


Hypertension Pearls

For the Diagnosis and Management
of Complex Hypertension

October 5, 2022

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Disclosures

- Funding: K23-HL133843, R01-HL153646, R01-HL157108, R01-HL155599, R01-HL157264, U01-HL160277, U24-DK060990, and R01-AG074989, and American Heart Association Bugher Award
- Disclosures: UpToDate (royalties)
- Off-Label Use: None

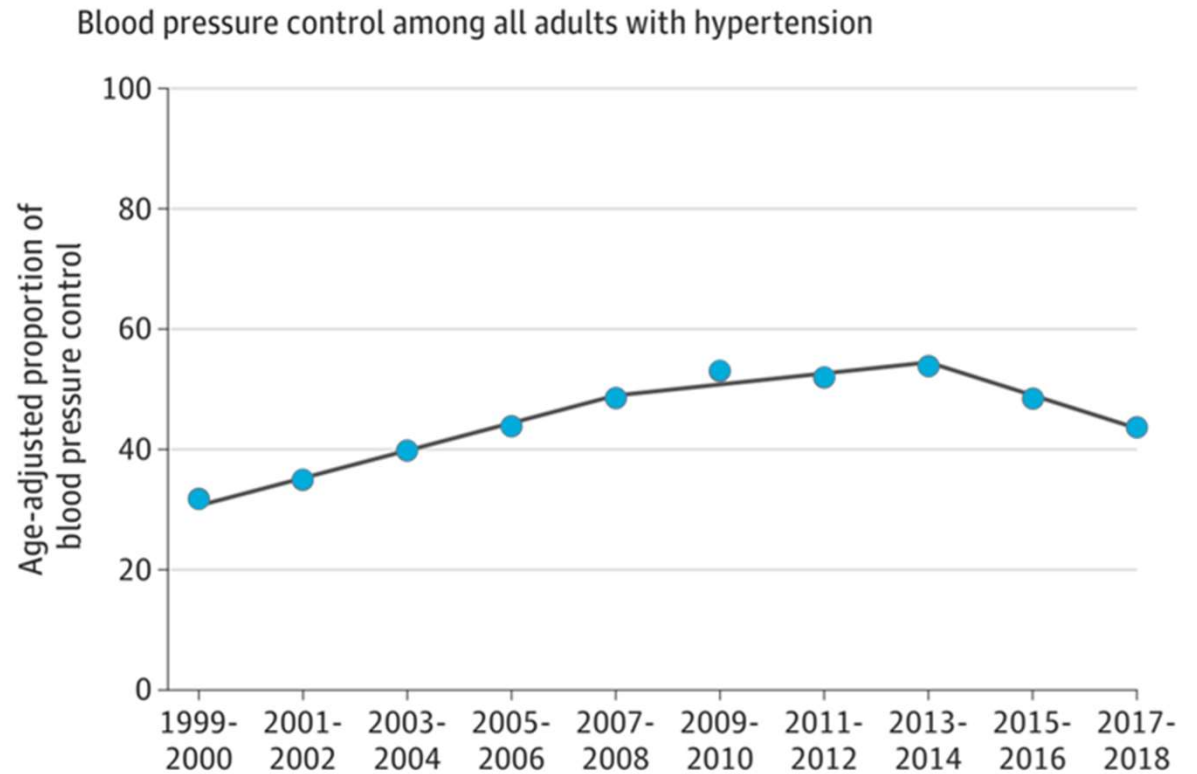
Objectives

- Reinforce key competencies in hypertension diagnosis and management based on most the recent guidelines and evidence
- Develop a practical approach to the evaluation and management of resistant hypertension

The power of inertia

Muntner P, et al. *JAMA*.
2020;324(12):1190-1200

4



- Current hypertension diagnostic thresholds
 - $\geq 130/80$ in all comers
 - *Except* $\geq 140/90$ in those with ASCVD risk $< 10\%$
- Current hypertension treatment thresholds
 - $< 130/80$ in all comers

2021 KDIGO Guidelines

• Recommendation 3.1.1

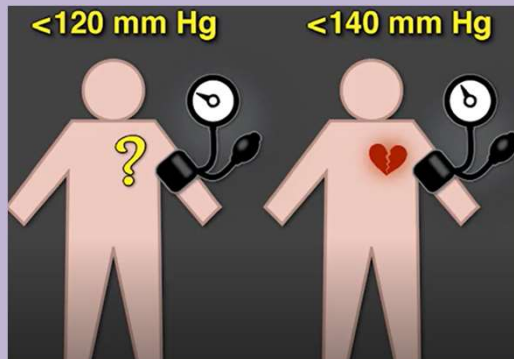
We suggest that adults with high BP and CKD be treated with a target systolic blood pressure (SBP) of < 120 mm Hg, when tolerated, using standardized office BP measurement (2B).

