

White-coat hypertension

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What is this?

- ▶ White coat hypertension is characterized by the variability of a patient's blood pressure measurements between the physician's office and the patient's home environment.
- ▶ White coat hypertension is a condition in which patients experience persistent high blood pressure levels when they are measured at a medical office or when a physician is present, but normal blood pressure levels during their daily lives and while in their home environment



- ▶ Some authors use the terms “white coat effect,” “white coat hypertension,” and “white coat syndrome” interchangeably; others suggest “white coat hypertension” is preferred.



- ▶ White coat effect describes the difference between an elevated clinic BP and a lower home or ambulatory BP in both untreated and treated patients.
- ▶ The white coat effect is considered clinically significant if the difference between clinic and out-of-office BP exceeds 20/10mmHg.

Cobos, B., Haskard-Zolnierok, K. and Howard, K., 2015. white coat hypertension: improving the patient-health care practitioner relationship. Psychology research and behavior management, 8, p.133.

Nuredini, G., Saunders, A., Rajkumar, C. and Okorie, M., 2020. Current status of white coat hypertension: where are we?. Therapeutic Advances in Cardiovascular Disease, 14, p.1753944720931637.

- White coat hypertension is likely caused by the patient's anxiety within the physician's office and in the presence of the physician



- Improving the relationship between a patient and their health care provider can decrease the patient's anxiety, with the implication of decreasing the patient's likelihood of demonstrating white coat hypertension.

Prevalence of WCH

- ▶ White-coat hypertension can account for up to 30 - 40% of people (and >50% in the very old) with an elevated office BP
- ▶ Its prevalence is lower in patients with hypertension-mediated organ damage, when office BP is based on repeated measurements, or when a doctor is not involved in the BP measurement.
- ▶ A significant white-coat effect can be seen at all grades of hypertension (including resistant hypertension), but the prevalence of white-coat hypertension is greatest in grade 1 hypertension

Categories of BP in Adults

BP Category	SBP		DBP
Normal	<120 mm Hg	and	<80 mm Hg
Elevated	120–129 mm Hg	and	<80 mm Hg
Hypertension			
Stage 1	130–139 mm Hg	or	80–89 mm Hg
Stage 2	≥140 mm Hg	or	≥90 mm Hg

*Individuals with SBP and DBP in 2 categories should be designated to the higher BP category.

BP indicates blood pressure (based on an average of ≥2 careful readings obtained on ≥2 occasions, as detailed in Section 4); DBP, diastolic blood pressure; and SBP, systolic blood pressure.

Current staging of hypertension by NICE, ESH/ESC and ACC/AHA

	Systolic BP (mmHg)	Diastolic BP (mmHg)
NICE (2019)		
Normotension	<120	<80
Stage 1 Hypertension	≥140	≥90
Stage 2 Hypertension	≥160	≥100
Severe hypertension	≥180	or ≥120
ESH/ESC (2018)		
Normotension	<120	<80
Grade 1 Hypertension	140–159	and/or 90–99
Grade 2 Hypertension	160–179	and/or 100–109
Grade 3 hypertension	≥180	and/or ≥110
ACC/AHA (2017)		
Normotension	<120	and <80
Elevated BP	120–129	and <80
Stage 1 Hypertension	130–139	or 80–89
Stage 2 Hypertension	≥140	or ≥90
ACC, American College of Cardiology; AHA, American Heart Association; BP, blood pressure; ESC, European Society of Cardiology; ESH, European Society of Hypertension; NICE, National Institute for Health and Care Excellence.		

