 0.008) and OBP < 140/90 mmHg (58.7% vs. 65.7%; p < 0.001). **Conclusion:** Continuous monitoring by the same physician and the use of home measurement tools can lead to better BP control in hypertensive patients.

Keywords

Hypertension, Risk Factors, Blood Pressure Monitoring, Remote Patient Monitoring, Antihypertensive Agents, Clinical Practice Patterns

1. Introduction

Hypertension is a frequent cause of both medical consultations and the chronic use of antihypertensive medications [1] [2]. Still, around half of diagnosed hypertensive patients do not have adequate blood pressure (BP) control [3].

Therapeutic decisions can be based on office blood pressure (OBP) results; however, using out-of-office measurements has resulted in treatment adjustments for almost half of patients and led to better BP control [4]. Among the available methods for obtaining BP measurements outside the office, home BP monitoring (HBPM) is validated, comfortable for the patient, and has a good cost-benefit ratio [5]. Furthermore, there is evidence demonstrating the beneficial effect of HBPM in increasing medication adherence and, consequently, improving blood pressure control [6] [7].

Continuity of care by a personal physician promotes positive patient attitudes, such as greater adherence to treatment, more frequent medical evaluations, and greater satisfaction with the monitoring of their illness [8] [9]. Physicians' ability to manage hypertension is essential to ensure that patients maintain adequate blood pressure levels, thereby reducing cardiovascular risk and other comorbidities [10] [11]. Proper management requires these professionals to take a multidimensional approach involving technical knowledge, sound clinical judgment, and effective communication skills [11].

This article aims to compare BP control rates in hypertensive patients who were treated and monitored by the same cardiologists over 5 years and were encouraged to frequently use HBPM as a method of monitoring BP, in addition to office measurements.

2. Methods

This was a multicenter study called the National Registry of Hypertension Control (LHAR Registry), structured to collect data at five distinct moments (cross-sections) with an annual interval. The first collection was carried out in 2019 and the last in 2023.

Personal data, such as date of birth (to calculate age) and gender, were collected from patients. Body mass in kilograms was measured using a calibrated and vali-

dated scale available in the doctor's office, as was height; these measurements were required to calculate the body mass index (BMI). Patients reported their use of oral antidiabetic drugs, statins, and antihypertensive drugs. Antihypertensives were categorized into the following classes: angiotensin-converting enzyme inhibitor (ACEI), beta-blocker (BB), calcium channel blocker (CCB), angiotensin receptor blocker (ARB), potassium-sparing diuretic, thiazide diuretic, and other antihypertensive drugs. The number of antihypertensive drugs used was also recorded.

OBP and HBPM were measured. The HBPM protocol consisted of taking six daily BP measurements (morning and afternoon) over four consecutive days. The first measurement was taken in the office to demonstrate the method to the patient or a companion. HBPM results were entered into the TeleMRPA platform (www.telemrpa.com) for analysis and reporting.

The OBP was measured three consecutive times with the patient seated. The first measurement was discarded, and the average of the last two measurements was considered as the result. For both OBP and HBPM, a validated OMRON (HEM-7320) oscillometric device was used.

Two cutoff points were considered for the analysis of blood pressure control by OBP: <140/90 mmHg and <130/80 mmHg. For HBPM, the cutoff point was <130/80 mmHg.

All participants read and signed an informed consent form. The study was approved by the Research Ethics Committee of the Federal University of Goiás (CAAE 08208619.8.0000.5078) and complies with the provisions of Resolution 466/2012. The principles of the Declaration of Helsinki were followed as the study involved human subjects.

Data were analyzed using Jamovi software, version 2.3.28. A descriptive analysis presented absolute and relative frequencies for qualitative variables and mean and standard deviation for quantitative variables. The Kolmogorov-Smirnov test was used to verify the distribution of data variables. The t-test was used to compare quantitative variables between years, and the chi-square test was used for qualitative variables. Comparisons were made between two selected years.