TABLE 23

BP Thresholds for and Goals of Pharmacological Therapy in Patients With Hypertension According to Clinical Conditions

Clinical Condition(s)	BP Threshold, mm Hg	BP Goal, mm Hg
General		
Clinical CVD or 10-year ASCVD risk $\geq 10\%$	$\geq 130/80$	$< 130/80$
No clinical CVD and 10-year ASCVD risk $< 10\%$	$\geq 140/90$	$< 130/80$
Older persons (≥ 65 years of age; noninstitutionalized, ambulatory, community-living adults)	≥ 130 (SBP)	< 130 (SBP)
Specific comorbidities		
Diabetes mellitus	$\geq 130/80$	$< 130/80$
Chronic kidney disease	$\geq 130/80$	$< 130/80$
Chronic kidney disease after renal transplantation	$\geq 130/80$	$< 130/80$
Heart failure	$\geq 130/80$	$< 130/80$
Stable ischemic heart disease	$\geq 130/80$	$< 130/80$
Secondary stroke prevention	$\geq 140/90$	$< 130/80$
Peripheral artery disease	$\geq 130/80$	$< 130/80$

SPRINT Trial

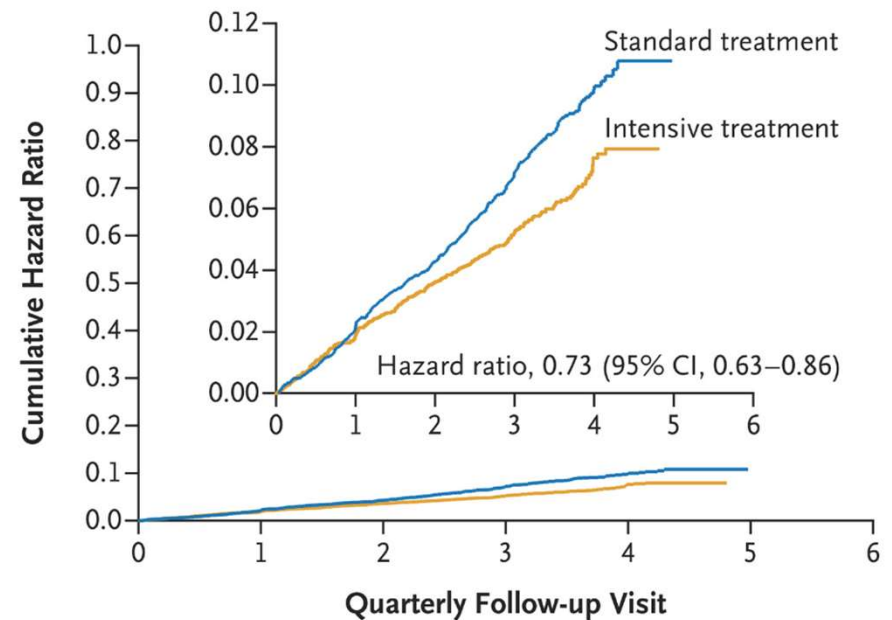


6

Final Report of a Trial of Intensive versus Standard Blood-Pressure Control

The SPRINT Research Group*

DOI: 10.1056/NEJMoa1901281



No. at Risk

Standard treatment	4683	4443	4247	2950	801	120
Intensive treatment	4678	4439	4275	3028	855	125

