Cracking the Pressure Code: Evidence –Based Hypertension Care

Smriti Ohri MD, FAAFP
Associate Professor
Department of Family Medicine
Oregon Health & Science University

Feb 12, 2026

Objectives

1. Apply evidence-based strategies to confirm the diagnosis of **primary hypertension** using office, home, and ambulatory blood pressure measurements
2. Individualize BP treatment thresholds and targets based on CV risk, comorbidities, and patient preferences
3. Select and titrate first-line antihypertensive therapies using a practical, stepwise approach appropriate for primary care
4. Incorporate lifestyle interventions and adherence strategies as foundational components of long-term HTN management

Screening

U.S. Preventive Services TASK FORCE

Hypertension in Adults: Screening

April 27, 2021

	Grade
Screen for HTN (≥ 18 y/o) with office BP measurement and obtain BP outside clinical setting for diagnostic confirmation before starting treatment	A

High Blood Pressure in Children and Adolescents: Screening

November 10, 2020

	Grade
Current evidence insufficient to assess the balance of benefits and harms of screening for high BP in children and adolescents	I

Screening

American Academy of Pediatrics
DEDICATED TO THE HEALTH OF ALL CHILDREN®

FROM THE AMERICAN ACADEMY OF PEDIATRICS | CLINICAL PRACTICE GUIDELINE | SEPTEMBER 01 2017

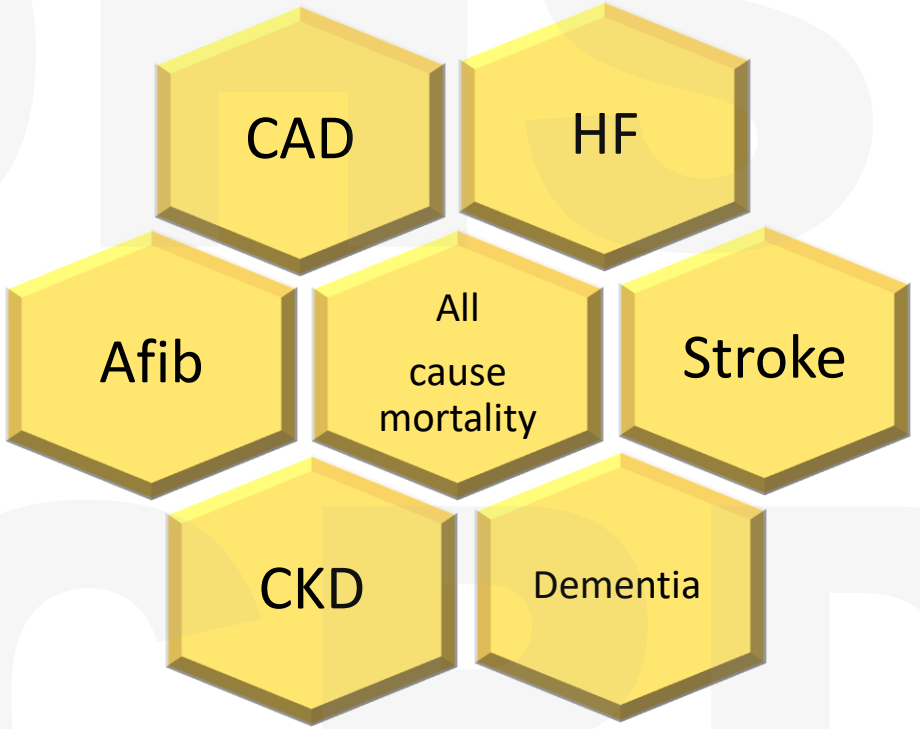
Clinical Practice Guideline for Screening and Management of High Blood Pressure in Children and Adolescents

- Measure BP annually in children and adolescents ≥3 y/o
- Check BP in all children and adolescents ≥3 y/o at every health care encounter if they:
  - have obesity, renal disease, DM, h/o aortic arch obstruction or coarctation
  - are taking medications that can increase BP

Evidence Quality: C, SOR: Moderate

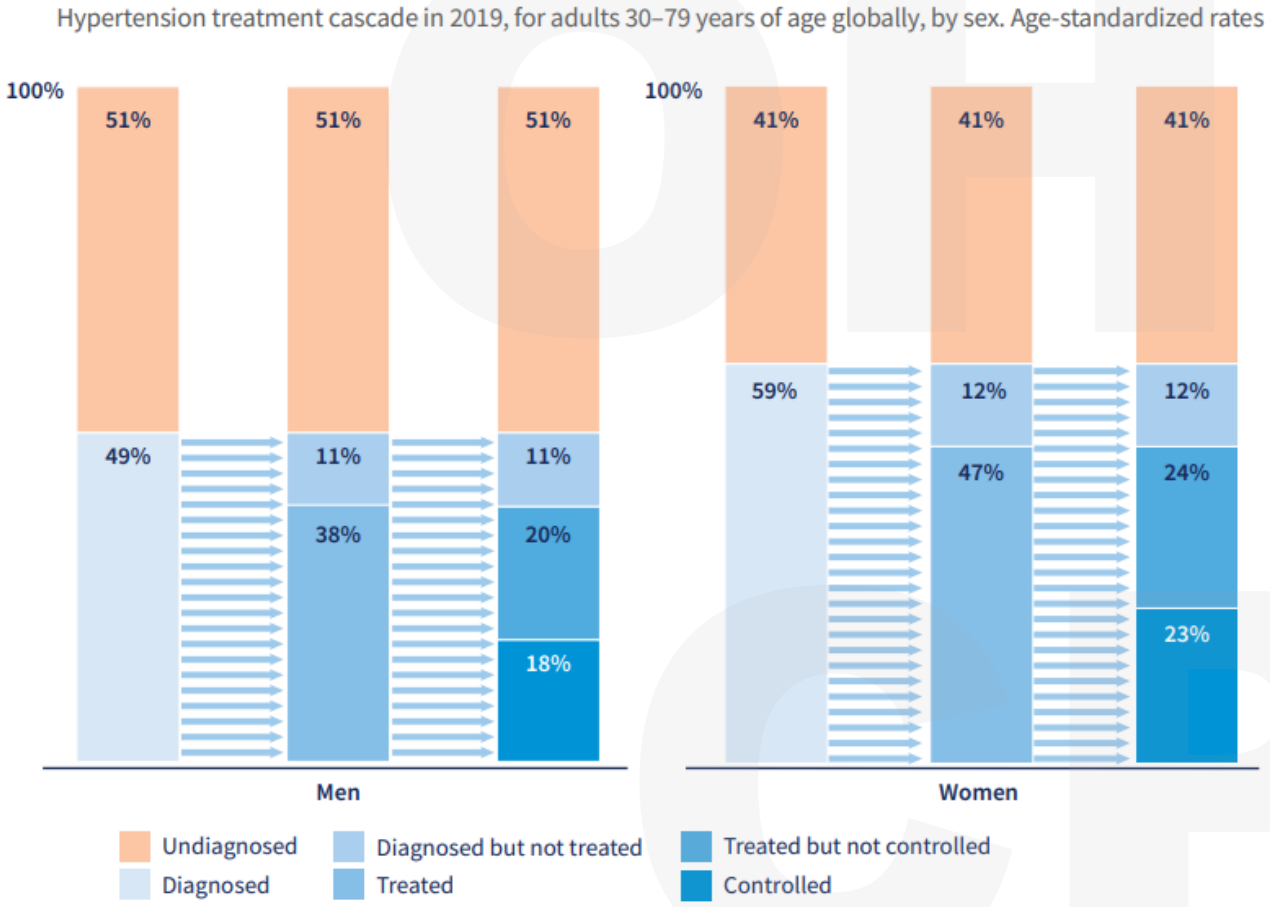
Why do we care?