*Adapted from NICE, ESH/ESC and ACC/AHA guidelines

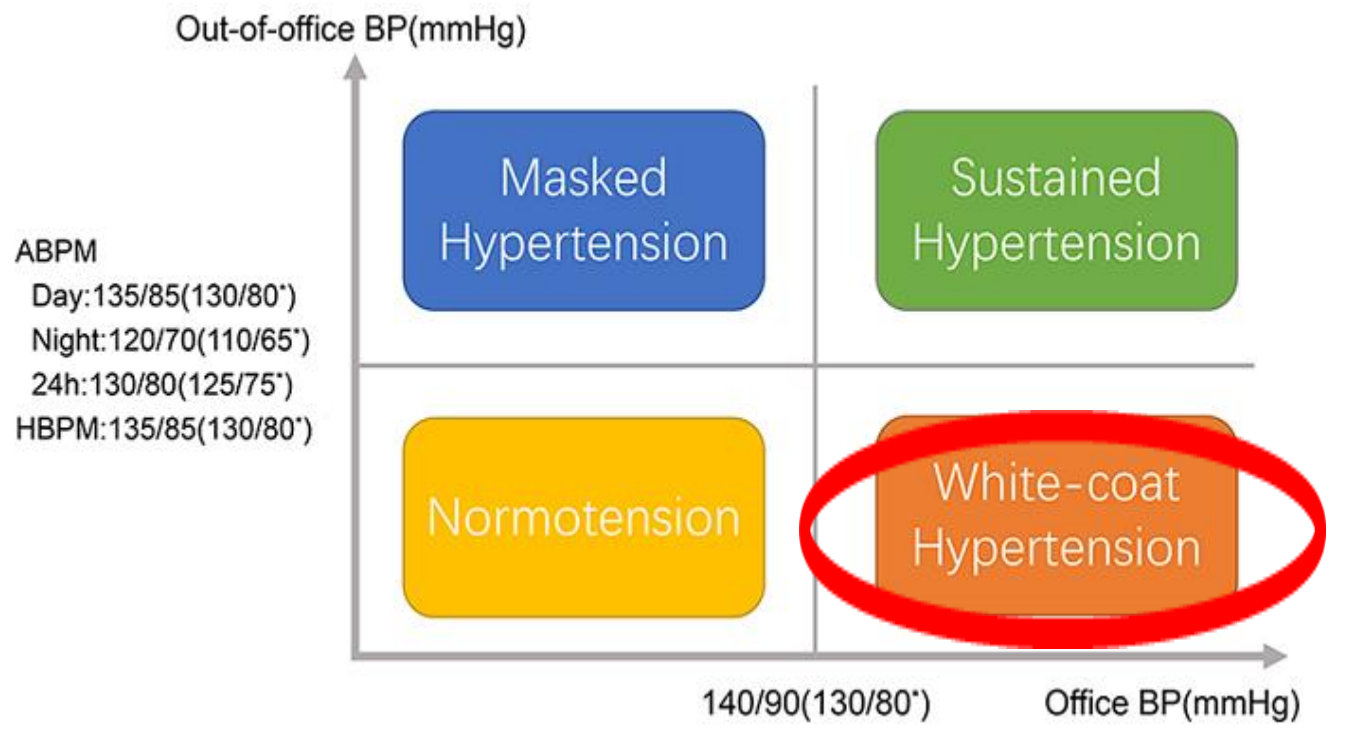
Criteria for Hypertension Based on Office-, Ambulatory, and Home Blood Pressure Measurement

	SBP/DBP, mm Hg
Office BP	≥140 and/or ≥90
ABPM	
24-h average	≥130 and/or ≥80
Day time (or awake) average	≥135 and/or ≥85
Night time (or asleep) average	≥120 and/or ≥70
HBPM	≥135 and/or ≥85

The general characteristics of OBPM, HBPM, and ABPM

Characteristics	OBPM	HBPM	ABPM
Popularity of device	Wider use in office	General use at home	Less use in office
Reproducibility	Poor	Better	Poor
Diagnostic threshold for hypertension (mmHg)	140/90(130/80 ^a)	135/85(130/80 ^a)	Mean day time 135/85(130/80 ^a) Mean night time 120/70(110/65 ^a) Mean 24-h 130/80(125/75 ^a)
Detection of BP variability	Provide visit-to-visit BP variability	Provide day to day BP variability	Provide 24-h BP variability
Evaluation of nocturnal BP	Not applicable	Not applicable	Applicable
Evaluation of morning surge	Not applicable	Applicable	Applicable
White coat effect	Present	Absent	Absent
^a The diagnostic threshold in America based on the 2017 ACC guideline. ABPM, ambulatory blood pressure measurement; ACC, American College of Cardiology; BP, blood pressure; HBPM, home blood pressure measurement; OBPM, office blood pressure measurement.			

Classification of BP subtypes by combination of clinic office BP and out-of-office BP



The diagnostic threshold in the United States based on the 2017 ACC/AHA guideline. ABPM, ambulatory blood pressure measurement; ACC/AHA, American College of Cardiology/American Heart Association; BP, blood pressure; HBPM, home blood pressure measurement.

Masked hypertension, sustained hypertension, true normotension

- ▶ 'Masked hypertension' refers to untreated patients in whom the BP is normal in the office, but is elevated when measured by HBPM or ABPM
- ▶ Masked hypertension can be found in approximately 15% of patients with a normal office BP
- ▶ The term 'true normotension' is used when both office and out-of-office BP measurements are normal, and 'sustained hypertension' is used when both are abnormal.



BP Patterns Based on Office and Out-of-Office Measurements

	Office/Clinic/ Healthcare Setting	Home/Nonhealthcare/ ABPM Setting
Normotensive	No hypertension	No hypertension
Sustained hypertension	Hypertension	Hypertension
Masked hypertension	No hypertension	Hypertension
White coat hypertension	Hypertension	No hypertension

ABPM indicates ambulatory blood pressure monitoring; and BP, blood pressure.

