

# Unattended automated office blood pressure measurement — current evidence and the role in clinical practice

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## Abstract

Arterial hypertension is a leading preventable cardiovascular risk factor. The definition and thresholds for the diagnosis of hypertension vary between European and American guidelines. That is mainly due to the widely known SPRINT trial in which unattended automated blood pressure measurements were used. This technique of blood pressure estimation requires a patient to be left alone in an office and then a programmed device measures blood pressure automatically. The absence of a health professional during the measurement helps to reduce or eliminate the “white coat” effect; therefore, values of blood pressure may be lower than in conventional office blood pressure measurements. There are premises that this technique can be a solid substitution for 24-hour ambulatory blood pressure measurements and that it can predict hypertension-mediated organ damage more accurately than standard techniques. However, due to the many methods in which measurement can be carried out, no universal protocol exists. More research is needed to evaluate the usefulness of unattended automated office blood pressure measurements in clinical practice.

**Key words:** arterial hypertension; blood pressure measurement; unattended automated blood pressure measurement; ambulatory blood pressure measurement; home blood pressure measurement, hypertension-mediated organ damage

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## Introduction


Arterial hypertension is the leading preventable cardiovascular risk factor [1, 2]. High blood pressure is responsible for 47% of cases of ischemic heart disease and 54% of stroke cases globally [3]. Hypertension also increases the risk of heart failure, atrial fibrillation, and chronic kidney disease [4]. Despite new advances and recommendations in the treatment of chronically elevated blood pressure (BP), such as the usage of single pill drug combinations

[5], many cases of hypertension are still suboptimally controlled. In Poland, for example, only 20.7% of hypertensive patients have their blood pressure in the recommended target range [6].

Another discussed issue is the definition of arterial hypertension. Threshold values of arterial hypertension are chosen arbitrarily because the association between blood pressure and cardiovascular risk is continuous [7]. According to the guidelines of the European Society of Hypertension and European Society of Cardiology, threshold values of arterial

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hypertension are a systolic blood pressure of 140 millimeters of Mercury (mm Hg) and above, and a diastolic blood pressure of 90 mmHg and above [5]. In contrast, the American College of Cardiology and American Heart Association defines arterial hypertension as a systolic blood pressure of 130 mmHg and above and a diastolic blood pressure of 80 mmHg and above [8]. This discrepancy is caused primarily by the results of the SPRINT study, in which the method of unattended automated blood pressure measurements (UAOBPM) was used [9].

The aims of this article is to explore this method, discuss its advantages and disadvantages, its possible use in clinical practice, and its comparison to other, traditional methods such as conventional office blood pressure measurement or ambulatory blood pressure monitoring (ABPM).

### The use of unattended automated office blood pressure measurement

The main tenet of UAOBPM is to avoid or reduce the “white coat” effect — a phenomenon of the acute rise of blood pressure during measurement in the presence of medical professionals primarily due to anxiety [10]. This effect is common and it may be responsible for up to 50% of cases of white-coat hypertension, a condition in which BP values are above the threshold during the office BP measurements, while they are normal when measured at home or in ABPM [11]. Although white-coat hypertension is not a true arterial hypertension, patients with the former have a higher cardiovascular risk than normotensive patients [12]. This is why it is essential to distinguish between those 3 states. Home blood pressure measurements (HBPM) and ambulatory blood pressure monitoring are methods that can accomplish that [13]. It may be also useful to use unattended automated measurements. In the course of UAOBPM, a health professional places the blood pressure cuff and programs the device, then the patient is left alone in the office. After a specified amount of time, blood pressure will be measured automatically for a defined number of times [14]. On the market, there are many devices customized to unattended measurements that have been used in research. The list of available equipment is presented in Table 1.