- HTN- most prevalent and modifiable risk factor for development of CVD



- Overall prevalence from 2017 to 2020: BP ≥130/80 or receiving antihypertensive therapy among adults in the US= 46.7%

Global problem



Adults 30–79 y/o with HTN

54%
Diagnosed

42%
Treated

21%
Controlled

2023 WHO Global report on hypertension: the race against a silent killer

Definition

	SBP mmHg		DBP mmHg
Category			
Normal	<120	and	<80
Elevated	120-129	and	<80
Hypertension			
Stage 1	130-139	or	80-89
Stage 2	≥140	or	≥90

Treatment Goal < 130/80

Initiate Treatment

FROM THE AMERICAN ACADEMY OF PEDIATRICS | CLINICAL PRACTICE GUIDELINE | SEPTEMBER 01 2017

Clinical Practice Guideline for Screening and Management of High Blood Pressure in Children and Adolescents

HTN (child or adolescent): confirmed BP readings ≥95th%ile at 3 different visits

Treatment goal: reduction in SBP and DBP to <90th%ile.
Adolescents ≥ 13y/o: <130/80

Why these numbers?

Age-specific relevance of usual blood pressure to vascular mortality: a meta-analysis of individual data for one million adults in 61 prospective studies

Lancet 2002; 360: 1903–13

Each difference of 20/10 → doubles the risk of death from stroke, heart disease, or other vascular disease

Blood pressure and incidence of twelve cardiovascular diseases: lifetime risks, healthy life-years lost, and age-specific associations in 1·25 million people

Lancet 2014; 383: 1899–911

Higher BP (>115/75) associated with increased risk of CVD incidence and angina, MI, HF, stroke, PAD, and AAA, each evaluated separately

Association of Normal Systolic Blood Pressure Level With Cardiovascular Disease in the Absence of Risk Factors

JAMA Cardiol. 2020;5(9):1011-1018.

- Association of SBP with coronary artery calcium and incident ASCVD in persons without HTN or other traditional ASCVD risk factors.
- 1457 participants, SBP 90 -129.
  - Beginning with SBP of 90, stepwise increase in prevalence of traditional ASCVD, coronary artery calcium, and risk of ASCVD
  - For every 10-mm Hg increase in SBP, there was a 53% higher risk for ASCVD.

Treatment thresholds

- All guidelines recommend SBP< 140
- Variation exists for lower targets

AAFP *(US)*	<140 in most adults (consider <135 to prevent MI)
ESH *(Europe)*	<140; if well tolerated, consider <130
ISH *(Global)*	Target 20/10 reduction (ideally <140/90; optimal <130/80, if <65y/o)
LASH *(Latin America)*	Minimum <140, most <130
WHO *(Global)*	<140, if high CVD risk <130
Chinese societies *(China)*	<130
JSH *(Japan)*	<130
ESC *(Europe)*	120-129, aim for <120
AHA/ACC *(US)*	<130 (preferably <120)
Australia Heart Foundation	<140, if high CV risk <120
Hypertension Canada	<140, if high CV risk <120