Associated features of normotension, white coat syndrome, and hypertension

Features	Normotension	White coat effect	White coat hypertension	Masked hypertension	Hypertension	
					Within normal BP limits	Exceeding normal BP limits
Office BP levels	$\leq 120/80$ mmHg ¹⁶	$>20/10$ mmHg when compared to home measurements ¹⁴	$\geq 140/90$ mmHg ³⁸	$<140/90$ mmHg ³⁸	$<140/90$ mmHg ¹⁶	$\geq 140/90$ mmHg ¹⁵
24 hours ABPM levels	$<130/80$ mmHg ¹⁶	$<130/80$ mmHg ¹⁴	$<130/80$ mmHg ³⁸	$\geq 130/80$ mmHg ³⁸	$<130/80$ mmHg ¹⁶	$\geq 130/80$ mmHg ¹⁵
HBPM levels	$<135/85$ mmHg ¹⁶	$\leq 135/85$ mmHg ¹⁴	$<135/85$ mmHg ³⁸	$\geq 135/85$ mmHg ³⁸	$<135/85$ mmHg ¹⁶	$\geq 135/85$ mmHg ¹⁵
Clinical characteristics	—	Higher heart rate levels and BP non-dipping condition ¹⁷	Higher in female sex, obese, and it seems to increase with respect to age ²⁴	Increased risk of atherosclerotic CVD, ⁴¹ morbidity, and mortality for CVD ^{43,44}	Sustained elevated BP levels are related to the development of TOD and, consequently, increased CV risk ²⁵	
Target organ damage	—	Low relationship with TOD development; ²² correlation with arterial stiffness ^{20,21}	Correlation with arterial stiffness ²⁸ and LVH ³⁴	Presents a higher risk of developing TOD than other phenomena but less risk than hypertensive ¹¹	LVH, diastolic dysfunction, carotid intima-media thickening or plaque, renal damage, and micro- as well as macro-vascular alterations ²⁴	

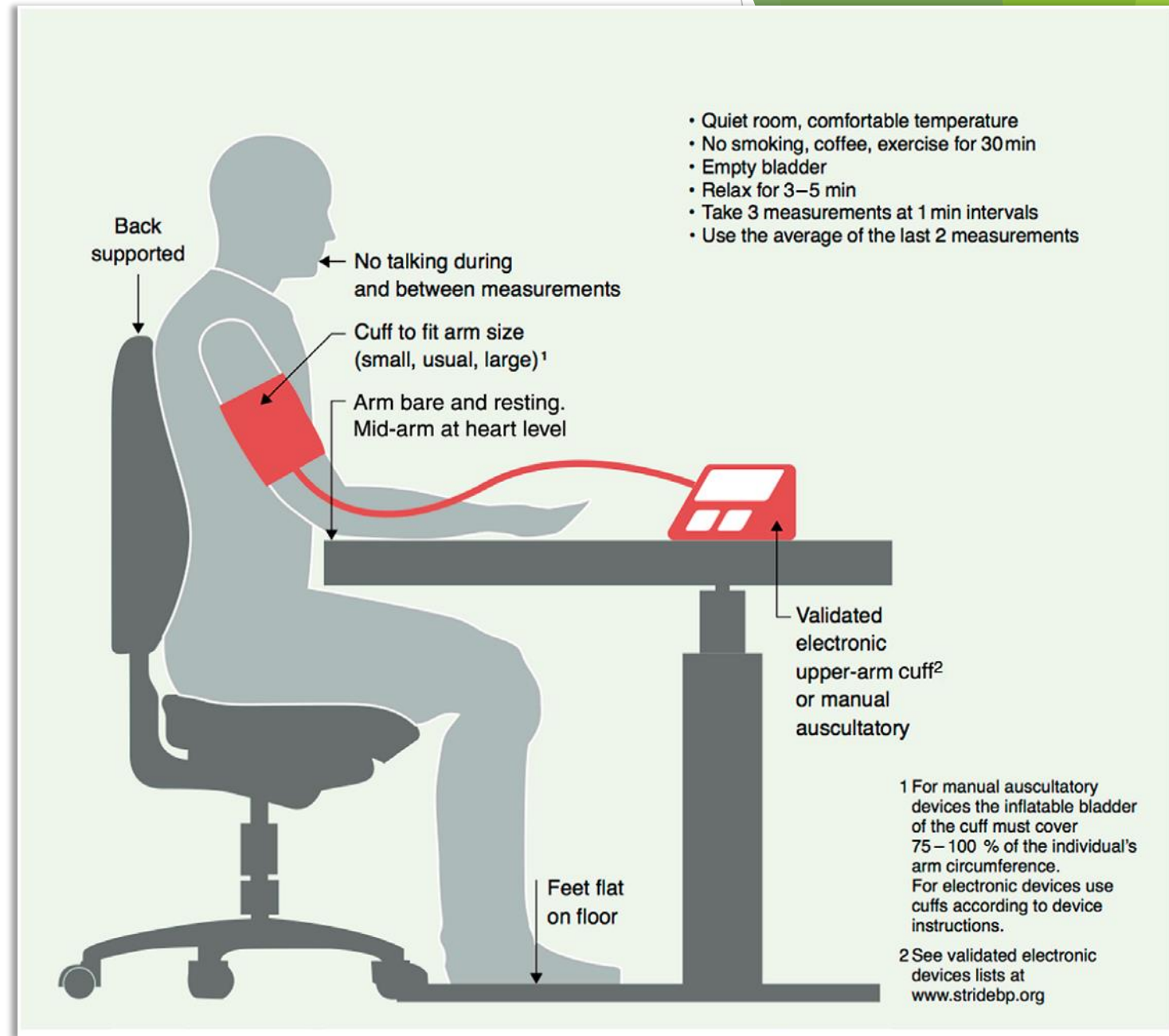
Abbreviations: ABPM, ambulatory BP monitoring; BP, blood pressure; CV, cardiovascular risk; CVD, cardiovascular disease; HBPM, home BP monitoring; LVH, left ventricular hypertrophy; TOD, target organ damage.