3. Results

A total of 8890 participants with a mean age of 63.3 (±14.9) were evaluated, who used an average of two antihypertensive drugs and had a mean BMI, office and home blood pressure of 28.0 ± 6.5 kg/m^2, 125.3 ± 15.9/77.5 ± 9.7 and 131.1 ± 19.9/81.9 ± 12.2, respectively. The sample distribution in relation to sex, year of data collection, AH phenotype and medications used is shown in **Table 1**.

This study demonstrated a reduction in the average CAP values when comparing the years 2020 and 2022 (**Figure 1**).

In 2019, there was a higher frequency of antihypertensive use per year, with ARBs and thiazide diuretics being the most frequent. The higher frequency of ARB use continued throughout the years until 2023 (**Figure 2**).

Table 1. Total sample distribution 2019-2022, n = 8890.

Variable	n (%)
Sex	
Women	5854 (65.8)
Men	3036 (34.2)
Year	
2019	2197 (24.7)
2020	1946 (21.9)
2021	2473 (27.8)
2022	1611 (18.1)
2023	660 (7.4)
Phenotype	
UWCH	896 (10.1)
CH	3599 (40.5)
SUH	2691 (30.3)
MUH	1704 (19.2)
Anti-hypertensives	
ARB	4449 (50.0)
BB	2860 (32.2)
Thiazide diuretic	2836 (31.9)
CCB	2828 (31.8)
ACEI	1906 (21.4)
K-sparing diuretic	681 (7.7)
Others antihypertensives	2828 (31.8)
Statins	1615 (18.2)
Oral antidiabetics	876 (9.9)

ACEI: Angiotensin Converting Enzyme Inhibitor; ARB: Angiotensin Receptor Blocker; BB: Beta-blocker; CCB: Calcium Channel Blocker; CH: Controlled Hypertension; MUH: Masked Uncontrolled Hypertension; SUH: Sustained Uncontrolled Hypertension; UWCH: Uncontrolled White Coat Hypertension.

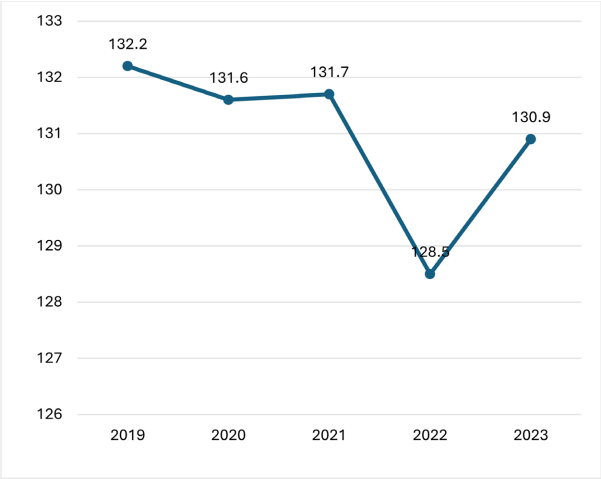
Furthermore, there was a reduction in the number of antihypertensives in 2020, with fewer than 2 classes of drugs (1.99) being taken on average that year (Figure 3).

In the assessment of the frequency of medication use (Figure 4), comparing the year 2020 with 2023 there was an increase in the use of oral antidiabetics ($p < 0.001$) and statins remained stable ($p = 0.980$).

Compared to 2020, in 2022, there was an improvement in control rates for BP < 130/80 and BP < 140/90 (Figure 5).