STEP Trial

Intensive Treatment
110 to <130 mm Hg

Target Systolic
Blood Pressure

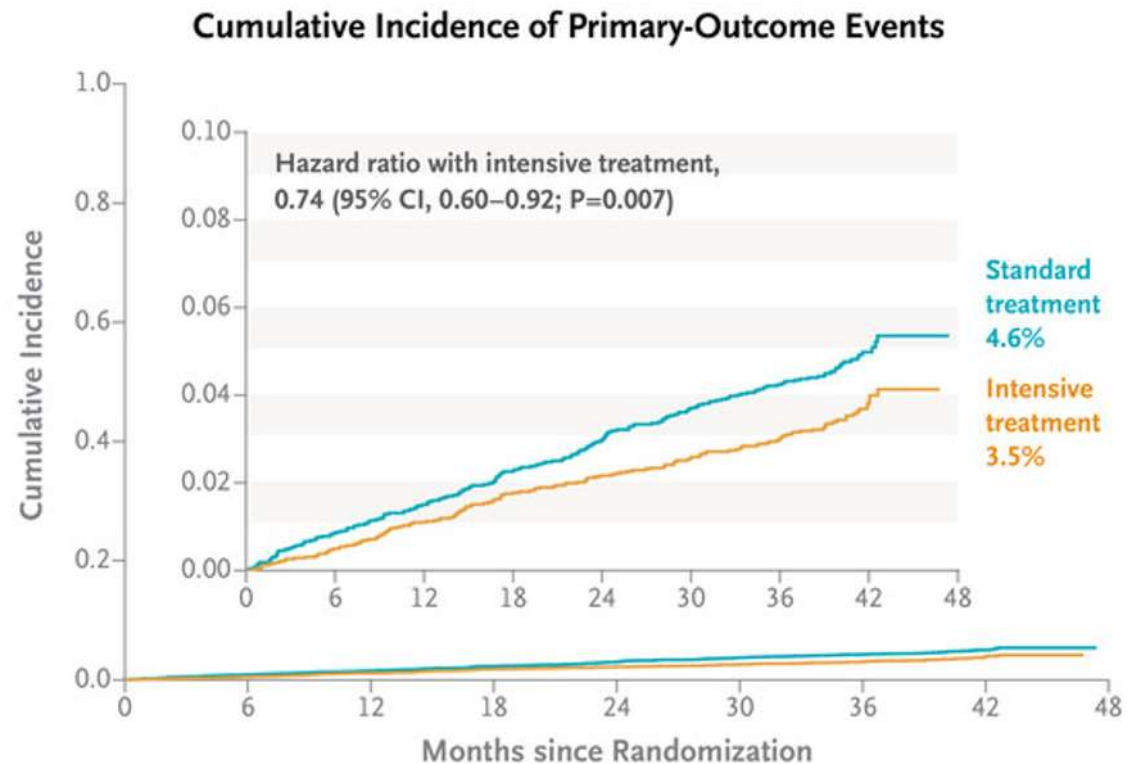
Standard Treatment
130 to <150 mm Hg



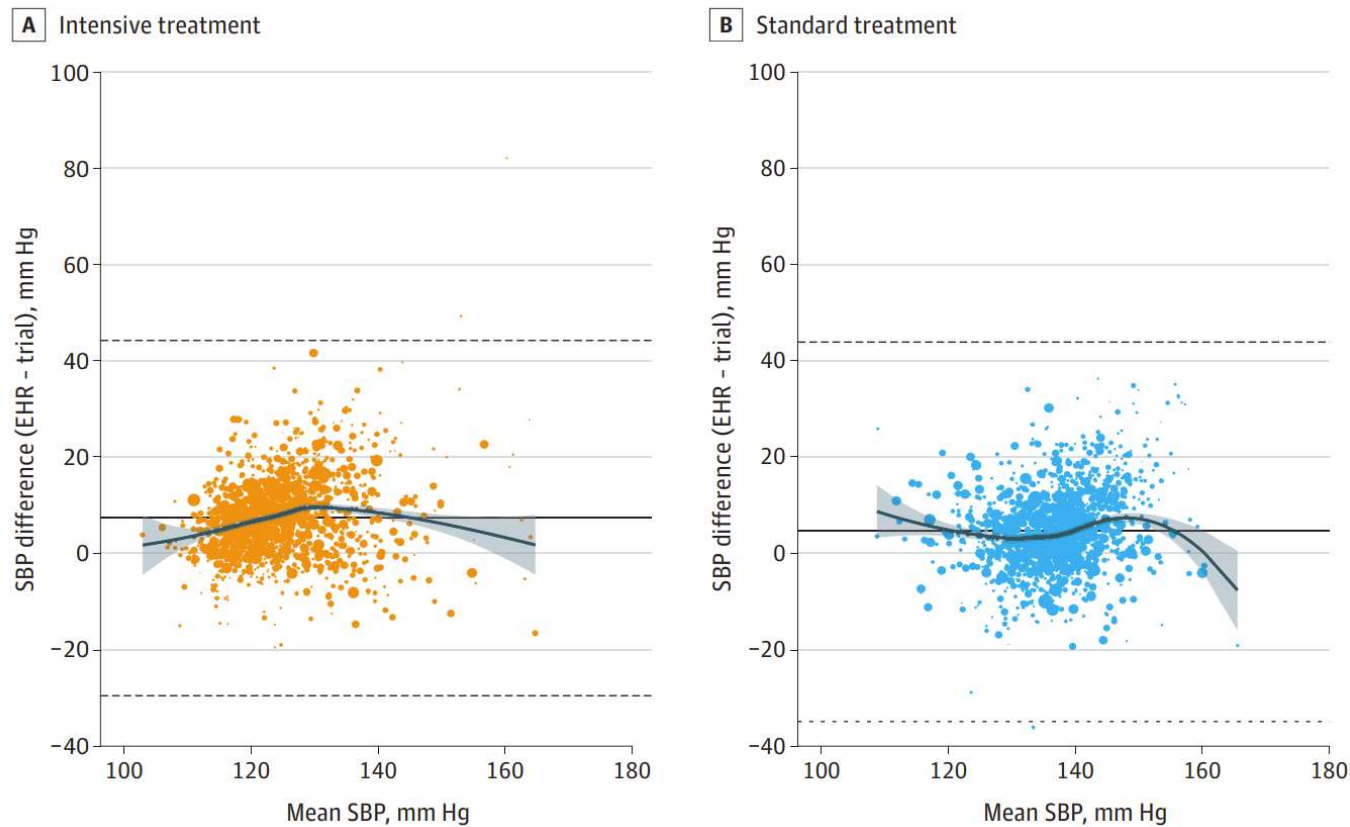
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Trial of Intensive Blood-Pressure Control in Older Patients with Hypertension