SPRINT Trial

9361 persons with SBP ≥130 + increased CV risk, **No DM**

Intensive Treatment:
Target SBP <120

Mean SBP= 121.4

Achieved with 2.8 meds

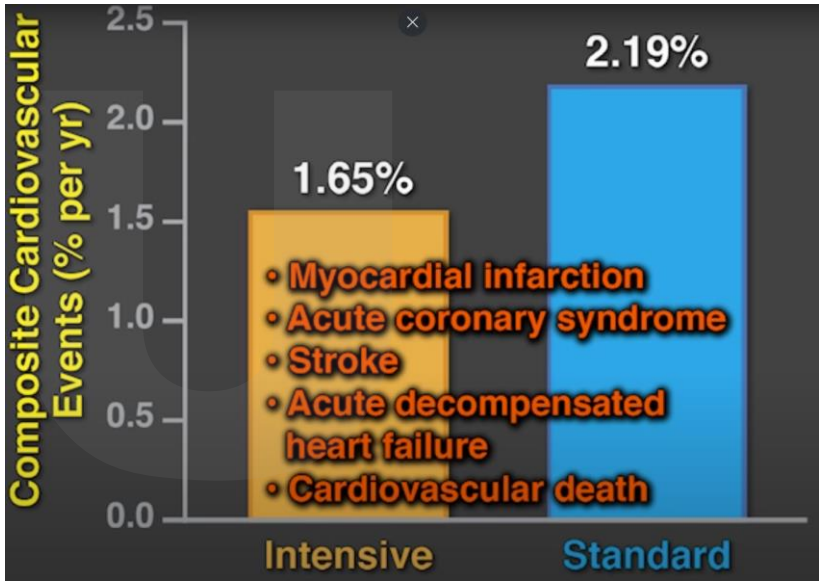
Standard Treatment:
Target SBP <140

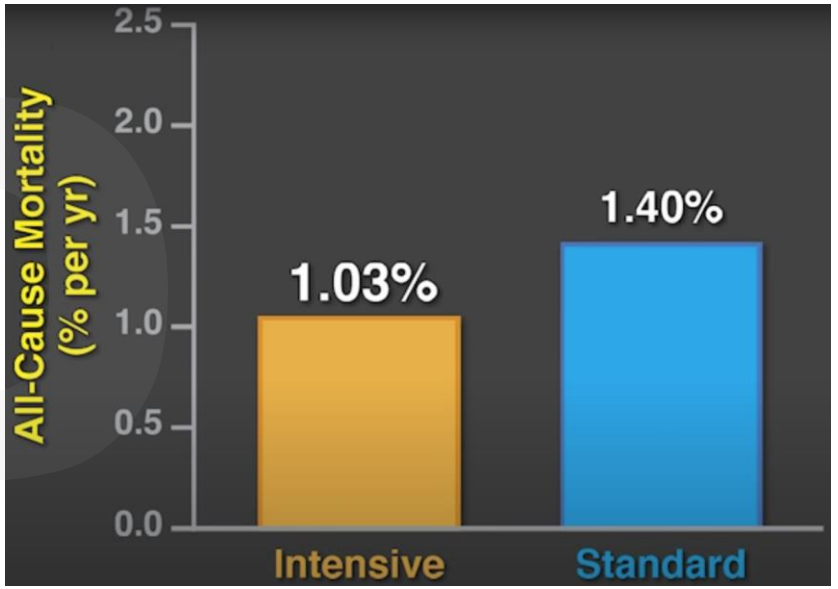
Mean SBP= 136.2

Achieved with 1.8 meds

Adverse events:
- ✓ Hypotension
- ✓ Syncope
- ✓ Electrolyte abnormalities
- ✓ AKI or failure
- **X** Risk of injurious falls

SPRINT participants ≥ 75 yrs (mean 79.9 yrs), f/u = 3.14 yrs
Intensive vs Standard treatment
- ➢ Lower rate of primary composite outcome and all-cause mortality in intensive group
- ➢ No difference in rate of serious AE (including injurious falls) (HR= 0.99 [95%CI, 0.89-1.11).





JAMA. 2016;315(24):2673-2682.

N Engl J Med 2015;373:2103-16

ESPRIT Trial

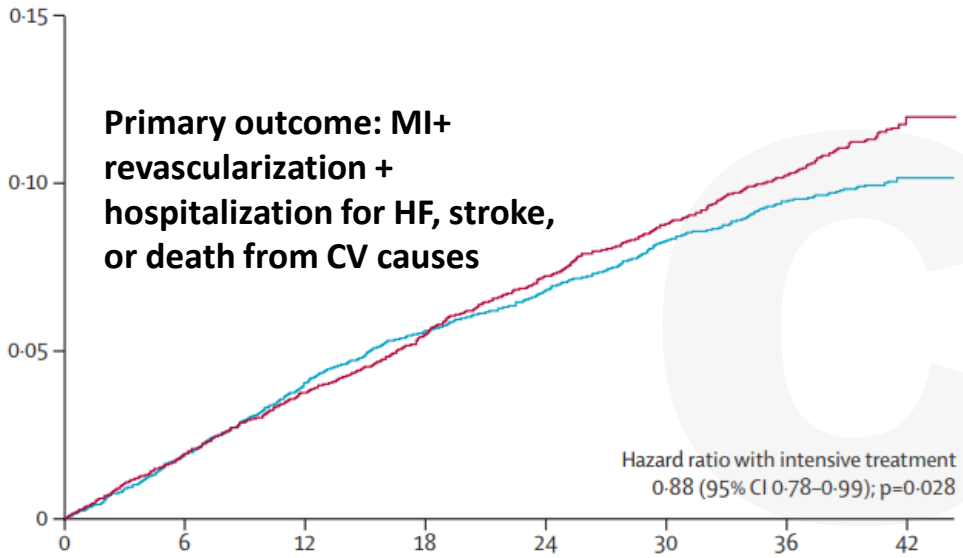
11255 patients with high CV risk (included with diabetes (4359) and with previous stroke (3022) [unlike SPRINT trial]

Intensive Treatment: Target SBP <120

Mean SBP= 119.1

Standard Treatment: Target SBP <140

Mean SBP= 134.8



Lancet 2024; 404: 245–55

BPROAD Trial

12821 patients with T2D + high CV risk

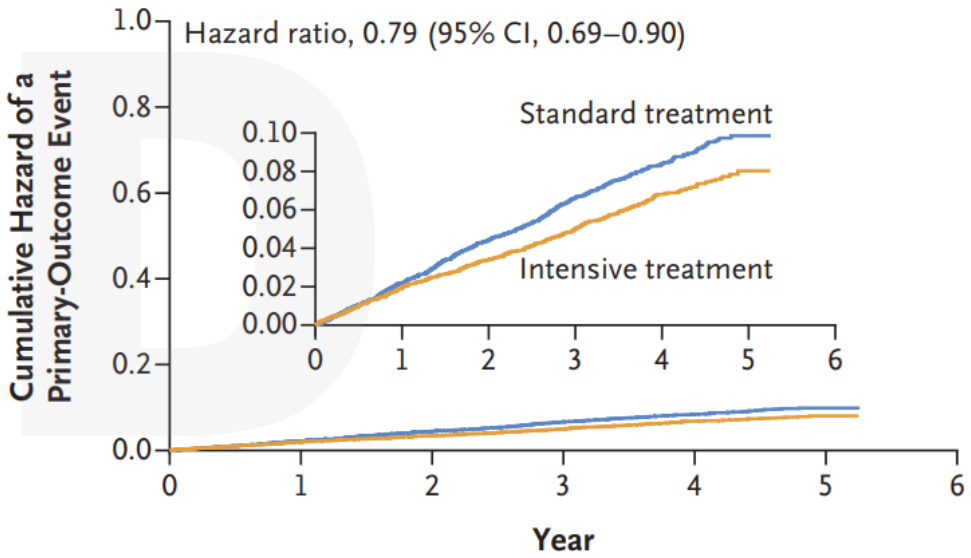
Intensive Treatment: Target SBP <120

Mean SBP= 121.6

Standard Treatment: Target SBP <140

Mean SBP= 133.2

Primary outcome: Nonfatal stroke +nonfatal MI + treatment or hospitalization for HF, or death from CV causes

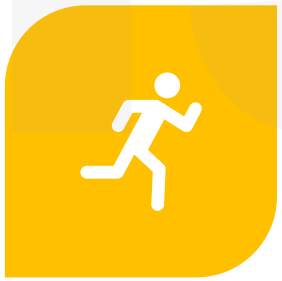


N Engl J Med 2025;392:1155-67.