The main concern of unattended measurements is that there are many variables and ways in which the device can be programmed. Programmable values are: a number of measurements, the time between measurements, and the delay before the first mea-

**Table 1.** Devices customized for unattended automated blood pressure measurements (UAOBPM)

Omron HEM 907 [15]
Omron 907XL [14]
Omron HEM 9000Ai [16]
OMRON M10-IT [17]
Omron HEM-705CP [18]
Omron i-C10 [19]
Microlife WatchBP office [20]
BpTRU model BP300 [21]
Welch Allyn Connex Spot BP [22]
Mobil-O-Graph NG device [23]
CB-1805-B Biox [24]
Task Force Monitor, CNS Systems [25]
Dinamap ProCare DPC 400 Vital Signs Monitor [26]

surement. One must also decide if the values are displayed for the patients, or if the first measurement is discarded. Programmable variables and possible settings are presented in Table 2.

Therefore, there is currently not one universally-acceptable protocol for UAOBPM, although some studies have been performed to get the best settings. Studies of Myers and colleagues suggest that a 1- or 2-minute interval between measurements provides the best results [27, 28]. For the number of measurements, Kronish et al. found that averaging two or three measurements gives the best precision of blood pressure estimation [29]. Similar conclusions were presented by Moore et al. [30]. In the office blood pressure measurements, Guidelines of the European Society of Hypertension state that patients should rest for 5 minutes before BP measurements commence [5]. This recommendation has been transferred to many protocols of UAOBPM, including the most famous SPRINT trial [9]. In fact, in the research of Colella et al. mean BP values were higher by 4 mmHg for UAOBPM without a rest period in comparison to a standardized 5-minute delay before the first measurement [31].

Another difficulty of UAOBPM is the place in which the measurements are done. In some facilities, it may cause a problem as a patient needs to

**Table 2.** Possible setting of unattended automated blood pressure measurements (UAOBPM)

Variable	Possible settings
Number of measurements	1, 3, 5, 6
Time between measurements	0, 5, 1, 2, 5 [minutes]
Delay before the first measurement	0, 3, 5, 10 [minutes]
Results displayed for patients	Yes/No
First measurements discarded	Yes/No

stay in an office for a few minutes alone, which may require an additional room. Research has been conducted to resolve this shortcoming. Armstrong et al. has shown that patients do not need to stay in the office for unattended measurements. Measurements taken in the waiting room without the presence of a medical professional were similar to those taken in the office while left alone [32]. Chambers et al. found that UAOBPM can be also performed at the community pharmacy with the same results as in the doctor's office [33]. It may resolve the important drawback of UAOBPM. Nevertheless, more research is needed to provide the best setting of programmable variables to obtain a universal UAOBPM protocol.

### **Unattended automated office blood pressure measurement versus the classic office blood pressure measurement techniques**

In many research studies, it has been shown that unattended measurements are often associated with lower BP values than the readings conducted in the presence of a medical professional. Paini et al. found that attended measurements provide higher values than measurements taken without the presence of a health professional while using the same device, although this effect is not present for all patients [34].

A similar elimination of the white-coat effect was observed in the study of Myers et al. in which unattended systolic blood pressure was lower by 19 mm Hg in comparison to measurements done by a hypertension specialist; however, both values were higher than those obtained by ABPM [35]. Beckett and Godwin achieved similar results; UAOBPM values were lower and more similar to ABPM than office measurements [36]. In the meta-analysis of Jegatheswaran et al., UAOBPM differed from ABPM only by 1.5 mmHg, suggesting that UAOBPM may be a solid ABPM substitution. UAOPM has been tested in routine clinical practice. In a multi-center study by Myers et al., UAOBPM values were comparable with ABPM and lower than those obtained during conventional measurements [37].