Zhang W et al. DOI:10.1056/NEJMoa2111437



Differences in clinic vs. research study blood pressure measurements: SPRINT



Drawz PE. *JAMA Intern Med.* 2020 Dec 1;180(12):1655-166

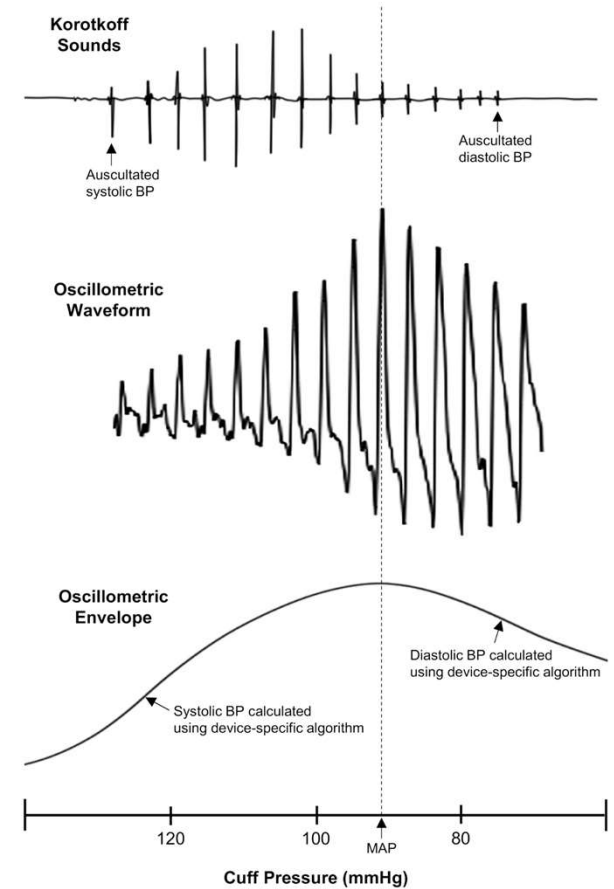
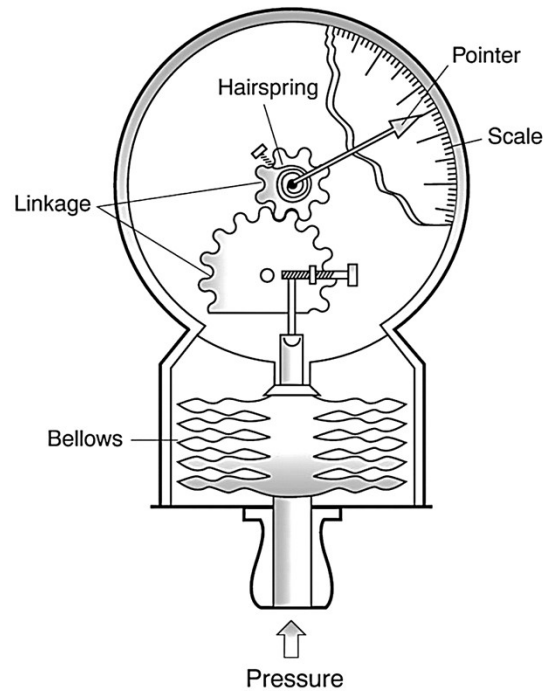
Table 9. Blood Pressure Variability⁵²

Factor	Systolic (mmHg)
Cuff too small	10–40 ↑
Cuff over clothing	10–40 ↑ or ↓
Back/feet unsupported	5–15 ↑
Legs crossed	5–8 ↑
Arm tense	15 ↑
Not resting 3 to 5 minutes	10–20 ↑
Anxiety/white coat hypertension	As much as 30 ↑
Patient talking	10–15 ↑
Labored breathing	5–8 ↑
Full bladder	10–15 ↑
Pain	10–30 ↑
Arm below or above heart level	10 ↑ or ↓ For every 1 cm above or below heart level, blood pressure varies by 0.8 mmHg.
Factor	Diastolic (mmHg)
Arm extended and unsupported	Diastolic ↑ 10%

Evolution of blood pressure measurement

History and Justification of a National Blood Pressure Measurement Validated Device Listing

7



Cohen JB, Brady TM. *Circulation* 2022;145(2):94-96

One solution to issues with in-office blood pressure measurement: *Automated office blood pressure*

- Considered “standardized blood pressure measurement” by multiple guidelines
- Oscillometric device
- Records multiple blood pressure readings (observed or unobserved) after a rest period with a single activation
 - Pre-programmed 5-minute rest, then 3 readings at 1-minute intervals
 - Can calculate an average of these readings