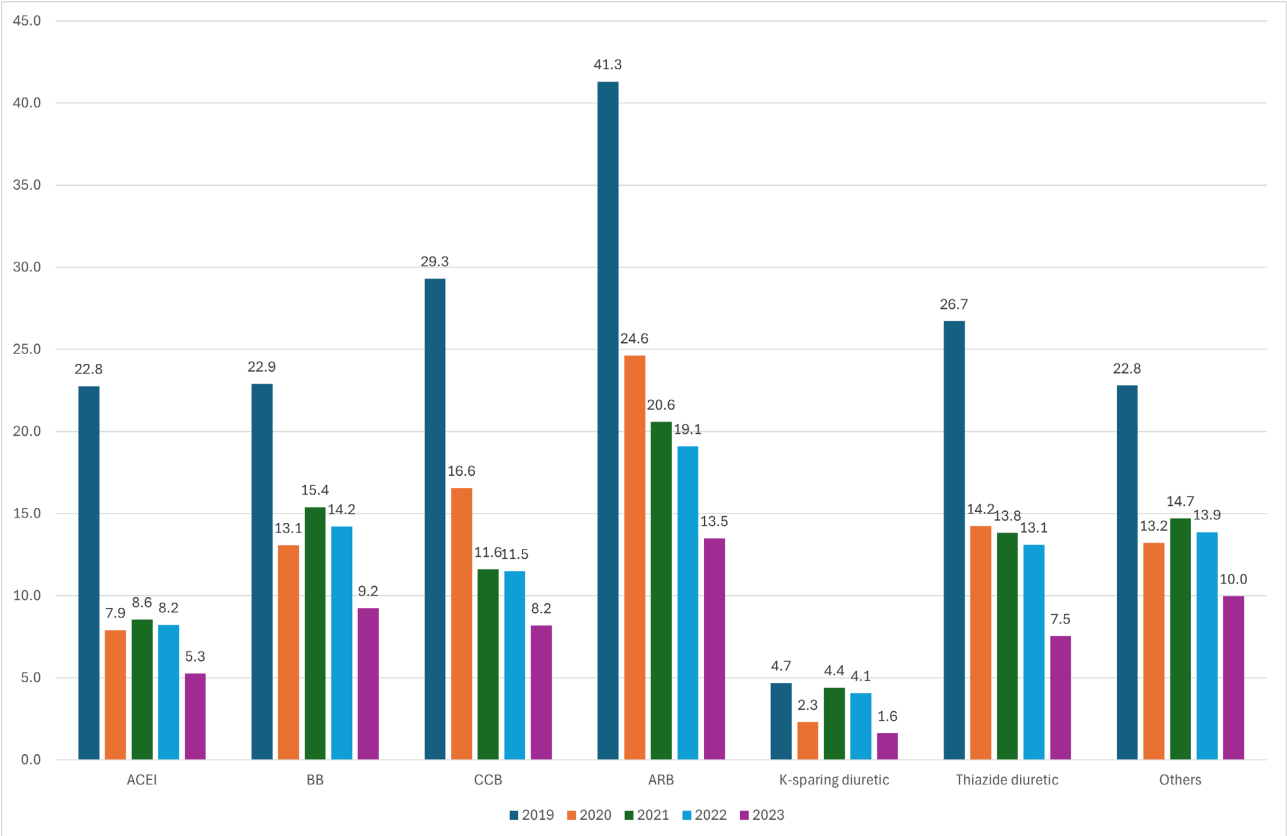
Between 2020 and 2023, there was an improvement in control rates for PAC

(Figure 6).



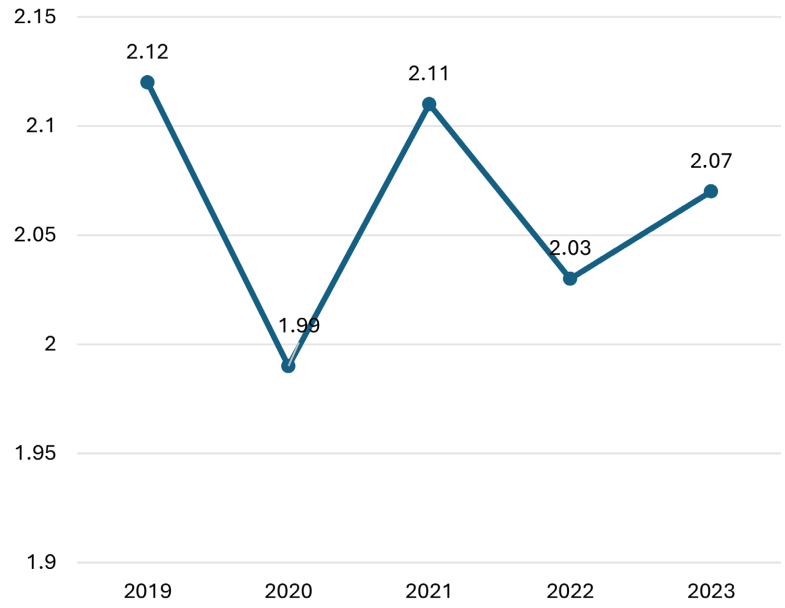
Independent t-test (2020 and 2022). $p < 0.001$; Independent t-test (2020 and 2023): $p = 0.443$.