Recommendations for Office Blood Pressure Measurement

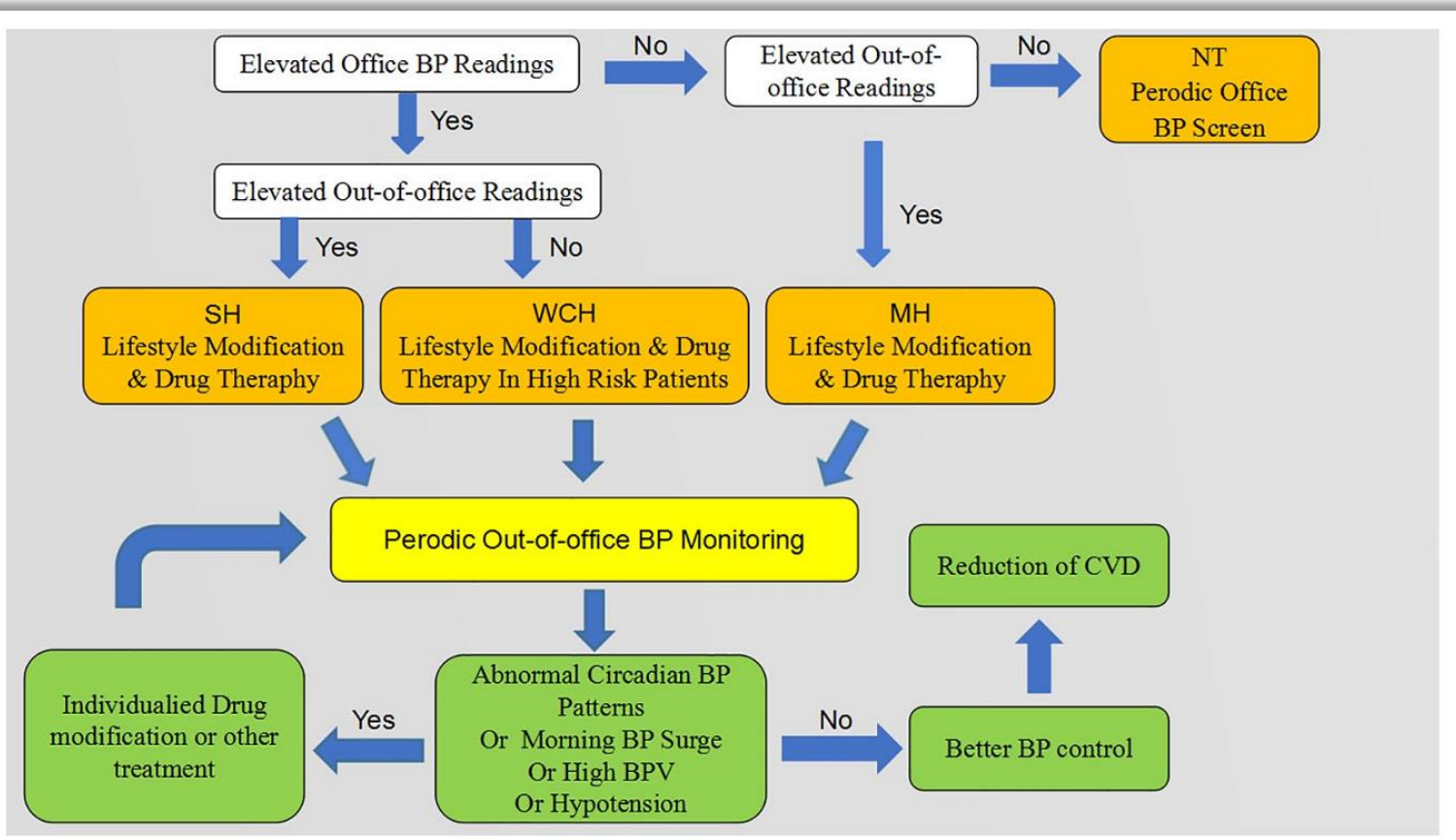
Conditions	<ul style="list-style-type: none"> • Quiet room with comfortable temperature. • Before measurements: Avoid smoking, caffeine and exercise for 30 min; empty bladder; remain seated and relaxed for 3–5 min. • Neither patient nor staff should talk before, during and between measurements.
Positions	<ul style="list-style-type: none"> • Sitting: Arm resting on table with mid-arm at heart level; back supported on chair; legs uncrossed and feet flat on floor (Figure 1).
Device	<ul style="list-style-type: none"> • Validated electronic (oscillometric) upper-arm cuff device. Lists of accurate electronic devices for office, home and ambulatory BP measurement in adults, children and pregnant women are available at www.stridebp.org.²² (see also Section 11: Resources) • Alternatively use a calibrated auscultatory device, (aneroid, or hybrid as mercury sphygmomanometers are banned in most countries) with 1st Korotkoff sound for systolic blood pressure and 5th for diastolic with a low deflation rate.²²
Cuff	<ul style="list-style-type: none"> • Size according to the individual's arm circumference (smaller cuff overestimates and larger cuff underestimates blood pressure). • For manual auscultatory devices the inflatable bladder of the cuff must cover 75%–100% of the individual's arm circumference. For electronic devices use cuffs according to device instructions.
Protocol	<ul style="list-style-type: none"> • At each visit take 3 measurements with 1 min between them. Calculate the average of the last 2 measurements. If BP of first reading is <130/85 mm Hg no further measurement is required.
Interpretation	<ul style="list-style-type: none"> • Blood pressure of 2–3 office visits $\geq 140/90$ mm Hg indicates hypertension.