Out-of-office Blood pressure screening

12

Annals of Internal Medicine

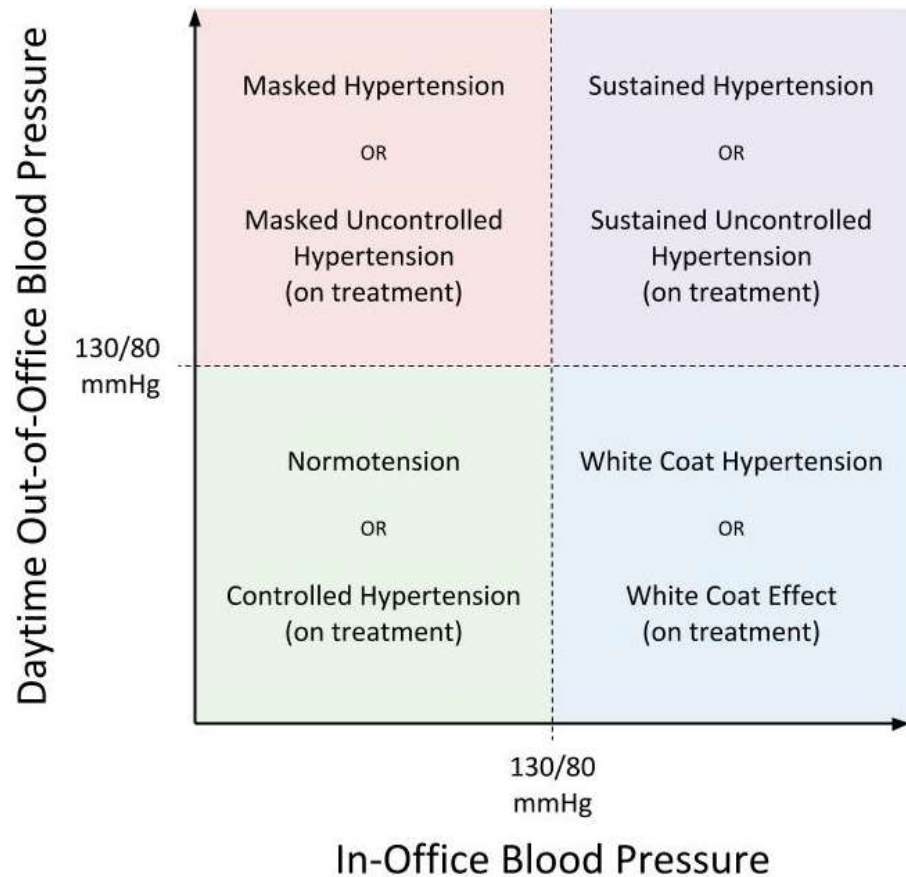


U.S. Preventive Services
TASK FORCE

www.USPreventiveServicesTaskForce.org

Population	Adults aged ≥ 18 y without known hypertension
Recommendation	Screen for high blood pressure; obtain measurements outside of the clinical setting for diagnostic confirmation. Grade: A

Siu AL et al. *Ann Intern Med.* 2015;163:778-786

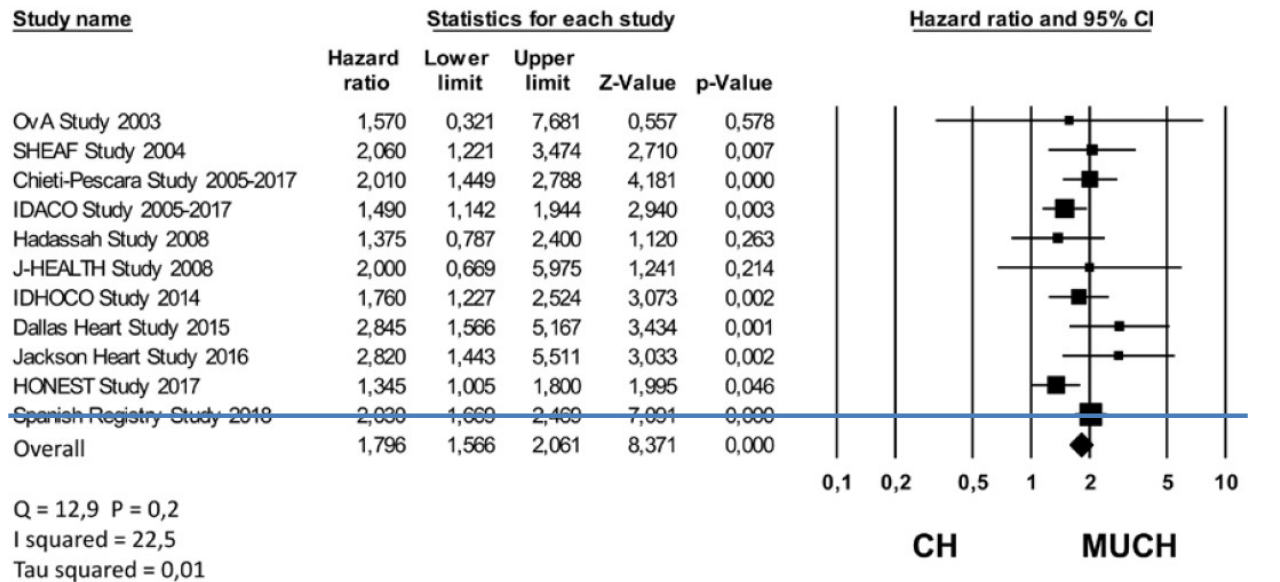


Many of the limitations of in-office BP are mitigated by out-of-office BP measurement

Clinic	HBPM	Daytime ABPM	Nighttime ABPM	24-Hour ABPM
120/80	120/80	120/80	100/65	115/75
130/80	130/80	130/80	110/65	125/75
140/90	135/85	135/85	120/70	130/80
160/100	145/90	145/90	140/85	145/90