Figure 1. Average systolic blood pressure values (office) by year (2019-2023).



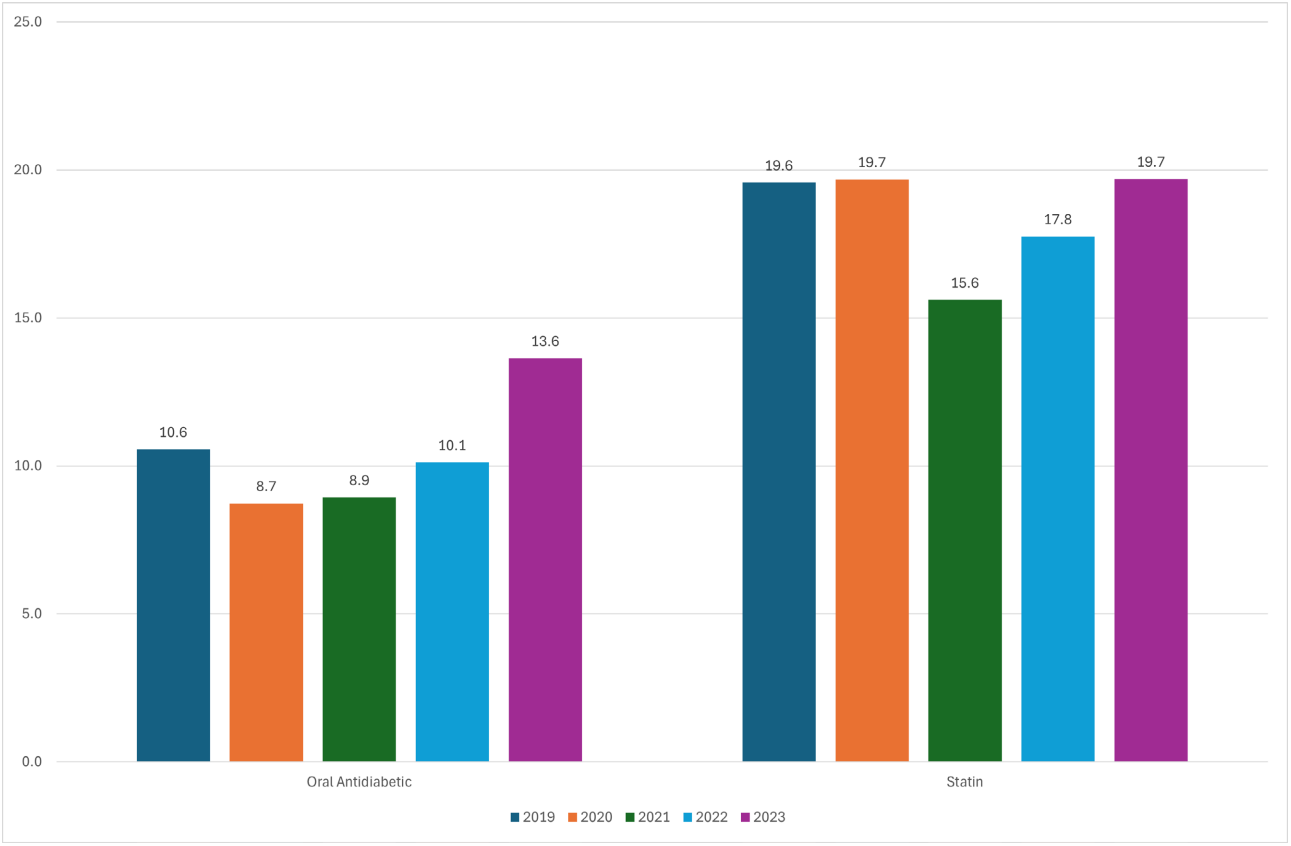
Comparison 2020 with 2022: ACEI: $p = 0.033$; BB: $p < 0.001$; CCB: $p < 0.001$; ARB: $p < 0.001$; K-sparing diuretic: $p < 0.001$; Thiazide diuretic: $p = 0.576$; Others: $p = 0.001$; Comparison 2020 with 2023: ACEI: $p = 0.129$; BB: $p = 0.002$; CCB: $p = 0.015$; ARB: $p = 0.213$; K-sparing diuretic: $p = 0.281$; Thiazide diuretic: $p = 0.208$; Others: $p < 0.001$; ACEI: Angiotensin Converting Enzyme Inhibitor; ARB: Angiotensin Receptor Blocker; BB: Betablocker; CCB: Calcium Channel Blocker.