How to measure blood pressure

Unger, T., Borghi, C., Charchar, F., Khan, N.A., Poulter, N.R., Prabhakaran, D., Ramirez, A., Schlaich, M., Stergiou, G.S., Tomaszewski, M. and Wainford, R.D., 2020. 2020 International Society of Hypertension global hypertension practice guidelines. Hypertension, 75(6), pp.1334-1357.



Proposed clinical procedure for application of out-of-office BP monitoring



BP, blood pressure; BPV, blood pressure variability; CVD, cardiovascular disease; MH, masked hypertension; NT, normotension; SH, sustained hypertension; WCH, white coat hypertension.

Clinical Use of Home and Ambulatory Blood Pressure (BP) Monitoring

	Home Blood Pressure Monitoring	24-Hour Ambulatory Blood Pressure Monitoring
Condition	As for office blood pressure (see above).	Routine working day.
Position	As for office BP (see above).	Avoid strenuous activity. Arm still and relaxed during each measurement.
Device	Validated electronic (oscillometric) upper-arm cuff device (www.stridebp.org , and Section 11: Resources)	
Cuff	Size according to the individual's arm circumference	
Measurement protocol	<p>Before each visit to the health professional:</p> <ul style="list-style-type: none"> • 3–7-day monitoring in the morning (before drug intake if treated) and the evening. • Two measurements on each occasion after 5 min sitting rest and 1 min between measurements. <p>Long-term follow-up of treated hypertension:</p> <ul style="list-style-type: none"> • 1–2 measurements per week or month. 	<ul style="list-style-type: none"> • 24-hour monitoring at 15–30 min intervals during daytime and nighttime. • At least 20 valid daytime and 7 nighttime BP readings are required. If less, the test should be repeated.
Interpretation	<ul style="list-style-type: none"> • Average home blood pressure after excluding readings of the first day ≥ 135 or 85 mm Hg indicates hypertension. 	<ul style="list-style-type: none"> • 24-hour ambulatory blood pressure $\geq 130/80$ mm Hg indicates hypertension (primary criterion). • Daytime (awake) ambulatory blood pressure $\geq 135/85$ mm Hg and nighttime (asleep) $\geq 120/70$ mm Hg indicates hypertension

Unger, T., Borghi, C., Charchar, F., Khan, N.A., Poulter, N.R., Prabhakaran, D., Ramirez, A., Schlaich, M., Stergiou, G.S., Tomaszewski, M. and Wainford, R.D., 2020. 2020 International Society of Hypertension global hypertension practice guidelines. *Hypertension*, 75(6), pp.1334-1357.

Comparison of ambulatory blood pressure monitoring and home blood pressure monitoring

ABPM	HBPM
Advantages <ul style="list-style-type: none">• Can identify white-coat and masked hypertension• Stronger prognostic evidence• Night-time readings• Measurement in real-life settings• Additional prognostic BP phenotypes• Abundant information from a single measurement session, including short-term BP variability	Advantages <ul style="list-style-type: none">• Can identify white-coat and masked hypertension• Cheap and widely available• Measurement in a home setting, which may be more relaxed than the doctor's office• Patient engagement in BP measurement• Easily repeated and used over longer periods to assess day-to-day BP variability
Disadvantages <ul style="list-style-type: none">• Expensive and sometimes limited availability• Can be uncomfortable	Disadvantages <ul style="list-style-type: none">• Only static BP is available• Potential for measurement error• No nocturnal readings^a

ABPM = ambulatory blood pressure monitoring; BP = blood pressure; HBPM = home blood pressure monitoring.

^aTechniques are being developed to enable nocturnal BP measurement with home BP devices.

Ambulatory blood pressure monitoring



Ambulatory Blood Pressure Monitoring over 24 hours provides a more comprehensive view about your blood pressure than conventional one off clinic readings.

https://www.google.com/url?sa=i&url=https%3A%2F%2Fwww.radiancehealthcare.in%2Fservices-abpm.html&psig=AOvVaw1k4HYjB8_2FD9_8aBPGLU&ust=1606935000901000&source=images&cd=vfe&ved=0CAMQjB1qFwoTCODmjMC5re0CFQAAAAAdAAAAABAK

https://www.google.com/url?sa=i&url=https%3A%2F%2Faabpmc.org%2F&psig=AOvVaw1k4HYjB8_2FD9_8aBPGLU&ust=1606935000901000&source=images&cd=vfe&ved=0CAMQjB1qFwoTCODmjMC5re0CFQAAAAAdAAAAABAD