Cardiovascular risk of masked hypertension

14

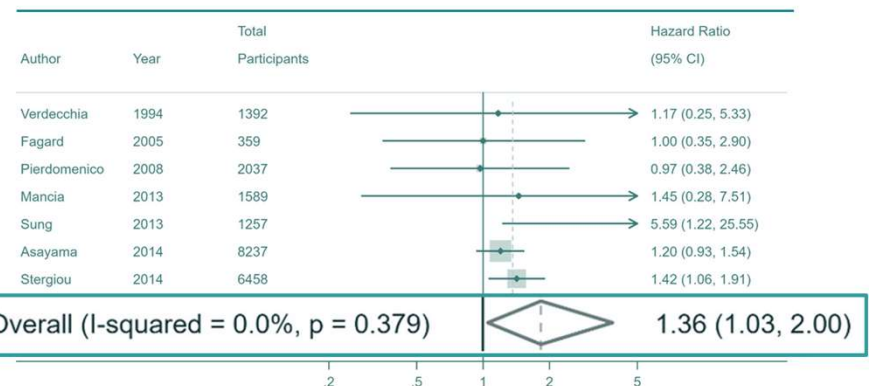


Meta Analysis

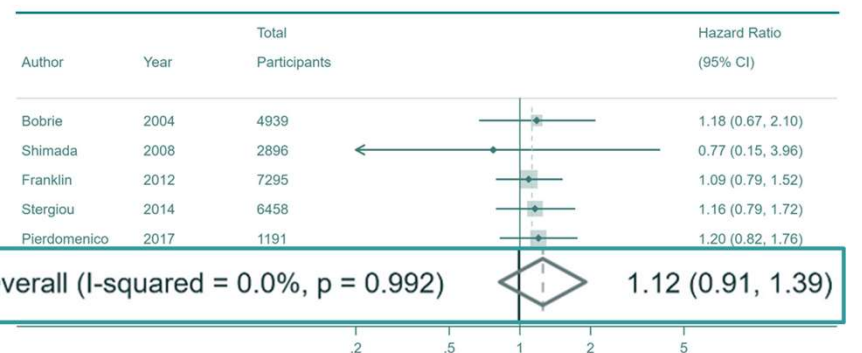
Cardiovascular risk of white coat hypertension

- Risk is only present among untreated patients
- Risk is substantially lower than sustained or masked hypertension
- Patients with white coat hypertension
 - Should be treated based on their out-of-office BP readings
 - Should be monitored closely with out-of-office BP monitoring due to a high risk of transitioning to sustained hypertension

Cardiovascular event risk in WCH and WCE.



Cardiovascular event risk in WCH and WCE.



FDA 510(k) device clearance



- The FDA does not "approve" most devices for patient use, they "clear" them
- Clearance requires demonstrating "equivalence" to an existing device
 - There are no enforced guidelines on what "equivalence" means
 - Up to the manufacturer to determine
- **The 510(k) process does not require demonstration of accuracy**
- The FDA has no enforcement division to prohibit selling invalid devices

“From about 3000 cuff-based BP measuring devices on the market today, less than 15% have published evidence on accuracy performance.”

Cuffless Technology

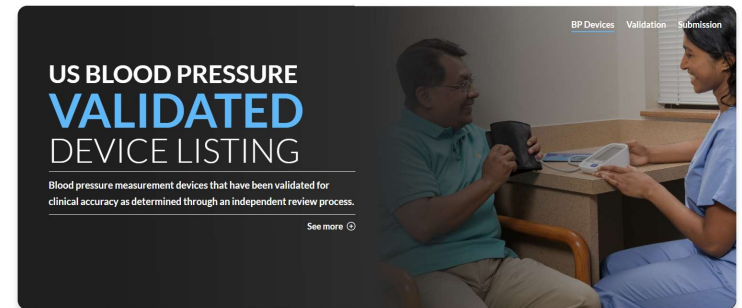
Caution : FDA 510(k) cleared, NOT recommended for clinical use



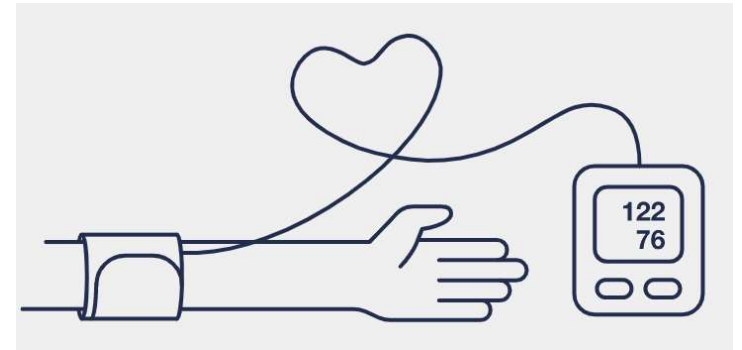
Validated device listings

19

www.validatebp.org



www.stridebp.org



Cohen JB et al. *Hypertension* 2019; 73:258-264
Cohen JB, Brady TM. *Circulation* 2022;145(2):94-96

Evaluation and Management of Patients with Difficult to Control Hypertension

Treatment Resistant Hypertension

- Hypertension affects 46% of the adult population in the United States
- Approximately 20% of patients taking antihypertensive medications appear to have treatment-resistant hypertension
 - BP not adequately controlled with 3 antihypertensive medications including a diuretic or requires a minimum of 4 antihypertensive medications to achieve adequate control
- Apparent treatment-resistant hypertension is associated with a markedly higher risk of cardiovascular mortality and all-cause mortality, independent of BP control