Figure 2. Frequency of antihypertensive use by year, 2019-2023.



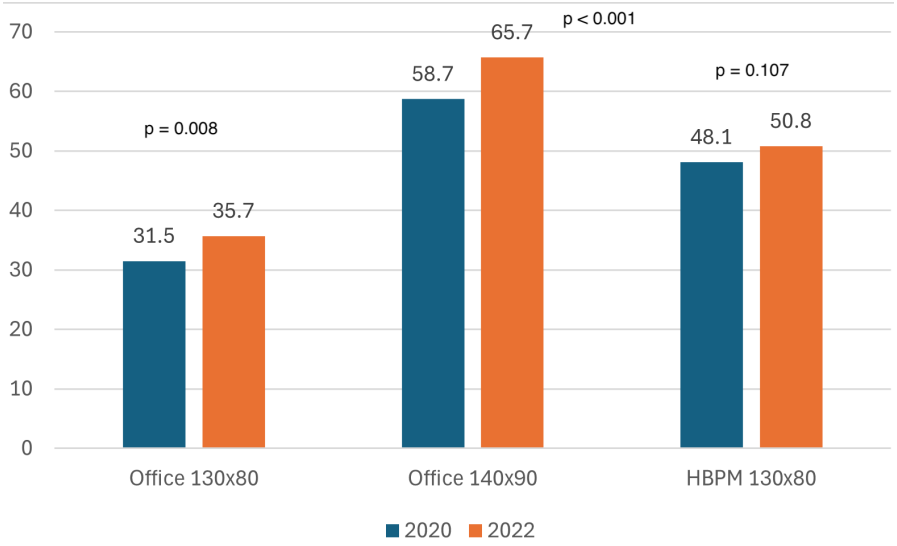
Independent t-test (2020 and 2022). p = 0.198; Independent t-test (2020 and 2023). p = 0.076.

Figure 3. Average number of antihypertensives per year, 2019-2023.



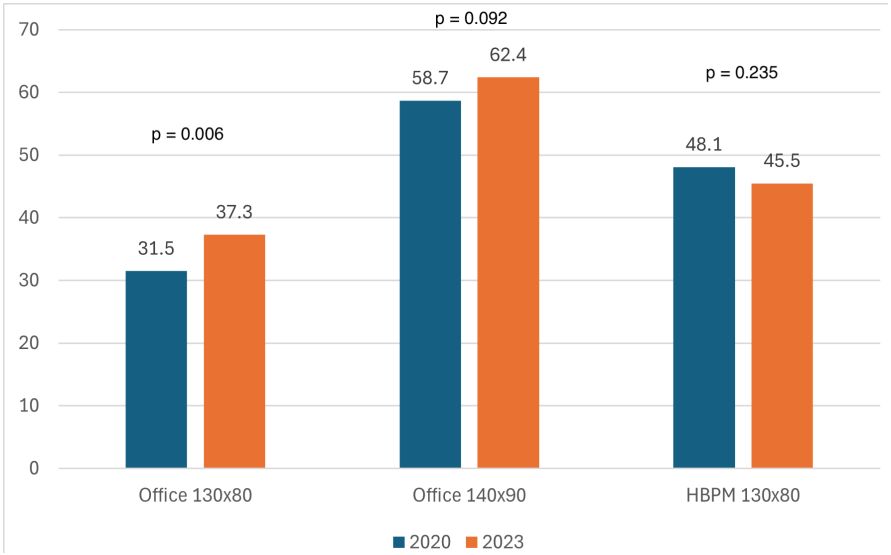
Comparison 2020 with 2022: oral antidiabetic: p = 0.155; statin: p = 0.149; Comparison 2020 with 2023: oral antidiabetic: p < 0.001; statin: p = 0.980.