Approach to Hypertension

CONFIRM THE DIAGNOSIS

ASSESS GLOBAL CV RISK



START LIFESTYLE THERAPY FOR ALL

INITIATE AND TITRATE MEDICATIONS DELIBERATELY

REASSESS, INTENSIFY, AND INDIVIDUALIZE

BP measurement

Office Blood Pressure Measurement

1. The patient should avoid caffeine, exercise, and smoking for at least 30 minutes before measurement. Ensure the patient has emptied their bladder.
2. Use a blood pressure device that has been validated for accuracy (validatebp.org).
3. Use the correct cuff size on a bare arm.
4. The patient's arm should be supported at heart level.
5. Have the patient relax, sitting in a chair (feet on floor, legs uncrossed, and back supported) for more than 5 minutes of rest.
6. Neither the patient nor the clinician should talk during the rest period or during the measurement. The patient should not be using their phone.
7. Blood pressure measurement should be taken in a temperature-controlled room.
8. Take 2 or more blood pressure measurements at least 1 minute apart. Average the readings, and provide the patient their blood pressure readings both verbally and in writing.

Diagnosis

Suspected HTN: based on clinic BP reading

Diagnosis based on out of office measurement by either ambulatory BP monitoring (ABPM) or home BP monitoring (HBPM)

ABPM

- Systematic reviews- more strongly predicts long-term CVD outcomes than office BP
- Provides distinctive information on nighttime BP

HBPM (preferred)

- Evidence - more strongly predicts CVD outcomes than office BP
- Evidence
  - ✓ HBPM alone- modest reductions in office SBP and DBP at 6 months and 1 year as compared with usual care
  - ✓ More clinically meaningful reductions and improved BP control at 6 months and 1 year noted: HBPM+ cointerventions (education, telehealth and medication titration) compared with usual care.
- More reproducible and more practical than ABPM

ABPM & HBPM vs Office BP

Office, mm Hg	HBPM, mm Hg	Daytime ABPM, mm Hg	Nighttime ABPM, mm Hg	24-Hour ABPM, mm Hg
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

https://www.validatebp.org/devices

A public health service supported by AMA AMERICAN MEDICAL ASSOCIATION

Validated devices meet the highest standards for accuracy

The AMA receives no funding from device manufacturers or third parties for developing the VDL Criteria or process.
This list is intended for use as a reference. *Devices listed cannot be purchased on this website.*

Name
$, $$, $$$

HBPM

https://targetbp.org/tools_downloads/how-to-accurately-measure-blood-pressure-2/

How to measure your blood pressure at home

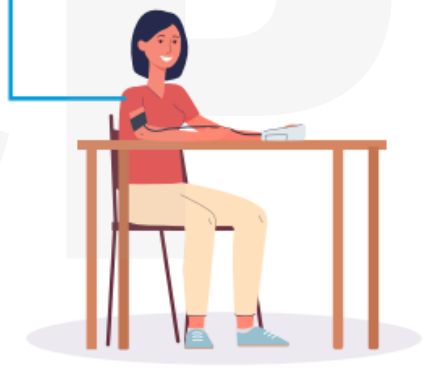
Follow these steps to get an accurate blood pressure measurement:

1. Prepare

- Avoid these things for 30 minutes:
  - Eating
  - Smoking
  - Exercise
  - Caffeine, such as coffee and some teas and sodas
- Measure before taking your blood pressure medicine
- Use the bathroom to empty your bladder, if needed
- Find a quiet space to sit with no distractions

2. Position

- Sit in a chair that supports your back
- Sit next to a flat surface, like a desk or table
- Put the cuff above your elbow on your upper arm, on your skin and not over clothing
- Rest your arm on the flat surface at mid-chest or heart level with your palm up
- Keep both feet flat on the floor with your legs uncrossed



3. Measure

- Rest quietly for 5 minutes in your seated position
- Keep your arm and body relaxed
- Sit quietly without:
  - Talking or conversations
  - TV, phone, or other electronic devices
- Take 2 measurements, waiting 1 minute in between. Do this twice a day, once in the morning and once at night, for 7 days
- Write down each of your measurements as instructed by your doctor or care team
- Share your measurements with your doctor or care team as instructed

Note: If you are using a wrist cuff, talk to your doctor or care team about how to position your arm.

White Coat vs Masked HTN

White Coat HTN

- Elevated BP only in the office (normal HBPM or ABPM)
- Evidence
  - Associated with no-low risk of increased CVD as compared to normotension (except in older adults with high baseline CVD risk)
  - **Not** associated with an increased risk of CVD and mortality as compared to controlled HTN on meds

Masked HTN

- Normal BP in the office but elevated out of office BP (HBPM or ABPM)
- Evidence:
  - Associated with an increased risk of CVD as compared to normotension (similar to patients with HTN)
  - Associated with increased risk of CVD and mortality as compared to controlled HTN on meds

Should we intensify regimen in these patients ?

Case #1

- 58 y/o woman sees you for f/u after high BP in previous visit. PMH: T2D, Obesity (BMI= 32). Meds: metformin 1,000 mg BID and atorvastatin 20 mg daily. Denies smoking and alcohol. BP= 147/88. Labs: GFR= 85 (normal ≥ 60), fasting glu= 110 (normal 70-140), HbA1C= 7.2% (normal 4.0–5.6), LDL 110 (goal <100). You discuss her CV risk profile (calculate her PREVENT score) and educate on benefits of controlling her BP.

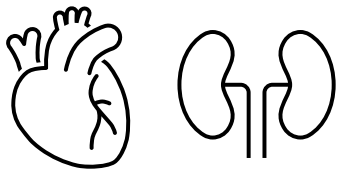
Which of the following is the best next step in addition to lifestyle modifications (weight loss, increased physical activity and low sodium diet)?

A. Initiate monotherapy with benazepril 20 mg once daily
B. Initiate monotherapy with HCTZ 25 mg once daily
C. Initiate monotherapy with atenolol 25mg once daily
❤ Initiate combination therapy with benazepril 20 mg and amlodipine 5 mg once daily (in a single-pill formulation)

Lifestyle modification of foundational

Weight loss	• Goal of at least 5% body weight • Loss of 10kg reduced SBP by 5-20
DASH Diet	• Rich in fruits, vegetables, whole grains, low fat dairy products, with reduction of saturated and total fat
Reduce salt intake	• Optimal <2300 mg/d, ideal <1500 mg/d • Consider potassium- based salt substitutes (except in CKD or use of K sparing meds)
Reduce/no alcohol intake	• Goal of abstinence, or at least reduce to ≤1/day for women and ≤2/day for men
Increase exercise	• Aerobic and resistance exercise (≥150 minutes of moderate physical activity per week and resistance exercise ≥2 days per week)
Stress reduction	• Meditation, yoga, breathing exercises- added in 2025 guidelines