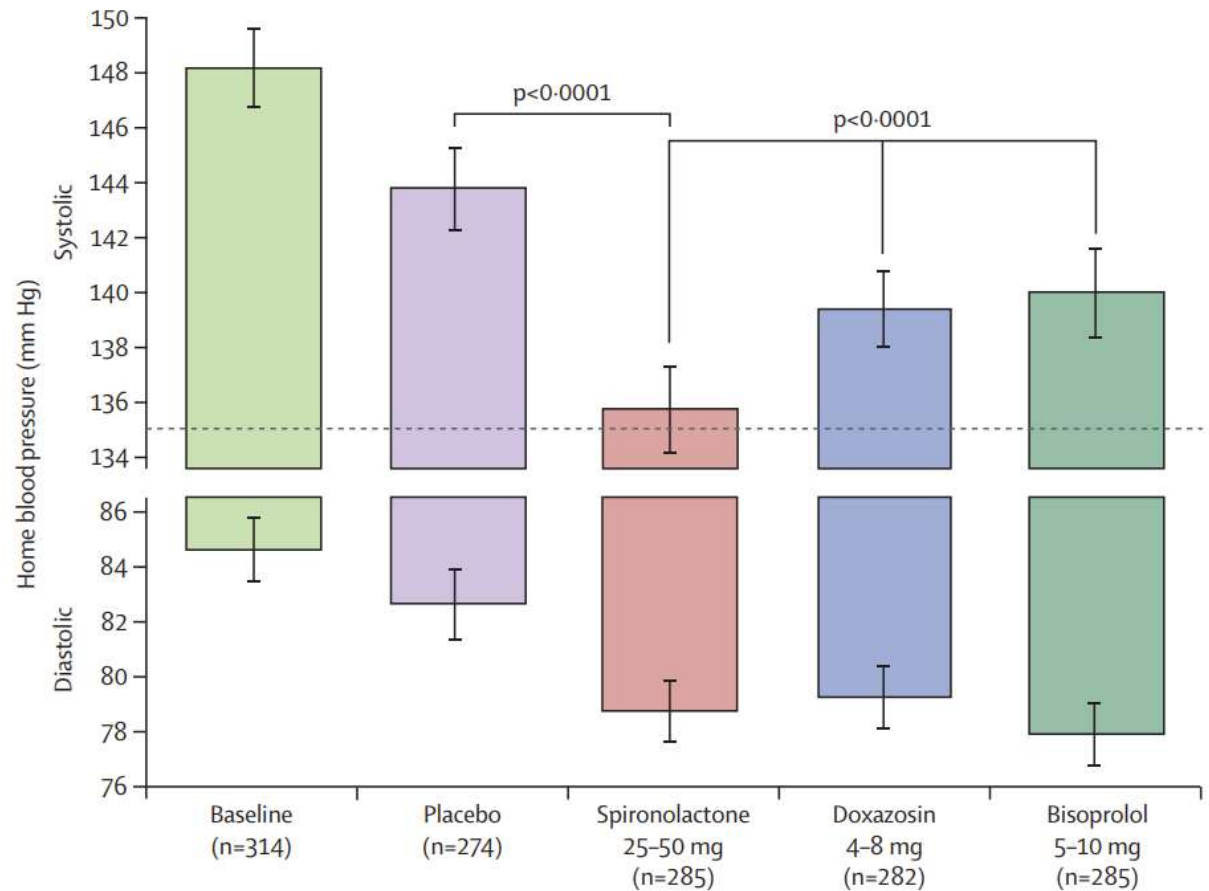
Management of resistant hypertension

- 1) Highest tolerated dose of first line agents
 - a) ACEIs/ARBs, CCBs, thiazide/thiazide-like diuretics
- 2) Maximize diuretic therapy
- 3) Add a mineralocorticoid receptor antagonist or potassium-sparing diuretic
 - a) Do this BEFORE adding a beta-blocker unless there is a specific indication
- 4) Add other agents with different/complimentary mechanisms of action

Management of Treatment Resistant Hypertension

High quality evidence supports the use of mineralocorticoid receptor antagonist (MRA) therapy for the management of treatment-resistant hypertension

23



Williams B, et al. *Lancet* 2015; 386(10008): 2059-68
Chen C, et al. *Medicine* 2020; 99(34):e21694

Adding fourth through n_{th} line therapy

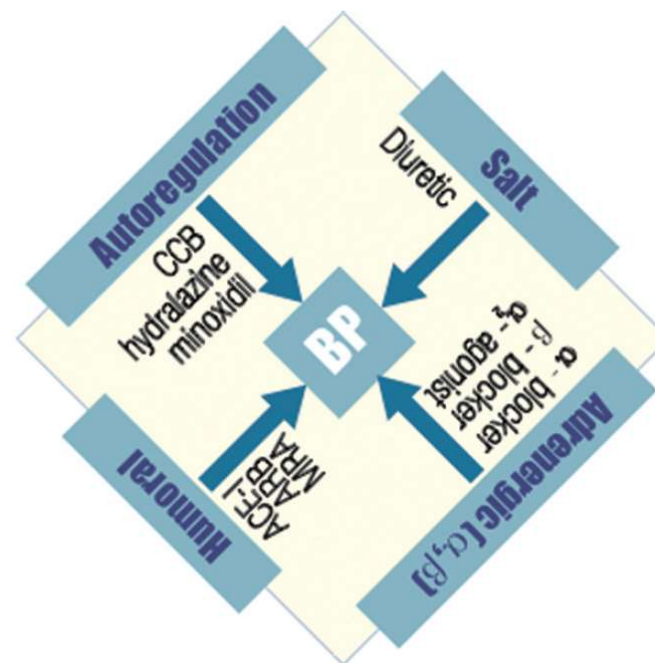
- Beta-blockers should NOT be used as first- (or even 4th) line antihypertensive therapy unless there is a specific indication for their use