Ambulatory blood pressure monitoring


Number	Date	Time	Systole	MAP	Diastole	Heart rate	Comment
48	11/16/2016	04:00	119	92	71	53	
49	11/16/2016	04:30	117	95	76	66	
50	11/16/2016	05:00	116	88	67	68	
51	11/16/2016	05:30	112	86	67	64	
52	11/16/2016	06:00	115	99	86 d	52	
53	11/16/2016	06:30	116	88	68	53	
54	11/16/2016	07:00	124	91	65	47	
55	11/16/2016	07:15	106	76	53	56	
56	11/16/2016	07:30	114	89	72	52	
57	11/16/2016	07:45	113	86	65	63	
58	11/16/2016	08:00	127	90	65	59	
59	11/16/2016	08:15	111	90	73	66	
60	11/16/2016	08:30	121	90	69	55	
61	11/16/2016	08:45	137	99	74	59	
62	11/16/2016	09:00	128	100	81	64	
63	11/16/2016	09:15	128	101	82	63	
64	11/16/2016	09:30	125	96	75	61	
65	11/16/2016	09:45	145 d	103	74	68	
66	11/16/2016	10:00	142 d	113	92 d	78	
67	11/16/2016	10:15	136	105	81	65	
68	11/16/2016	10:30	129	91	64	70	
69	11/16/2016	10:45	132	110	95 d	77	
70	11/16/2016	11:00	136	113	97 d	87	
71	11/16/2016	11:15	135	109	88	88	
72	11/16/2016	11:30	126	105	90	86	
73	11/16/2016	11:48	148 d	118	94 d	80	
74	11/16/2016	12:00	131	107	89	78	
75	11/16/2016	12:15	131	107	90	73	
(76)	11/16/2016	12:33					Failure (E3)
(77)	11/16/2016	12:48					Failure (E1)
78	11/16/2016	13:00	161 d	122	97 d	110	
79	11/16/2016	13:15	163 d	126	101 d	105	
80	11/16/2016	13:30	153 d	122	97 d	86	
81	11/16/2016	13:45	157 d	123	98 d	94	
82	11/16/2016	14:00	154 d	129	111 d	92	
83	11/16/2016	14:18	154 d	128	107 d	112	
84	11/16/2016	14:33	191 d	140	107 d	104	

Numbers in brackets are excluded from statistics.

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<https://www.google.com/url?sa=i&url=https%3A%2F%2Fwww.suntechmed.com%2Fsupport%2Fcase-studies%2F2143-abpm-in-the-community-pharmacy&psig=A0vVaw1At7kXcITXkBzOfQQL50-t&ust=16069307290000&source=images&cd=vfe&ved=0CAMQjB1qFwoTCPDj-LC6re0CFQAAAAAABAL>

https://www.google.com/url?sa=i&url=https%3A%2F%2Fwww.researchgate.net%2Ffigure%2Fambulatory-blood-pressure-monitoring-report-showed-nocturnal-average-blood-pressure_fig3_319304399&psig=AOvYaw1rAt7xkCitXkZbZQOL50-&ust=1606935237090000&source=images&cd=vfe&ved=0CAMQjB1qFwoTCPDi-LC6re0CFQAAAAAaAAAAABAD



Ambulatory Blood Pressure Report

Patient Name : Sample 2 Hypertensive Data

Patient ID : 74642-D

Test Date: 6/9/2015

Date of Birth : 3/11/1950

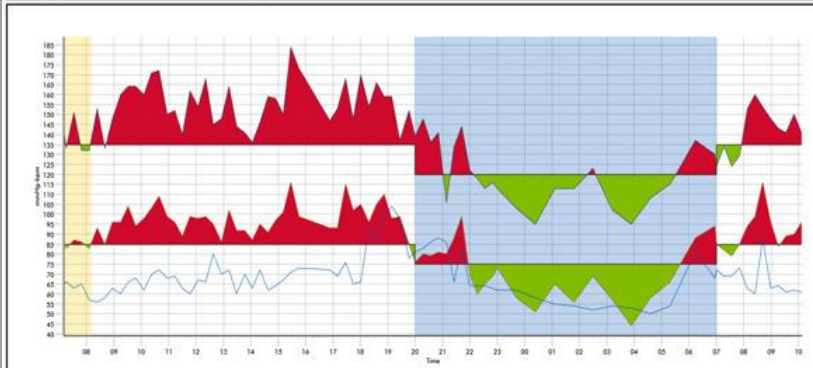
Gender :

Interpretive Summary

Based upon JNC 7 and AHA recommendations, the ABPM data suggests:

- 24 hour SYS and DIA hypertension (142/88 mmHg)
- awake SYS and DIA hypertension (151/95 mmHg)
- Normal asleep SYS and DIA pressure (120/71 mmHg)

Asleep dip is 20.4 % SYS and 25.7 % DIA, Dipper (normal).