On the contrary, in the systematic review and meta-analysis of Kollias et al., differences between unattended and attended measurements were not statistically significant [38]. However, this paper included solely 10 studies that used a very strict, standardized protocol of both unattended and attended measurement. As authors concluded, lower values of the blood pressure during unattended measurements

in comparison to conventional measurements seen in many other research studies are not dependent on whether a medical professional is present or absent, but it is due to minimization of common errors which are usually present during the office blood pressure measurements. In a systematic review and meta-analysis of Roerecke et al. which consisted of 31 articles, UAOBPM values were similar to ABPM recording, and as according to authors UAOBPM should be the preferred method of BP measurements in clinical practice [39]. Further research is needed to discover the true relationship between UAOBPM, ABPM, HBPM, and conventional office BP measurements.

### **Prediction of hypertension mediated organ damage by UAOBPM**

Hypertension-mediated organ damage (HMOD) are specific changes caused by elevated blood pressure. Examples of HMOD are left ventricular hypertrophy, arterial wall thickening and albuminuria [40]. The early detection of HMOD can accelerate the initiation of pharmacotherapy in patients with grade 1 hypertension [5]. Few studies were performed to evaluate UAOBPM accuracy in the prediction of HMOD in comparison to standard methods of blood pressure measurement. In the study of Campbell et al., unattended measurements were better related to carotid intima-media thickness than auscultatory blood pressure measurements [41]. In contrast, Calompa et al. found no significant differences between correlations of blood pressure measured using either the attended or unattended method with respect to the intima-media thickness [42]. Salvetti et al. found that both attended and unattended blood pressure measurements were similarly correlated to left ventricular hypertrophy and intima-media thickness [43], while in the study of Andreadis et al., unattended measurements had a better correlation with left ventricular mass than attended measurements [20]. Additional research is needed to evaluate the usefulness of UAOPM in the prediction of HMOD.

### **Pros, cons and practical aspects of unattended automated office blood pressure measurements use**

UAOBPM method has its advantages and disadvantages. Some of them given by the various publications are listed in Table 3.

**Table 3.** Advantages and Disadvantages of unattended automated blood pressure measurements (UAOBPM)

Advantages	Disadvantages
Reduction or elimination of the “white coat” effect Possible better accuracy in detection of hypertension-mediated organ damage Better correlation between HBPM and ABPM than attended measurements Helps to avoid common errors during office blood pressure measurements such as limited amount of measurements	Cost of the device Increased time of measurement Requirement of office space No medical personnel present to detect errors in device measurements No standardized protocol

HBPM — home blood pressure measurements; ABPM — ambulatory blood pressure monitoring

UAOBPM is a rather new method and it is still not very well established in the application of hypertension management. The Canadian Society of Hypertension finds UAOBPM as a preferred method of measuring blood pressure. Thresholds for the diagnosis of hypertension using UAOBPM are 135 mmHg and above for systolic blood pressure, and 85 mmHg and above for diastolic blood pressure. The first measurement is taken by a health professional and the next measurements are automatic while the patient is left alone in the room [44].

In the guidelines of the European Society of Hypertension [5], and the Polish Society of Hypertension [45], there is only a small chapter dedicated to UAOBPM. It is stated that due to the small amount of research on this topic, threshold values are unclear and therefore, there are no specific recommendations of this method. The most recent Guidelines of the International Society of Hypertension as well as the Consensus of European Society of Hypertension consider UAOBPM as a more standardized assessment of blood pressure than standard office measurements, but thresholds for decisions are still uncertain. [46][47]

## Conclusions

Unattended automated office blood pressure measurement is a new method of blood pressure assessment. It has its advantages and disadvantages in comparison to standard methods such as conventional office blood pressure measurements, home blood pressure measurements, or 24-hour ambulatory blood pressure measurements. Due to many variants of UAOBPM, further research is needed to provide a standard protocol for such measurements. More research is also needed to assess the accuracy

of UAOBPM in the prediction of subclinical target organ damage caused by arterial hypertension. Nevertheless, UAOBPM has already been advised in the recent guidelines of many hypertension societies worldwide. Perhaps in the near future, with more available evidence, unattended measurements will be significantly highlighted in the guidelines of the Polish Society of Hypertension or the European Society of Hypertension and considered to be a preferred method of assessing blood pressure in patients.

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