Figure 4. Frequency of oral antidiabetic and statin use by year, 2019-2023.



Chi-square. HBPM: Home Blood Pressure Measurement.

Figure 5. Comparison of the frequency of controlled blood pressure between the years 2020 and 2022 considering office and home blood pressure measurements.



Chi-square. HBPM: Home Blood Pressure Measurement.

Figure 6. Comparison of the frequency of controlled blood pressure between the years 2020 and 2023 considering office and home blood pressure measurements.

4. Discussion

Blood pressure control is essential to reduce morbidity and mortality in hypertensive patients [12]. The use of strategies capable of optimizing this goal is highly desirable, and HBPM has been shown to be an important tool for both diagnosis and increased treatment adherence [5].

It is worth noting that the COVID-19 pandemic, which occurred from 2020 to 2022, could have negatively impacted BP control rates in this sample. One study showed that, based on home BP readings, there was an increase in the monthly

average BP, raising questions about the impact of lifestyle changes, alterations in care routines, and difficulties in accessing healthcare during the pandemic [13]. However, positive aspects resulting from the pandemic included the development and improvement of telemonitoring, telemedicine, and greater use of HBPM as a solution for monitoring hypertension [14]. In this study, there was a reduction in mean OBP values in the post-pandemic years, possibly related to the use of HBPM.

A reduction in the prescription of antihypertensive medications, known as "tapering," may occur in patients who present adverse effects secondary to antihypertensive therapy, including symptoms of hypotension and postural hypotension, mainly in individuals who do not present target organ damage (TOD) [15]. Part of the population in this study is elderly, and there is also discussion about reducing medication use in frail elderly people with a reduced life expectancy [16]. However, in individuals with TOD, such as hypertensive hypertrophic cardiomyopathy, a more thorough analysis must be carried out, as there is a risk of the condition progressing in the absence of medication [17]. On the other hand, a plausible explanation for the reduction in the number of antihypertensive drugs with a concomitant improvement in blood pressure control is the increase in adherence to pharmacological treatment [18] [19].

Previous studies have demonstrated improvements in blood pressure control with HBPM and telemonitoring due to greater accuracy in diagnosis and increased adherence, in addition to being cost-effective in reducing cardiovascular morbidity and mortality [7] [20]. In the present study, the use of HBPM was associated with a reduction in the number of antihypertensive drugs and an improvement in blood pressure control over the years, despite the COVID-19 pandemic.

The increase in the prescription of antidiabetics highlights a possible pursuit of better glycemic control in diabetic hypertensive patients as a way of reducing cardiovascular events [21]. Standard antihypertensive drug therapy in diabetics focuses primarily on blood pressure reduction; in addition, some drugs have pleiotropic properties that promote cardiovascular and renal protection [22].

Some limitations of the study are noteworthy: detailed clinical data, such as the presence of comorbidities and cardiovascular risk factors, are not known in detail, and this was not a follow-up of the same patients. However, the same doctors followed. The significant number of patients evaluated from 2019 to 2023 should also be highlighted.

Most hypertensive patients will require lifelong antihypertensive medication to control their BP. A minority can achieve normal blood pressure with a low-sodium diet, and a few can achieve it with just one medication. Antihypertensive therapy is the basis for effective treatment, yet BP control among hypertensive patients continues to be a major challenge for both patients and physicians. The pandemic caused by SARS-CoV-2 led to major changes in the care routines of hypertensive patients, one of which was the increased incentive to use tools like

HBPM to better monitor them.

5. Conclusion

The use of home blood pressure monitoring, as an integral part of clinical practice, resulted in improved blood pressure control, even during a critical period for healthcare due to the COVID-19 pandemic.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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