Brachial BP Results

Period	Time	Samples	Mean SYS mmHg (+/- Std.Dev)	Mean DIA mmHg (+/- Std.Dev)	Mean HR BPM (+/- Std.Dev)	BP Load Sys (%)	BP Load Dia (%)
Overall	07:11-10:07 (26:56)	78	142 (+/-19.8)	88 (+/-15.3)	69 (+/-11.2)	73	69
Awake Period	07:00-20:00	55	151 (+/-13.3)	95 (+/-8.7)	69 (+/-10.5)	85	82
Asleep Period	20:00-07:00	23	120 (+/-15.8)	71 (+/-14.1)	67 (+/-12.9)	43	39
White Coat Period	07:11-08:10 (1st Hr.)	5				40	40
	Max		151	87	66		
	Mean		137	85	63		

Asleep Dip: SYS = 20.4% DIA =25.7%

Referring physician Dr. Jonathon Hawking

Signature _____ Date _____

Interpreting physician Dr. Roberta Mariotto

Signature _____ Date _____

Ambulatory Blood Pressure Report

Oscar 2

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Page 1 of 11

Home blood pressure monitoring




<https://www.google.com/url?sa=i&url=https%3A%2F%2Fbetterhealthcare.com%2F5-best-home-blood-pressure-monitor%2F&psig=AOvVaw0wwkjtDudv5P6uU8raS22z&ust=1606935355020000&source=images&cd=vfe&ved=0CAMQjB1qFwoTCOiwpOm6re0CFQAAAAAdAAAAABAK>


<https://www.google.com/url?sa=i&url=http%3A%2F%2Fwww.bloodpressureuk.org%2Fyour-blood-pressure%2Fgetting-diagnosed%2F&psig=AOvVaw0wwkjtDudv5P6uU8raS22z&ust=1606935355020000&source=images&cd=vfe&ved=0CAMQjB1qFwoTCOiwpOm6re0CFQAAAAAdAAAAABAR>

<https://www.google.com/url?sa=i&url=https%3A%2F%2Fwww.getqardio.com%2Fhealthy-heart-blog%2Fmonitoring-blood-pressure-home%2F&psig=AOvVaw0wwkjtDudv5P6uU8raS22z&ust=1606935355020000&source=images&cd=vfe&ved=0CAMQjB1qFwoTCOiwpOm6re0CFQAAAAAdAAAAABAD>

Home blood pressure monitoring



Home Blood Pressure (BP) Diary



Name: _____ Start date: _____

When to take home BP?

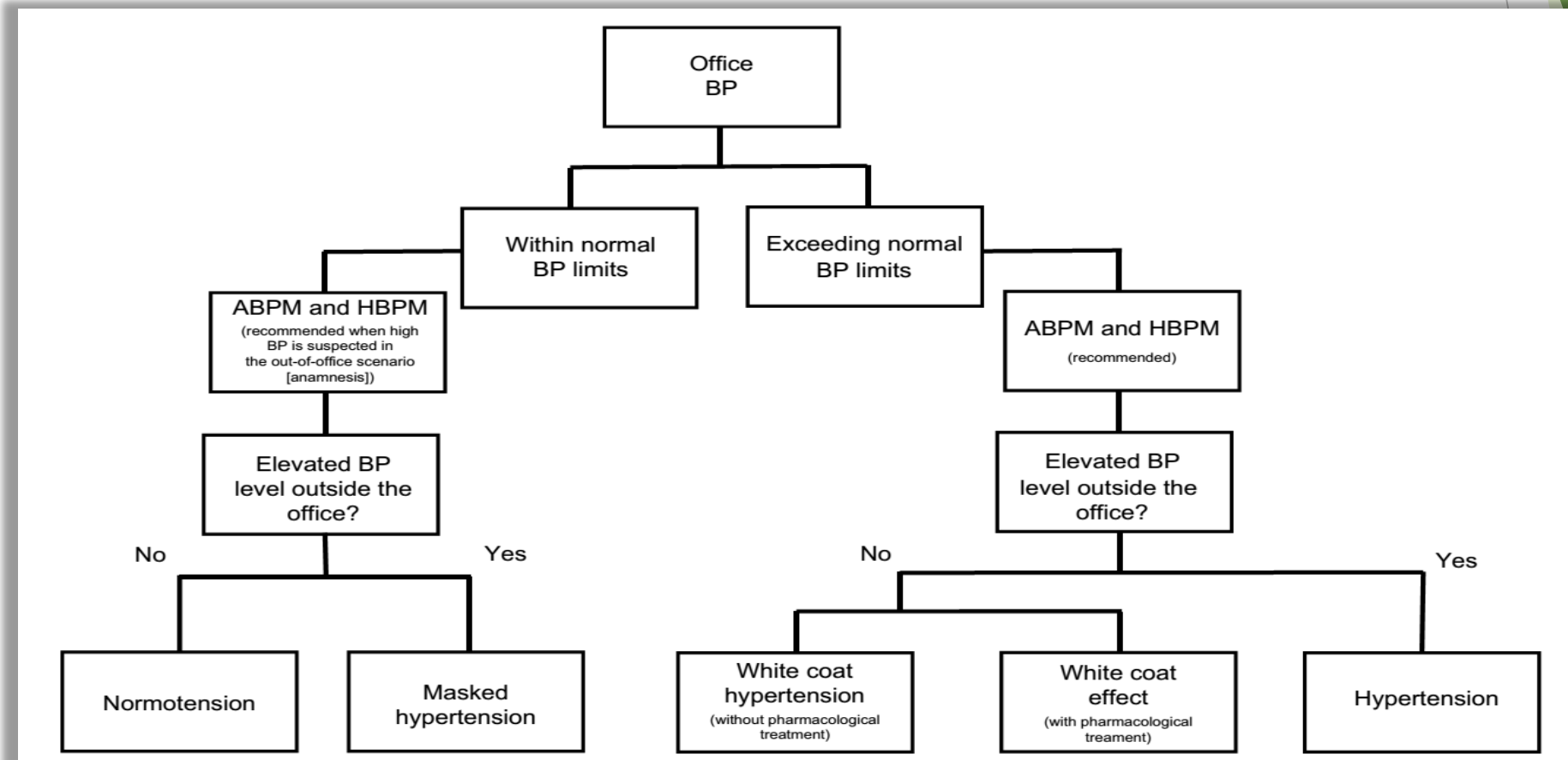
- DO take measures at around the same time in the morning and evening
- DO take before taking medication, food or vigorous exercise
- DO take for 7 days (5 day minimum)
- DO take as advised by your doctor e.g. before visiting the doctor or after medication change