Table 3. Hazard Ratios of Incident CVD by Time-Updated Antihypertensive Class

Outcome	ACE inhibitor/ARB	β -Blocker	CCB*
		HR (95% CI)	HR (95% CI)
Incident CVD or death	Ref	1.71 (1.42–2.05)	0.88 (0.72–1.08)
Incident CVD	Ref	1.76 (1.45–2.14)	0.85 (0.67–1.08)
Incident HF	Ref	1.47 (1.12–1.92)	0.73 (0.52–1.03)

Adding fourth through n_{th} line therapy

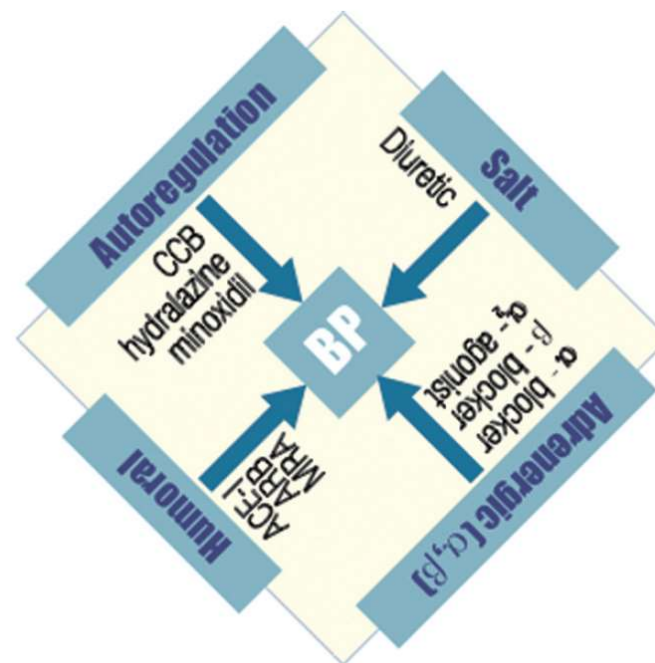
- Aim for simplicity
 - Things to **consider**:
 - Fixed-dose combinations
 - Long-acting medications (e.g., chlorthalidone, torsemide; if absolutely needed, consider clonidine patch or guanfacine over clonidine PO)
- Only use minoxidil as a last resort; must be given with a loop diuretic



<https://doi.org/10.2215/CJN.04120511>

Adding fourth through n_{th} line therapy

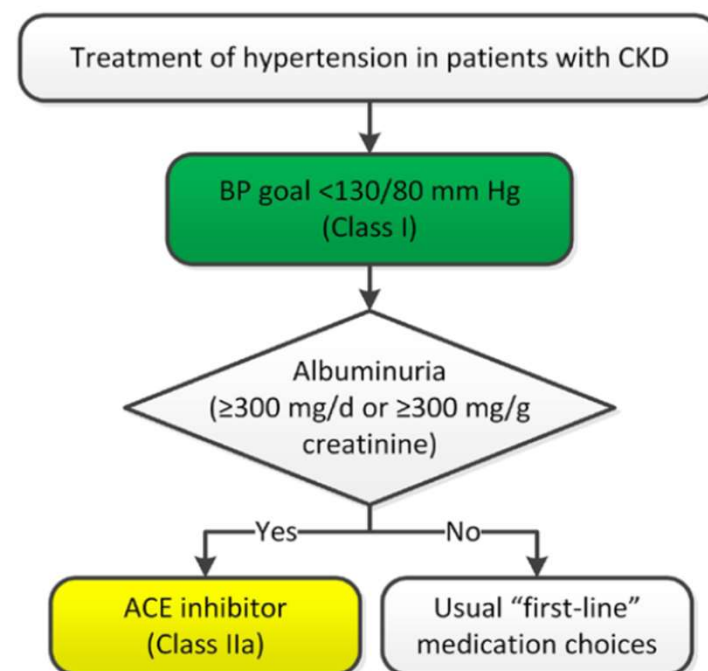
- Aim for simplicity
 - Things to **avoid**:
 - Short-acting medications like hydralazine and PO clonidine
 - Less frequent dosing of short-acting medications (e.g. QD furosemide, BID hydralazine)
 - Once-daily short-acting diuretics can increase sodium avidity later in the day
 - Even “appropriate” dosing of and adherence to hydralazine and clonidine can exacerbate labile hypertension due to short duration of action and rebound effects



<https://doi.org/10.2215/CJN.04120511>

Additional considerations in CKD


- Optimize diuretic therapy
 - Hypertension is often more volume-mediated in CKD than in the general population
 - Long-acting diuretics like chlorthalidone and torsemide
 - Loop AND thiazide/thiazide-like diuretic or MRA
 - Kaliuresis is a great way to help patients better-tolerate ACE-Is/ARBs
- MRAs and SGLT-2 inhibitors have anti-proteinuric properties



Summary of challenges in hypertension management

- Therapeutic inertia is a major driver of inadequate management of hypertension and low (and declining) rates of blood pressure control in the US
- Greater trust in the accuracy of our blood pressure readings and use of out-of-office blood pressure monitoring can help to overcome inertia
 - **Accurate blood pressure measurement with validated devices is critical**
- We as clinicians need to do a better job of implementing best evidence
 - β -blockers should be considered 5th-line therapy for hypertension unless there is another indication
 - Avoid short-acting PO medications whenever possible

Thank you!

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