Treatment



10yr CVD risk ≥7.5%

	SBP mmHg		DBP mmHg
Category			
Normal	<120	and	<80
Elevated	120-129	and	<80
Hypertension			
Stage 1	130-139	or	80-89
Stage 2	≥140	or	≥90

Treatment Goal < 130/80

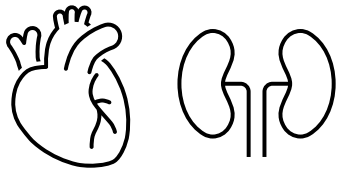
Initiate Treatment

ASCVD risk score vs PREVENT

	PCE (ASCVD risk score)	PREVENT
Data derived from/ years	20338 White adults and 4288 Black adults/ 1960s-1990s	3.2 million individuals, including diverse sample of racial and ethnic groups/1992 -2022
Estimates	Risk of ASCVD (MI, Stroke)	Risk of total CVD (MI, stroke and HF)
Applicable to	Adults 40-79 years, not on statin therapy	Adults 30- 79 years, includes statin therapy as a predictor
CKD	NA	Incorporates kidney function
SDoH	NA	Includes integration of place-based social risk (social deprivation index [SDI])

PCE= Pooled Cohort Equation
PREVENT= Predicting Risk of CVD Events

Treatment



	SBP mmHg		DBP mmHg
Category			
Normal	<120	and	<80
Elevated	120-129	and	<80
Hypertension			
Stage 1	130-139	or	80-89
Stage 2	≥140	or	≥90

10yr CVD risk ≥7.5%

Start with single first-line antihypertensive

Titrate dose → Addition of other agents as needed

Treatment

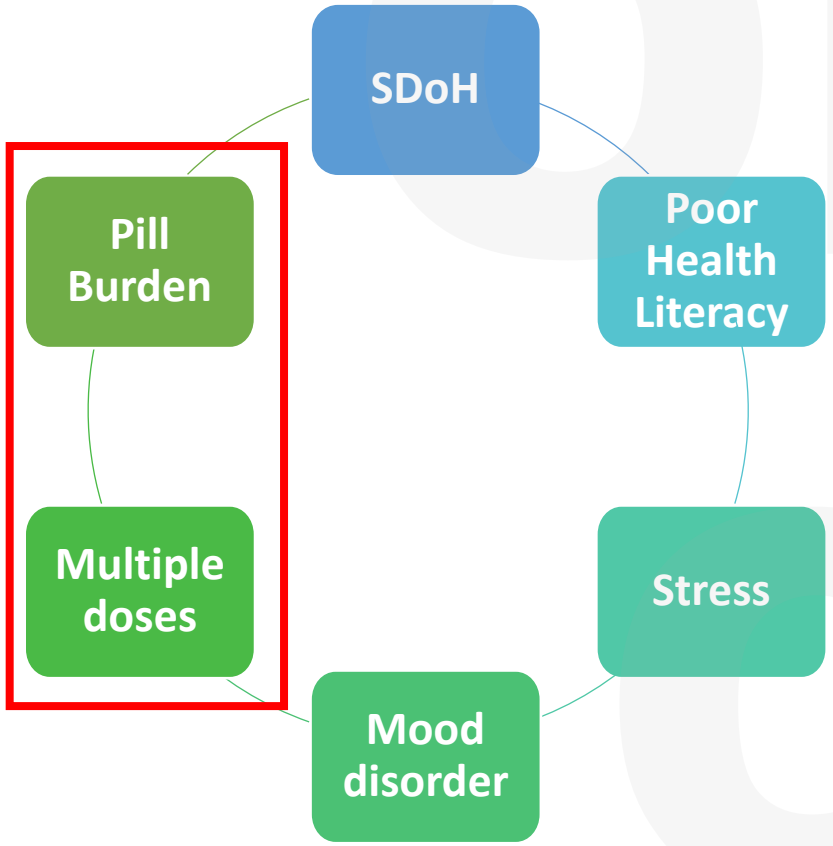
	SBP mmHg		DBP mmHg
Category			
Normal	<120	and	<80
Elevated	120-129	and	<80
Hypertension			
Stage 1	130-139	or	80-89
Stage 2	≥140	or	≥90

- No RCTs directly compared monotherapy at escalating doses *vs* dual combined therapy
- Multiple studies suggest starting combination medication helps to
  - achieve target BP faster
  - reduce BP more than monotherapy
  - control BP long term

Initiate treatment with 2 first-line agents from different classes preferably as a single pill combination

Adherence

- 50% patients do not adhere to their meds after 1 year of treatment!



- ✓ Once daily dosing (*vs* multiple times daily) improves adherence
- ✓ Use of single combination pill (SPC) (*vs* separate pills) reduces pill burden improving adherence)

ESC and AHA/ACC recommend starting with combination of low or moderate doses of an ACEi/ARB + CCB *or* Thiazide diuretic, preferably in the form of a single pill.

Case #2

- 68 y/o man with HTN, MI 2 years ago, sees you for a f/u visit. His BP is uncontrolled despite med adherence. ABPM: average 148-150/88-92. Meds: valsartan 320 mg daily, amlodipine 10 mg daily, aspirin 81 mg daily, and rosuvastatin 40 mg daily. Exam: BMI= 25, HR= 76, BP= 154/86. mm Hg. Basic labs unremarkable.

What can be done to better control his BP?

A. Add spironolactone 25 mg daily
❤ Add chlorthalidone 25 mg daily
C. Change amlodipine to nifedipine ER 60 mg daily
D. Switch valsartan to telmisartan

Case #3

- 62 y/o woman with HTN and albuminuric CKD is on amlodipine 10 mg daily. BP remains 142/86 mmHg.

What is the most appropriate next medication?