How to take home BP?

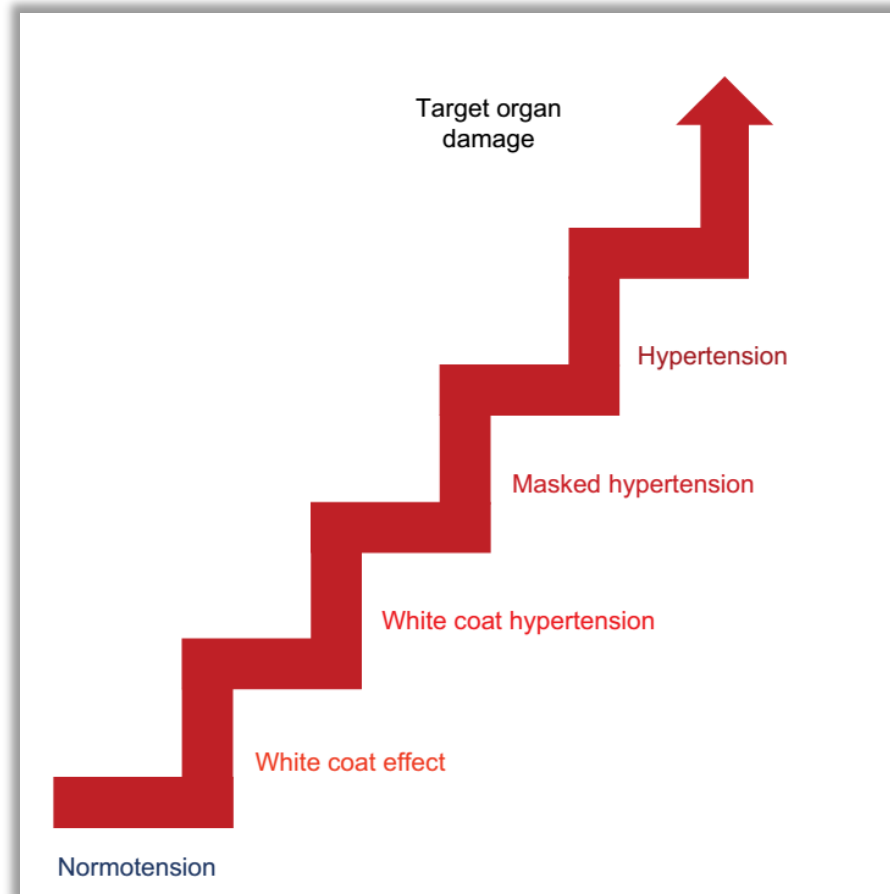
- DO sit quietly for 5 minutes (no talking/distractions such as TV/extreme temperatures)
- DO sit with feet flat on floor, legs uncrossed, upper arm bare, back and arm supported (relaxed position with the cuff at heart level)
- DO take two measures 1 minute apart
- DO record each measure in a paper diary or an electronic spread sheet
- DO take a copy of the BP readings to your doctor appointment
- DO NOT smoke or drink caffeine 30 minutes before measuring BP
- DO NOT measure your BP if uncomfortable, stressed or in pain

	Day 1		Day 2		Day 3		Day 4		Day 5		Day 6		Day 7	
	Morning	Evening	Morning	Evening	Morning	Evening	Morning	Evening	Morning	Evening	Morning	Evening	Morning	Evening
SBP 1														
DBP 1														
SBP 2														
DBP 2														
Average BP (except day 1)												SBP	DBP	

Pathway to diagnosis/classification of the white coat syndrome according to the BP levels



Increase in target organ disorders according to diagnosis of normotensive, white coat syndrome, and hypertension



Pioli, M.R., Ritter, A.M., de Faria, A.P. and Modolo, R., 2018. White coat syndrome and its variations: differences and clinical impact. Integrated blood pressure control, 11, p.73.

White coat hypertension: to treat or not to treat?



- ▶ Patients with white coat hypertension or white coat effect => out-of-office blood pressure readings at or below goal => no therapy initiated or intensified, respectively, due to the risk of adverse effects from potentially inappropriate antihypertensive treatment
- ▶ Intensive lifestyle modifications and cardiovascular risk reduction, including monitoring and managing concomitant dyslipidemia and diabetes, if present.

!!! Improving the relationship between a patient and their health care provider can decrease the patient's anxiety, with the implication of decreasing the patient's likelihood of demonstrating white coat hypertension.

Thank you for your attention!