A. Add HCTZ

 Add an ACEi or ARB

C. Switch to beta-blocker monotherapy

D. Add clonidine

First line Agents- no compelling indication/comorbidity

Thiazide type diuretics

Dihydropyridine CCB

ACEi/ARBs

Thiazide type diuretics- pearls

- More commonly used: Chlorthalidone *vs* HCTZ

✓ Weaker agent
✓ Preferred in combination therapy (ACEi/ ARB)

✓ Longer half-life
✓ More potent on a mg-to-mg basis
✓ More electrolyte abnormality
✓ No half dose pill available

HYPO
Hyponatremia
Hypokalemia
Hypochloremia
Hypomagnesemia

HYPER
Hypercalcemia
Hyperuricemia
Hyperglycemia
Hyperlipidemia

CCB

Long acting dihydropyridines preferred (amlodipine)

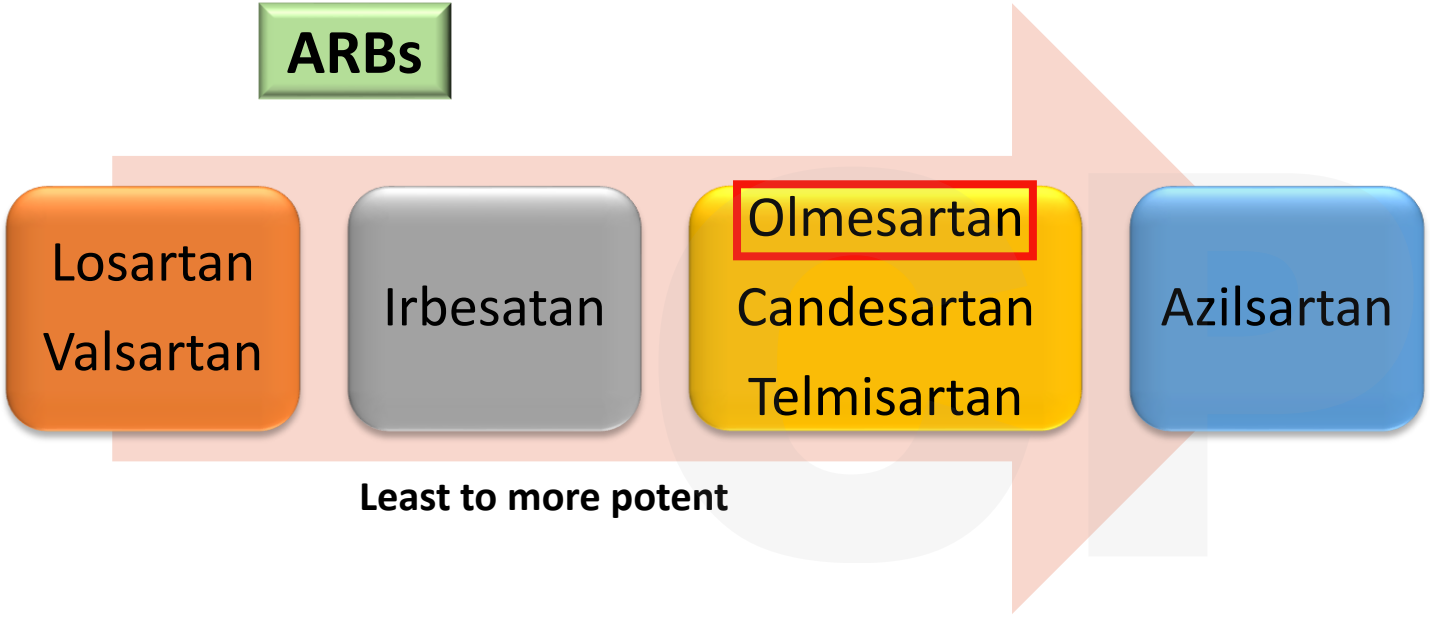
Associated with dose-related lower extremity edema

ACEi/ARBs- pearls

ACEi

- Long acting generally (**except** Ramipril and Enalapril) → once daily dosing
- Anti proteinuric effect for patients with albuminuria (DM or HTN)

ARBs



- Cough in 15% (with ACE → switch to an ARB- do not cause cough)
- Increase in serum Cr (30% acceptable)
- Angioedema in 0.1%–0.7% (mostly with ACEi, uncommon with ARB)
- Hyperkalemia (especially in CKD)
- Contraindicated in pregnancy

SPC	Med	Dose available
ACEi/ARB + Thiazide-type diuretic	Benazepril + HCTZ	10 mg/12.5 mg 20 mg/12.5 mg 20 mg/25 mg
	Enalapril + HCTZ	5 mg/12.5 mg 10 mg/25 mg
	Lisinopril + HCTZ	10 mg/12.5 mg 20 mg/12.5 mg 20 mg/25 mg
	Losartan + HCTZ	50 mg/12.5 mg 100 mg/12.5 mg 100 mg/25 mg
	Olmesartan + HCTZ	20 mg/12.5 mg 40 mg/12.5 mg 40 mg/25 mg
	Valsartan + HCTZ	80 mg/12.5 mg 160 mg/12.5 mg 160 mg/25 mg 320 mg/12.5 mg 320 mg/25 mg

SPC	Med	Dose available
ACEi/ARB + CCB	Benazepril + Amlodipine	10 mg/2.5 mg 10 mg/5 mg 20 mg/5 mg 20 mg/10 mg 40 mg/5 mg 40 mg/10 mg
	Olmesartan + Amlodipine	20 mg/5 mg 20 mg/10 mg 40 mg/5 mg 40 mg/10 mg
	Valsartan + Amlodipine	160 mg/5 mg 160 mg/10 mg 320 mg/5 mg 320 mg/10 mg

SPC	Med	Dose available
ARB + CCB + Thiazide type diuretic	Olmesartan + amlodipine + HCTZ	20 mg/5 mg/12.5 mg 40 mg/5 mg/12.5 mg 40 mg/5 mg/25 mg 40 mg/10 mg/12.5 mg 40 mg/10 mg/25 mg
	Valsartan + amlodipine + HCTZ	160 mg/5 mg/12.5 mg 160 mg/5 mg/25 mg 160 mg/10 mg/12.5 mg 160 mg/10 mg/25 mg 320 mg/10 mg/25 mg

Case #4

- 68y/o man is on lisinopril, amlodipine, and chlorthalidone at maximally tolerated doses. Office BP remains 150/88. Home readings average 128/76.

What is the most appropriate next step?

A. Add spironolactone

B. Increase diuretic dose


Confirm with HBPM/ABPM and reassess

D. Refer to nephrology

Resistant HTN

At least a 50% higher risk of MI, stroke, ESRD, and CV death than adults with HTN without resistance to treatment.

- BP above goal despite 3 antihypertensives with complementary mechanism of action, including a diuretic at maximally tolerated doses *or*
- BP at goal but requiring ≥ 4 medications

↓

Evaluation includes
- r/o pseudo resistance, inaccurate measurement
- assess med adherence and interfering medications
- obtaining HBPM

↓

Screen for secondary causes

↓

Treatment:
- Add spironolactone
- Consider replacing HCTZ to Chlorthalidone
- Add alternate agents
- Referral to a specialist

Alternate agents- Aldosterone antagonists

Spironolactone

- PATHWAY-2 trial *(Lancet 2015; 386: 2059–68)*
- Associated with greater risk of gynecomastia and impotence compared with eplerenone

Eplerenone

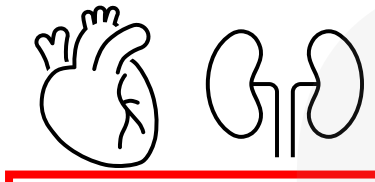
- Often requires twice-daily dosing for adequate BP lowering

- Mostly the 4th agent due to demonstrated efficacy as an add-on agent
- Avoid
  - when GFR <45
  - in pregnancy

Other Alternate Agents (not an exhaustive list)

BB	• Not first line unless CAD or HFrEF • Avoid non-cardioselective in reactive airway disease • Avoid abrupt cessation
Non DHP CCB (Diltiazem, Verapamil)	•Can be used for additional BP-lowering in selected patients •Can be combined with DHP CCB •Avoid use with BB, Do not use in HFrEF
Loop diuretics	•Preferred in HF •Severe CKD – might be better tolerated than thiazides •Longer acting (torsemide) preferred for HTN
K sparing diuretics (Amiloride, Triamterene)	•Minimally effective as monotherapy •Combination with a thiazide-type diuretic considered (hypokalemia on thiazide monotherapy)
Alpha-1 blockers (Doxazosin, Prazosin)	•Associated with orthostatic hypotension, especially in older adults •May be considered in symptomatic BPH

HTN in DM



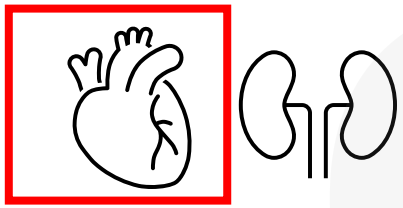
10yr CVD risk ≥7.5%

Hypertension			
Stage 1	130-139	or	80-89
Stage 2	≥140	or	≥90

- Drug of choice: Any first-line (thiazide type diuretics, CCB, ACEi/ARB)
- ACEi/ARB recommended in the presence of DM + CKD (eGFR< 60 or albuminuria ≥30)
- SGLT2i and GLP1RA → shown to have effect of lowering BP

SURMOUNT-1 Trial suggests that **Tirzepatide** reduces ambulatory BP, possibly mediated by weight reduction

HTN in Chronic Coronary Disease (CAD) and HF



Hypertension			
Stage 1	130-139	or	80-89
Stage 2	≥140	or	≥90

10yr CVD risk ≥7.5%

CAD

- ✓ Drug of choice: ACEi, ARB, BB
- ✓ If needed: CCB, thiazide type diuretic, MRA

HF

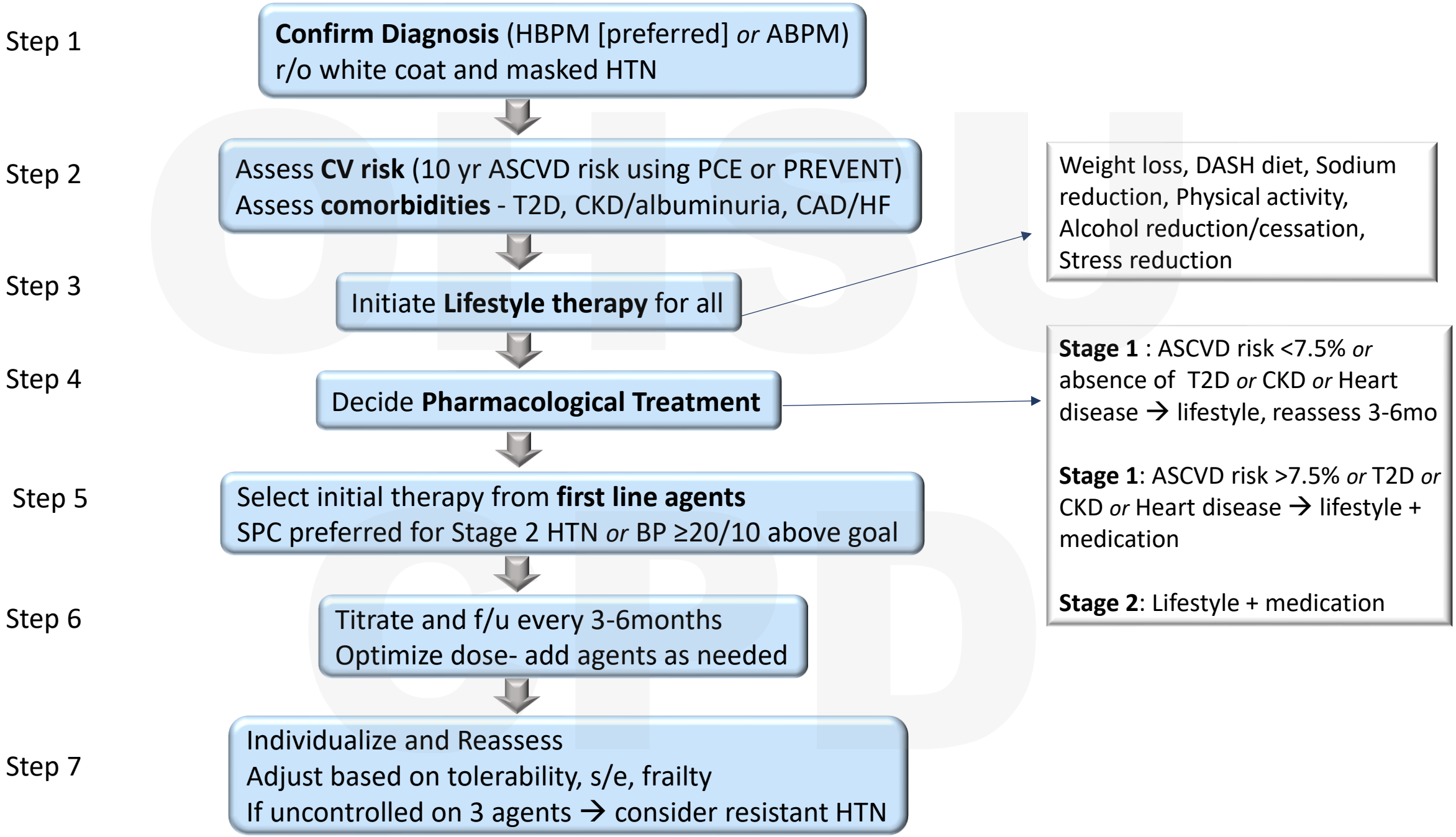
- ✓ HFrEF: GDMT (BB+ ARNi + MRA+ SGLT2i)
  - If needed: hydralazine and ISDN, Diuretics, dihydropyridine CCB
- ✓ HFpEF: ARNi (ARB when ARNi not feasible, SGLT2i
  - If needed: Diuretics

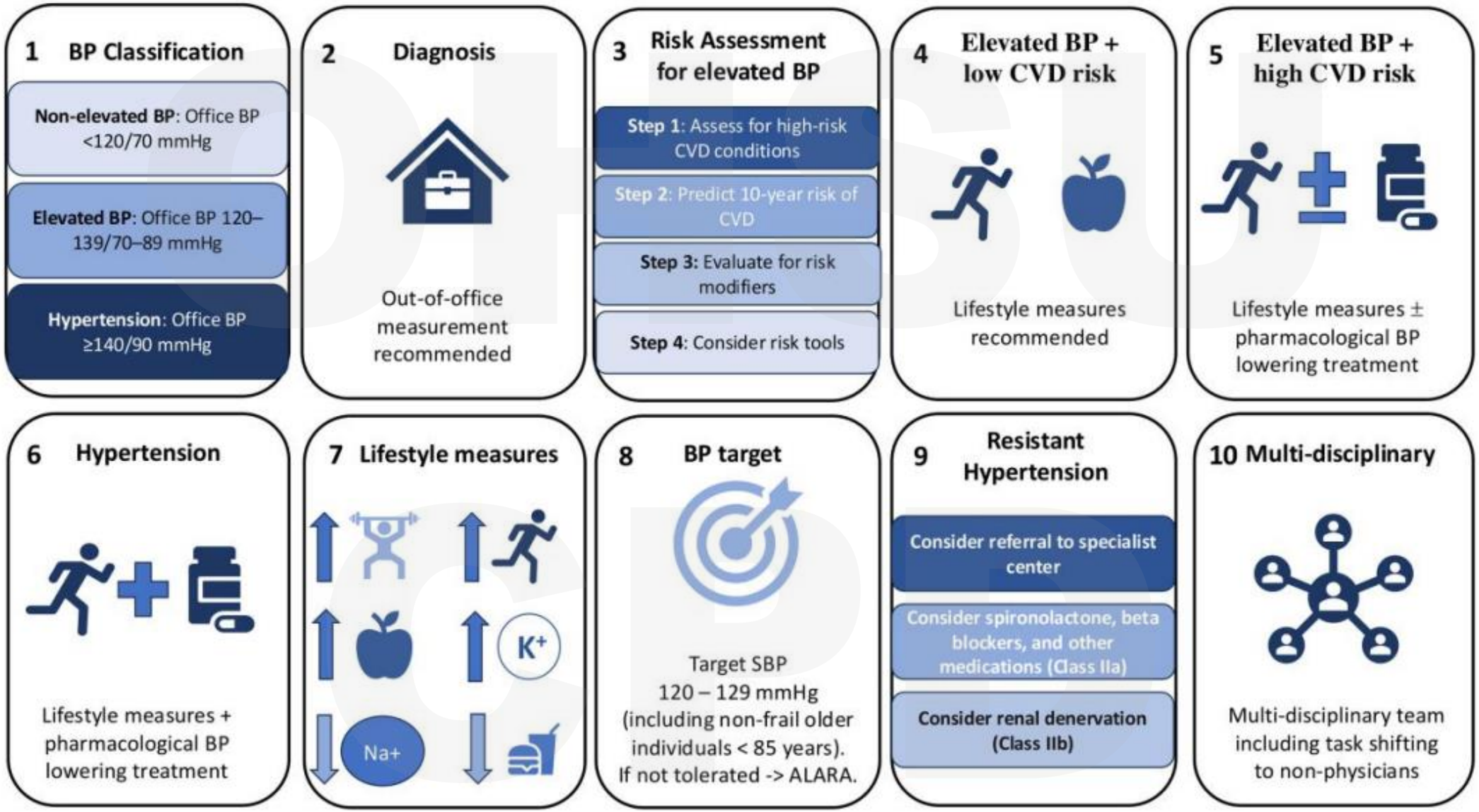
Individualize treatment

Clinical judgement and Shared Decision Making

Individualize BP target

- Tolerance
- Side effects
- Frailty
- Coverage


Step 1
Confirm Diagnosis (HBPM [preferred] or ABPM)
r/o white coat and masked HTN
Step 2
Assess CV risk (10 yr ASCVD risk using PCE or PREVENT)
Assess comorbidities - T2D, CKD/albuminuria, CAD/HF
Step 3
Initiate Lifestyle therapy for all
Weight loss, DASH diet, Sodium reduction, Physical activity, Alcohol reduction/cessation, Stress reduction
Step 4
Decide Pharmacological Treatment
Stage 1 : ASCVD risk <7.5% or absence of T2D or CKD or Heart disease → lifestyle, reassess 3-6mo
Stage 1: ASCVD risk >7.5% or T2D or CKD or Heart disease → lifestyle + medication
Stage 2: Lifestyle + medication
Step 5
Select initial therapy from first line agents
SPC preferred for Stage 2 HTN or BP ≥20/10 above goal
Step 6
Titrate and f/u every 3-6months
Optimize dose- add agents as needed
Step 7
Individualize and Reassess
Adjust based on tolerability, s/e, frailty
If uncontrolled on 3 agents → consider resistant HTN



Mc Carthy et al. The 'ten commandments' for the 2024 European Society of Cardiology guidelines on elevated blood pressure and hypertension

Summary

Accurate BP measurement and confirmation is important

Lifestyle modification: essential at every stage

For most adults, a target BP <130/80 provides meaningful CV benefit, but targets should be individualized

Simple regimens, once-daily dosing, and combination pills improve adherence and long-term BP control

Apparent resistant HTN requires reassessment of adherence, measurement accuracy, and secondary causes before escalation.

References

- 2025 AHA/ACC/AANP/AAPA/ABC/ACCP/ ACPM/AGS/AMA/ASPC/NMA/PCNA/ SGIM Guideline for the Prevention, Detection, Evaluation and Management of High Blood Pressure in Adults: A Report of the American College of Cardiology/American Heart Association Joint Committee on Clinical Practice Guidelines

  Circulation. 2025;152:e114–e218.

- Optimizing hypertension treatment: Evidence-based approaches and new drugs

  Cleve Clin J Med. 2025 Sep 2;92(9):555-564

- Outpatient management of essential hypertension: a review based on the latest clinical guidelines

  Ann Med. 2024 Apr 11;56(1):2338242

- 2023 WHO Global report on hypertension: the race against a silent killer